COMMONWEALTH of VIRGINIA

Jennifer B. DeBruhl
Director

DEPARTMENT OF RAIL AND PUBLIC TRANSPORTATION
600 EAST MAIN STREET, SUITE 2102
RICHMOND, VA 23219-2416

(804) 786-4440
FAX (804) 225-3752
Virginia Relay Center
800-828-1120 (TDD)

PRE -AWARD PURCHASER'S REQUIREMENTS CERTIFICATION

As required by Title 49 of the CFR. Part 663 - Subpart B, Department of Rail and Public Transportation (the recipient) certifies that the buses to be purchased, 12-Year Heavy Duty Low-Floor Transit Bus (description of buses) from Gillig, LLC. (the manufacturer), are the same product described in the recipient's solicitation specification and that the proposed manufacturer is a responsible manufacturer with the capability to produce a bus that meets the specifications.

Date: 10/16/2022

Signature:

Avery Daugherty, Statewide Program Manager

GILLIG

AMERICANBUILT

PRODUCT **BROCHURE**

Contents

About GILLIG

GILLIG is the leading heavy-duty transit bus manufacturer in the United States. We build the highest quality, safest, and most durable transit buses in industry. Because our products last as expected, they are the most cost-effective to own, operate and maintain. We're focused on delivering transformative transit solutions that provide lasting value, while planning for the technologies of tomorrow.

Our buses are powered by environmentally friendly propulsion systems, including zero-emission battery electric, diesel-electric hybrid, near-zero emission compressed natural gas, and clean-diesel built on our industry-proven Low Floor Platform. With 29-foot, 35-foot, and 40-foot configurations, a variety of styling alternatives, and a robust option portfolio, GILLIG buses can be configured to meet the needs of any fleet.

From initial design through final assembly, each and every GILLIG bus is designed and built by our dedicated and passionate team in Livermore, California. From here we operate one of the most modern high-volume manufacturing operations in the industry. Decades of innovative products have rolled off our assembly lines – products that are made to last and 100% American built.

We rigorously test our products to ensure we only deliver proven designs. But our commitment to excellence doesn't stop there. Because all buses will need product support sometime during their service life, we provide comprehensive aftermarket support, including parts, training, and warranty assistance. Our Customer Care organization is staffed with experienced and responsive professionals dedicated to keeping your buses on the road.

The more than 27,000 GILLIG buses in service throughout the U.S. today are a testament to the engineering prowess and manufacturing excellence that goes into our buses. GILLIG's reliability is unmatched. We welcome the opportunity to tell you more about why our buses are the best choice for all your transit needs.

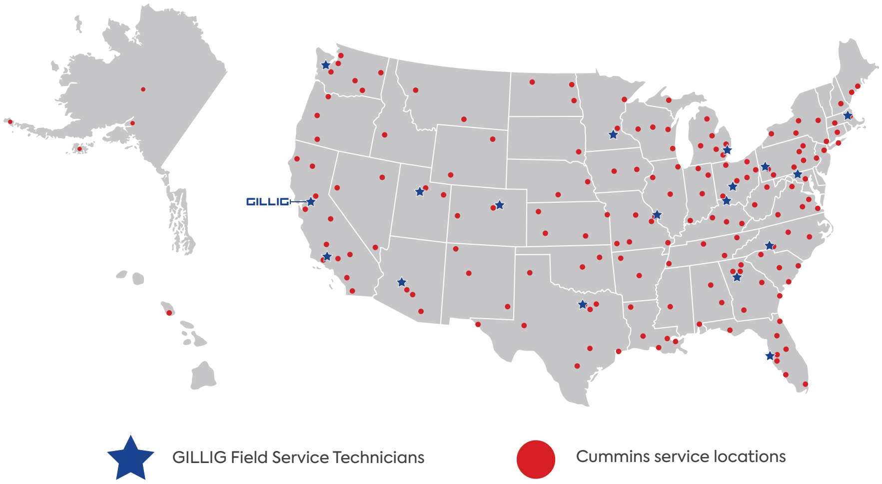
BATTERY ELECTRIC

Built On Experience
Engineered For Performance

The Standard in Zero-Emission Excellence

Cummins Powertrain +

- High-efficiency motor provides **smooth, quiet, and powerful performance**
- Powertrain is backed by **unmatched service and support network**
- Direct drive permanent magnet motor requires **no reoccurring maintenance**
- Motor and inverter proven through **millions of global in-service miles**



Energy Storage System +

- GILLIG's next-generation energy storage system provides a **32% increase** in on-board energy capacity
- Energy-dense cells from a global technology leader provide **longer range**
- **Maximum fleet flexibility** afforded through modular energy storage design

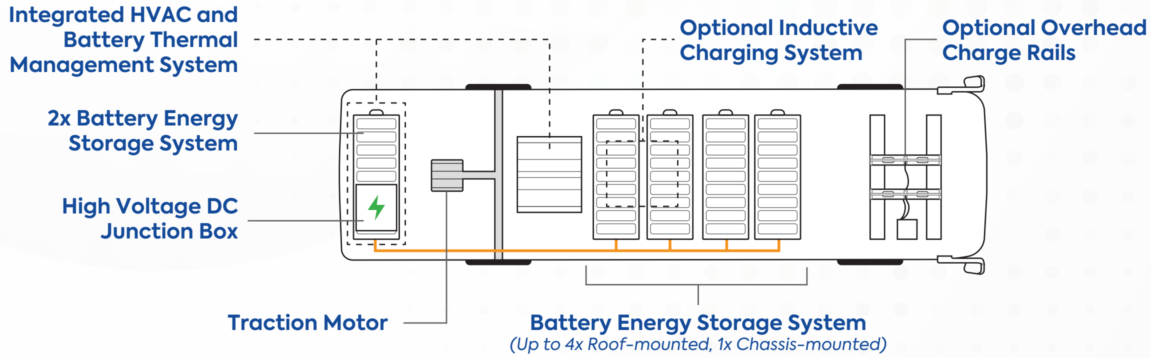
Proven Platform +

- Commonality with existing GILLIG buses affords greater **operator and technician familiarity**
- Standard electronic stability control and engineered weight balancing provide **superior ride quality and handling**
- **Best-in-class** braking performance

Highly Efficient Accessories +

- ThermoKing electric HVAC with integrated thermal management system ensures **passenger comfort** without sacrificing range
- Power management controls provide **optimal performance** and long battery life
- Optional cold weather package for **increased performance in extreme environments**

GILLIG Battery Electric Bus Components



Charging

- GILLIG's experts can provide **full turnkey infrastructure support**, including consulting, project management, and streamlined equipment procurement to support your transition to electric buses
- We offer broad access to state-of-the-art charging technology and expedited lead times from the leading U.S. manufacturers for **plug-in, overhead conductive, and inductive charging solutions**
- Our rigorous testing of non-proprietary chargers assures compatibility and performance, while providing **maximum flexibility to operators**

chargepoin+ ABB SIEMENS heliox WAVE Wireless Advanced Vehicle Electrification Momentum® Wireless Power

Bus Length	35'	40'
Battery Capacity	490 kWh, 588 kWh, 686 kWh	
Motor	Cummins Direct Drive, Permanent Magnet Motor	
Passenger Capacity (Seated / Total)*	31 / 62	38 / 75
Gross Vehicle Weight Rating	48,200 lbs.	48,200 lbs.
Maximum Height	135"	135"

** subject to seating configurations and option selections*

DIESEL

Powerful, Durable, And Reliable

Environmentally Friendly Fleet Workhorse

GILLIG Diesel buses have set the standard for reliability for decades and are the **workhorse of America's transit systems** with higher mean distance between failures and quicker repair times. GILLIG Diesel buses provide consistently high uptimes. The latest Cummins engine provides cleaner operations through lower NOx and particulate matter emissions.

A powerful addition to any fleet, GILLIG Clean Diesel buses are available in 29', 35', and 40' lengths with optional BRT, BRTPLUS, Low Floor Plus, and Trolley styling.

Clean-Diesel Performance

- Advancements in Cummins engine and emissions technology have made the L9 engine the **cleanest diesel engine on the market**
- Cummins 2021 EPA engine provides **2-4% fuel efficiency improvement** over prior engines*
- Engine maintenance intervals have been extended by up to 50%* **greatly reducing cost of ownership**

**Results may vary depending on application*

Designed For Your Fleet

- Built for **Reliability, Durability and Cost-Effective Ownership**
- **Robust option portfolio** provides flexibility to customize for your fleet requirements
- Large service accesses, easily sourced components and limited custom tools ensure **simple and cost-effective maintenance**

CNG

A Natural Choice

A Near-Zero Emission Alternative

The GILLIG CNG bus is a combination of the latest CNG technology and GILLIG's well-known reliability, safety, and efficiency. The proven design of our CNG bus recorded the **highest reliability and the best fuel economy** of any CNG bus tested at the Altoona Bus Research and Testing Center.

A natural addition to any fleet, GILLIG CNG buses are available in 29', 35', and 40' lengths with optional BRT, BRTPLUS, Low Floor Plus, and Trolley styling.

Engineered Better

Suspension and weight balancing designed to provide **optimal ride quality, high-speed and low-speed maneuverability**

Advanced composite fuel storage cylinders are **70% lighter** than steel, improving range, capacity and vehicle dynamics

Integrated fuel management panel incorporates critical features including pressure regulation, fuel filtration and filling connections into a **single, reliable, serviceable package**

Decreased Carbon Footprint

Cummins L9N Engine reduces smog forming NOx emissions by 90% vs. EPA NOx Standard for **near zero-emission operation**

Abundant domestic availability of natural gas helps reduce reliance on internationally sourced and transported fuel, **lowering overall well-to-wheel carbon footprint**

Significant additional **greenhouse gas emission reduction** opportunities are available through the use of renewable natural gas (RNG)

HYBRID

Proven, Reliable Hybrid Technology

Clean and Quiet Mobility Solutions

BAE SYSTEMS

Allison eGEN™

GILLIG hybrid buses are ideally suited to the demands of transit stop-and-go duty cycles. We offer two different propulsion systems – the Allison eGen Flex and BAE Series Drive – with components that make hybrids **cost-efficient to own and operate**, including regenerative braking that extends brake life, and engine-off capability for zero-emission operation. The buses also feature electric accessories that reduce wear and tear on engine components and eliminate some maintenance items from the bus.

Our Hybrid bus is available in 35', and 40' lengths with optional BRT, BRT Plus, Low Floor Plus, or Trolley styling.

Reduced Emissions

- GILLIG Hybrids can be approximately **90% cleaner** than the 12-year-old buses they replace
- GILLIG Hybrids can also run on domestic B20 biodiesel for **greener performance emissions**
- Engine start-stop operation provides for environmental sustainability and **less greenhouse gases**

Saves Energy

- GILLIG Hybrids use up to **25% less fuel** than diesel buses*
- GILLIG Hybrids allow for the use of electric components that **reduce fuel-consumption emissions**
- Lightweight design and structure optimization results in **greater efficiencies**

**Results may vary depending on application*

STYLING

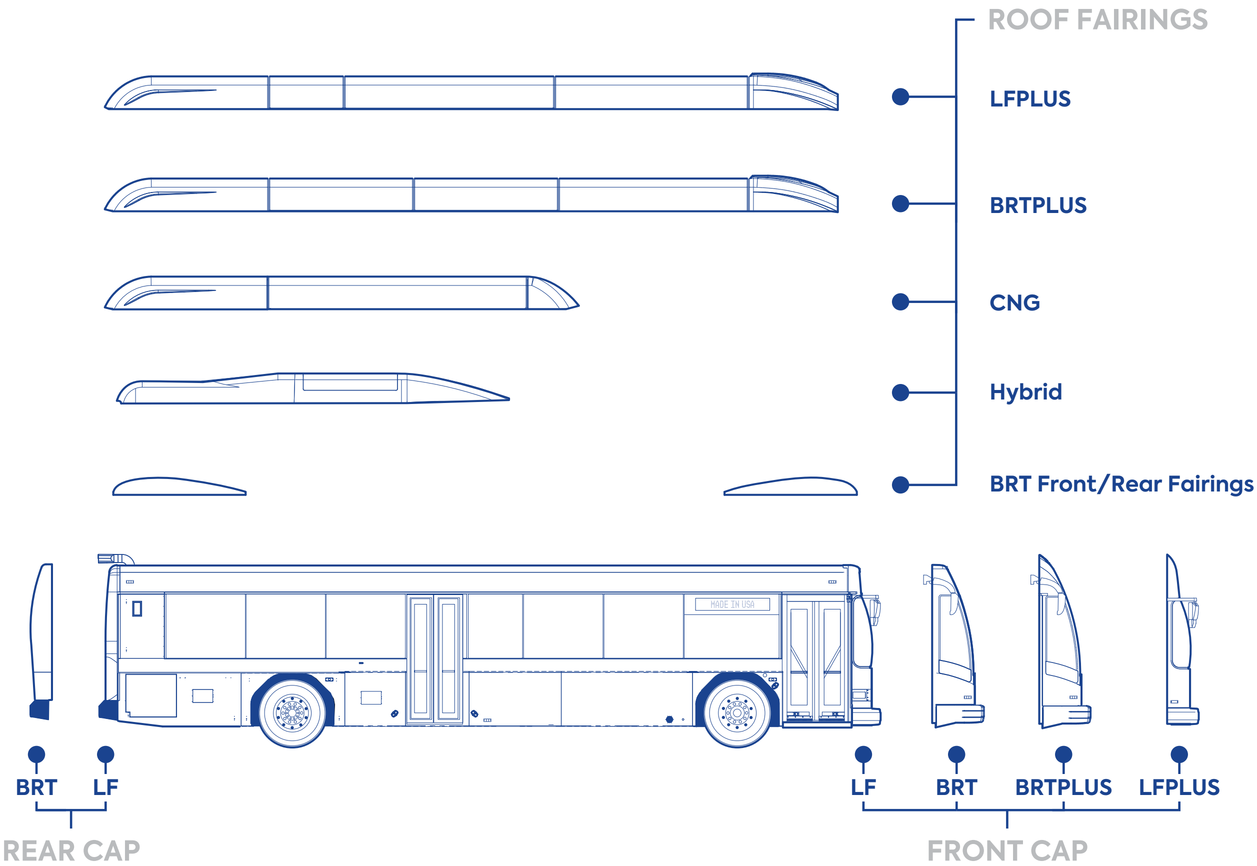
Modular Options For All Your Transit Needs

Our modular design allows operators to select the propulsion system and styling package that best meet the needs of their service while maintaining fleet commonality, as well as the reliability, durability, and cost-effectiveness for which GILLIG buses are renowned.

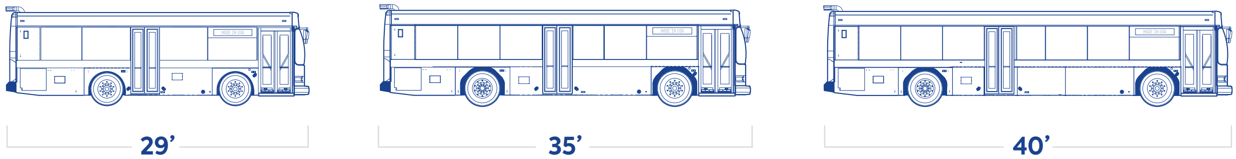
Styling options include Low Floor, Low Floor Plus, BRT, and BRT Plus.

GILLIG also offers a Trolley replica package which combines classic trolley appeal with the quality and contemporary features of our standard transit bus.

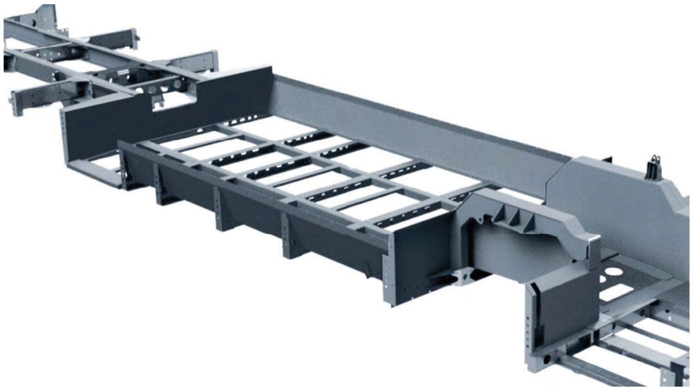
Available In 5 Distinct Styling Options



Available In 3 Lengths



LOW FLOOR PLATFORM



Engineered To Last

- Designed to **exceed FTA 12-year / 500,000-mile minimum life** requirements
- Stainless steel chassis **resists corrosion, increases life and requires less maintenance**
- Lightweight, high-strength aluminum body with anodized side posts resists corrosion and greatly **simplifies collision repairs**

Safe To Operate

- Ergonomically designed driver's workstation built on stainless steel chassis for **greater driver safety**
- Molded wraparound driver's barrier, with optional hinged enclosure, creates **added safety and comfort**
- Integrated side-impact beams provide **increased passenger protection** as well as reduced accident damage

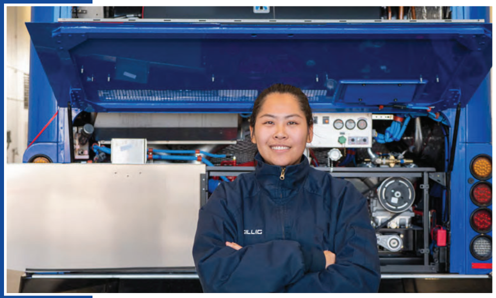
Maintenance Friendly

- Large doors make **servicing components easier through ready access**
- Quick-change skirt panels **make repairs easy and help ensure operational readiness**
- Standard-size tires **last 65% longer, deliver better ground clearance and experience less rim damage**

Comfortable To Ride

- 36" wide front aisle for **maximum ADA maneuverability**
- Large HVAC capacity and insulated air ducts distribute **increased air flow**
- Tuned suspension provides **better ride comfort** for passengers and drivers

SUPPORT FOR LIFE



Support For Life

- GILLIG's Customer Care department is staffed by **well-trained, caring professionals**, most of which are factory trained
- **Customized tech manuals** created on as-built documentation
- GILLIG's commitment to long-term relationships and **supporting our customer's future** changing needs is unwavering

Consistent Performance

- GILLIG's unmatched history of providing **state-of-the-art technology, great customer satisfaction and reliable performance**
- Continuous excellence programs focused on **streamlining manufacturing and reducing waste**
- Organizational stability ensuring **consistency in product build and performance**

Service Parts

- Dedicated "Class A" warehouse with **extensive inventory**
- Supply only **proven original equipment and premium aftermarket parts**
- Dedicated, knowledgeable, customer service team focused on **keeping your buses on the road**

Training

- **Experienced and proficient GILLIG employees** providing customized training
- Curriculum and materials **customized to individual customer and their students**
- **Class flexibility** for day or evening schedules

Quality

We believe that quality must be the cornerstone of everything that we do, which relies on a team of great people focused on excellence each and every day. From proper initial design, supplier and component selection, robust validation, in-plant inspection and continuous improvement, we maintain a steadfast emphasis on ensuring ultimate product quality. That detailed and disciplined focus has enabled us to deliver consistently reliable products.

www.GILLIG.com

05.12.2022

GILLIG

October 6, 2022

Electronic Submission: **eVA website**

Commonwealth of Virginia
Pamela Copeland
Statewide Sourcing and Contracting Officer
Richmond, VA

RE: **IFB 6447 – LOW FLOOR TRANSIT BUSES, COMMUTER COACH BUSES, AND TROLLEYS HEAVY DUTY, 12 YEAR (29FT. – 60FT. SIZES)**
DATE DUE: **OCTOBER 11, 2022 at 1:00 PM ET**

Ms. Copeland:

GILLIG is pleased to submit the enclosed documentation covering our response to the above solicitation for your review and consideration.

We appreciate this opportunity and look forward to a successful bid opening.

Very truly yours,

Derek Maunus
President & CEO
Phone: 800-735-1500
Phone Office: 510-264-3818
Email: sales@gillig.com

Cc: William F. Fay, Jr., Vice President Sales
Arminder Dhillon, Director, Sales Operations
Javier Hernandez, Jr., Director National Sales
Randy Brewer, Regional Sales Manager

Solicitation Paper Response

Paper Response Instructions

1. Print this response form → Print
2. Complete the printed response form by entering the required information and signed the form where indicated * denotes required information.
3. Add your attachments to your response package.
4. Submit your response.
   - See the Terms and Conditions Section for submission instructions and address information.

Responses must be received prior to the Solicitation closing date and time listed for the Solicitation.

Caution: The Commonwealth reserves the right to reject responses that are not complete and accurate.

Solicitation Paper Response 6447

Procurement Folder: 98694
Solicitation: 6447
Solicitation Type: IFB
Short Description: Vehicle: Transit Bus
Description: Vehicle: Low Floor Transit Buses, Commuter Coach Buses, and Trolleys Heavy Duty, 12 Year (29 ft. – 60 ft. sizes)

Solicitation Version Number: 1
Status: Open
Issued Date: 8/2/2022
Closing Date: 9/14/2022
Closing Time: 1:00 PM
Time Left: 28 Days
Open Responses Date: 9/15/2022
Open Responses Time: 10:00 AM

On Behalf Of Office: E194
Preparer Office: E194
Pre-Bid Conference Type: Pre-Bid Conference
Category: Equipment - Non-Technology
Sole Source/Emergency:
Work Location: Virginia - Statewide

Phone: (804) 786-4068
Phone: (804) 786-4068
Pre-Bid Conference Date: 8/15/2022
Pre-Bid Conference Time: 10:00 AM

Grand Total: $ SEE ATTACHMENT H - PRICING SCHEDULE

Attachments

Attachment Name: PRICING — Attachment Type(Select One): ☐ Standard ☐ Proprietary ☒ Pricing

Attachment Name: FEDERAL CERTIFICATIONS — Attachment Type(Select One): ☒ Standard ☐ Proprietary ☐ Pricing

Attachment Name: TECHNICAL INFORMATION — Attachment Type(Select One): ☒ Standard ☒ Proprietary ☐ Pricing

Contact Information

Pamela Copeland
Email: pamela.copeland@dgs.virginia.gov

Phone: (804) 786-4068
Fax:

Discount Information

I will offer a 0 % discount for payments made within ------ days of invoice
I will offer a 0 % discount for payments made within ------ days of invoice

Commodity Response Information

Lot 1: Lot 1

Lot 1, Line 1
NIGP Code: 55610 Coach, Transit (Articulated)
Description: Vehicle: Transit Bus Low Floor HD 12 yr. Diesel, CNG, Hybrid, Battery Electric

Line Type: Item
Quantity: 1
Unit: each

Specifications:

Manufacturer: GILLIG LLC
Manufacturer Part Number: - - - - - -
Product/Category Number: - - - - - -
Serial Number: TBD
Specification Number: - - - - - -

MSDS Required?: - - - - - -
Comments:
- - - - - -

Hazardous Materials:
- - - - - -

Handling Instructions:
- - - - - -

Packing Instructions:
- - - - - -

Detailed Instructions:
- - - - - -

Additional Instructions:
- - - - - -

* Price: SEE ATTACHMENT H - PRICING SCHEDULE
Line Total: $ - - - - - -
* Delivery Days: DIESEL/CNG/HYBRID BUSES - 12-15 MONTHS ARO
*Response Type: BATTERY ELECTRIC BUS - 18-24 MONTHS ARO

☒ Respond

☐ Respond w/Condition (must include a comment)

☐ No Response

Drawing Number: - - - - - -
Piece Number: - - - - - -
Color: TBD
Size: TBD
Model Number: TBD
Warranty: SEE GILLIG LIMITED WARRANTY DOCUMENT

Lot 1, Line 2
NIGP Code: 55620 Coach, Transit (Electric)
Description: Vehicle: Transit Bus Low Floor HD 12 yr. Diesel, CNG Hybrid, Battery Electric
Specifications:

Manufacturer: GILLIG LLC
Manufacturer Part Number: - - - - - -
Product/Category Number: - - - - - -
Serial Number: TBD
Specification Number: - - - - - -

MSDS Required?: - - - - - -
Comments:
- - - - - -

Line Type: Item
Quantity: 1
Unit: each

* Price: SEE ATTACHMENT H - PRICING SCHEDULE
Line Total: $
* Delivery Days: DIESEL/CNG/HYBRID BUSES - 12-15 MONTHS ARO
*Response Type: BATTERY ELECTRIC BUS - 18-24 MONTHS ARO

☒ Respond

☐ Respond w/Condition (must include a comment)

☐ No Response

Drawing Number: - - - - - -
Piece Number: - - - - - -
Color: TBD
Size: TBD
Model Number: TBD
Warranty: SEE GILLIG LIMITED WARRANTY DOCUMENT

Hazardous Materials:
\- - - - - -

Handling Instructions:
\- - - - - -

Packing Instructions:
\- - - - - -

Detailed Instructions:
\- - - - - -

Additional Instructions:
\- - - - - -

Subcontractor Plan

Who will be doing the work: ☐ I plan to use subcontractors ☒ I plan to complete all work

Subcontractor #1 NOT APPLICABLE - WE DO NOT SUBCONTRACT THE MANUFACTURE OF OUR VEHICLES

Company Name: __________ SBSD Cert #: __________

Contact Name: __________ SBSD Certification: __________

Contact Phone: __________ Contact Email: __________

Value % or $ (Initial Term): __________ Contact Address: __________

Description of Work:

Subcontractor #2 NOT APPLICABLE - WE DO NOT SUBCONTRACT THE MANUFACTURE OF OUR VEHICLES

Company Name: __________ SBSD Cert #: __________

Contact Name: __________ SBSD Certification: __________

Contact Phone: __________ Contact Email: __________

Value % or $ (Initial Term): __________ Contact Address: __________

Description of Work:

Subcontractor #3 NOT APPLICABLE - WE DO NOT SUBCONTRACT THE MANUFACTURE OF OUR VEHICLES

Company Name: ______________________ SBSD Cert #: ______________

Contact Name: ______________________ SBSD Certification: ______________________

Contact Phone: ______________________ Contact Email: ______________________

Value % or $ (Initial Term): ______________ Contact Address: ______________________

Description of Work:

____

Subcontractor #4 NOT APPLICABLE - WE DO NOT SUBCONTRACT THE MANUFACTURE OF OUR VEHICLES

Company Name: ______________________ SBSD Cert #: ______________

Contact Name: ______________________ SBSD Certification: ______________________

Contact Phone: ______________________ Contact Email: ______________________

Value % or $ (Initial Term): ______________ Contact Address: ______________________

Description of Work:

____

Subcontractor #5 NOT APPLICABLE - WE DO NOT SUBCONTRACT THE MANUFACTURE OF OUR VEHICLES

Company Name: ______________________ SBSD Cert #: ______________

Contact Name: ______________________ SBSD Certification: ______________________

Contact Phone: ______________________ Contact Email: ______________________

Value % or $ (Initial Term): ______________ Contact Address: ______________________

Description of Work:

____

Events

No Information Provided

Evaluation Criteria

No Information Provided

Reminders

No Information Provided

Terms And Conditions

Section GEN

NOTE

This public body does not discriminate against faith-based organizations in accordance with the Code of Virginia, § 2.2-4343.1 or against a bidder because of race, religion, color, sex, national origin, age, disability, sexual orientation, gender identity, political affiliation, or veteran status or any other basis prohibited by state law relating to discrimination in employment. Faith-based organizations may request that the issuing agency not include subparagraph 1.f in General Terms and Condition C. Such a request shall be in writing and explain why an exception should be made in that invitation for bid.

VENDORS MANUAL

This solicitation is subject to the provisions of the Commonwealth of Virginia Vendors Manual and any changes or revisions thereto, which are hereby incorporated into this contract in their entirety. The process for filing a complaint about this solicitation is in section 7.13 of the Vendors Manual. (Note section 7.13 does not apply to protests of awards or formal contractual claims.) The procedure for filing contractual claims is in section 7.19 of the Vendors Manual. A copy of the manual is normally available for review at the purchasing office and is accessible on the Internet at www.eva.virginia.gov under "I Sell To Virginia".

APPLICABLE LAWS AND COURTS

This solicitation and any resulting contract shall be governed in all respects by the laws of the Commonwealth of Virginia, without regard to its choice of law provisions, and any litigation with respect thereto shall be brought in the circuit courts of the Commonwealth. The agency and the contractor are encouraged to resolve any issues in controversy arising from the award of the contract or any contractual dispute using Alternative Dispute Resolution (ADR) procedures (Code of Virginia, § 2.2-4366). ADR procedures are described in Chapter 9 of the Vendors Manual. The contractor shall comply with all applicable federal, state and local laws, rules and regulations.

ANTI-DISCRIMINATION

By submitting their bids, bidders certify to the Commonwealth that they will conform to the provisions of the Federal Civil Rights Act of 1964, as amended, as well as the Virginia Fair Employment Contracting Act of 1975, as amended, where applicable, the Virginians With Disabilities Act, the Americans With Disabilities Act and § 2.2-4311 of the Virginia Public Procurement Act (VPPA). If the award is made to a faith-based organization, the organization shall not discriminate against any recipient of goods, services, or disbursements made pursuant to the contract on the basis of the recipient's religion, religious belief, refusal to participate in a religious practice, or on the basis of race, age, color, gender sexual orientation, gender identity, or national origin and shall be subject to the same rules as other organizations that contract with public bodies to account for the use of the funds provided; however, if the faith-based organization segregates public funds into separate accounts, only the accounts and programs funded with public funds shall be subject to audit by the public body. (Code of Virginia, § 2.2-4343.1E). In every contract over $10,000 the provisions in 1. and 2. below apply: 1. During the performance of this contract, the contractor agrees as follows: a. The contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, sexual orientation, gender identity, national origin, age, disability, or any other basis prohibited by state law relating to discrimination in employment, except where there is a bona fide occupational qualification reasonably necessary to the normal operation of the contractor. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause. b. The contractor, in all solicitations or advertisements for employees placed by or on behalf of the contractor, will state that such contractor is an equal opportunity employer. c. Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section. d. If the contractor employs more than five employees, the contractor shall (i) provide annual training on the contractor's sexual harassment policy to all supervisors and employees providing services in the Commonwealth, except such supervisors or employees that are required to complete sexual harassment training provided by the Department of Human Resource Management, and (ii) post the contractor's sexual harassment policy in (a) a conspicuous public place in each building located in the Commonwealth that the contractor owns or leases for business purposes and (b) the contractor's employee handbook. e. The requirements of these provisions 1. and 2. are a material part of the contract. If the Contractor violates one of these provisions, the Commonwealth may terminate the affected part of this contract for breach, or at its option, the whole contract. Violation of one of these provisions may also result in debarment from State contracting regardless of whether the specific contract is terminated. f. In accordance with Executive Order 61 (2017), a prohibition on discrimination by the contractor, in its employment practices, subcontracting practices, and delivery of goods or services, on the basis of race, sex, color, national origin, religion, sexual orientation, gender identity, age, political affiliation, disability, or veteran status, is hereby incorporated in this contract. 2. The contractor will include the provisions of 1. above in every subcontract or purchase order over $10,000, so that the provisions will be binding upon each subcontractor or vendor.

ETHICS IN PUBLIC CONTRACTING

By submitting their bids, bidders certify that their bids are made without collusion or fraud and that they have not offered or received any kickbacks or inducements from any other bidder, supplier, manufacturer or subcontractor in connection with their bid, and that they have not conferred on any public employee having official responsibility for this procurement transaction any payment, loan, subscription, advance, deposit of money, services or anything of more than nominal value, present or promised, unless consideration of substantially equal or greater value was exchanged.

IMMIGRATION REFORM

Applicable for all contracts over $10,000: By entering into a written contract with the Commonwealth of Virginia, the Contractor certifies that the Contractor does not, and shall not during the performance of the contract for goods and services in the Commonwealth, knowingly employ an unauthorized alien as defined in the federal Immigration Reform and Control Act of 1986.

DEBARMENT STATUS

By participating in this procurement, the vendor certifies that they are not currently debarred by the Commonwealth of Virginia from submitting a response for the type of goods and/or services covered by this solicitation. Vendor further certifies that they are not debarred from filling any order or accepting any resulting order, or that they are an agent of any person or entity that is currently debarred by the Commonwealth of Virginia. If a vendor is created or used for the purpose of circumventing a debarment decision against another vendor, the non-debarred vendor will be debarred for the same time period as the debarred vendor.

ANTITRUST

By entering into a contract, the contractor conveys, sells, assigns, and transfers to the Commonwealth of Virginia all rights, title and interest in and to all causes of action it may now have or hereafter acquire under the antitrust laws of the United States and the Commonwealth of Virginia, relating to the particular goods or services purchased or acquired by the Commonwealth of Virginia under said contract.

MANDATORY USE OF STATE FORM

Failure to submit a bid on the official state form provided for that purpose shall be a cause for rejection of the bid. Modification of or additions to any portion of the Invitation for Bids may be cause for rejection of the bid; however, the Commonwealth reserves the right to decide, on a case by case basis, in its sole discretion, whether to reject such a bid as nonresponsive. As a precondition to its acceptance, the Commonwealth may, in its sole discretion, request that the bidder withdraw or modify nonresponsive portions of a bid which do not affect quality, quantity, price, or delivery. No modification of or addition to the provisions of the contract shall be effective unless reduced to writing and signed by the parties.

CLARIFICATION OF TERMS

If any prospective bidder has questions about the specifications or other solicitation documents, the prospective bidder should contact the buyer whose name appears on the face of the solicitation no later than five working days before the due date. Any revisions to the solicitation will be made only by addendum issued by the buyer.

PAYMENT

1. To Prime Contractor: a. Invoices for items ordered, delivered and accepted shall be submitted by the contractor directly to the payment address shown on the purchase order/contract. All invoices shall show the state contract number and/or purchase order number; social security number (for individual contractors) or the federal employer identification number (for proprietorships, partnerships, and corporations). b. Any payment terms requiring payment in less than 30 days will be regarded as requiring payment 30 days after invoice or delivery, whichever occurs last. This shall not affect offers of discounts for payment in less than 30 days, however. c. All goods or services provided under this contract or purchase order, that are to be paid for with public funds, shall be billed by the contractor at the contract price, regardless of which public agency is being billed. d. The following shall be deemed to be the date of payment: the date of postmark in all cases where payment is made by mail, or when offset proceedings have been instituted as authorized under the Virginia Debt Collection Act. e. Unreasonable Charges. Under certain emergency procurements and for most time and material purchases, final job costs cannot be accurately determined at the time orders are placed. In such cases, contractors should be put on notice that final payment in full is contingent on a determination of reasonableness with respect to all invoiced charges. Charges which appear to be unreasonable will be resolved in accordance with Code of Virginia, § 2.2-4363 and -4364. Upon determining that invoiced charges are not reasonable, the Commonwealth shall notify the contractor of defects or improprieties in invoices within fifteen (15) days as required in Code of Virginia, § 2.2-4351.,. The provisions of this section do not relieve an agency of its prompt payment obligations with respect to those charges which are not in dispute (Code of Virginia, § 2.2-4363). 2. To Subcontractors: a. Within seven (7) days of the contractor's receipt of payment from the Commonwealth, a contractor awarded a contract under this solicitation is hereby obligated: (1) To pay the subcontractor(s) for the proportionate share of the payment received for work performed by the subcontractor(s) under the contract; or (2) To notify the agency and the subcontractor(s), in writing, of the contractor's intention to withhold payment and the reason. b. The contractor

is obligated to pay the subcontractor(s) interest at the rate of one percent per month (unless otherwise provided under the terms of the contract) on all amounts owed by the contractor that remain unpaid seven (7) days following receipt of payment from the Commonwealth, except for amounts withheld as stated in (2) above. The date of mailing of any payment by U. S. Mail is deemed to be payment to the addressee. These provisions apply to each sub-tier contractor performing under the primary contract. A contractor's obligation to pay an interest charge to a subcontractor may not be construed to be an obligation of the Commonwealth. 3. Each prime contractor who wins an award in which provision of a SWaM procurement plan is a condition to the award, shall deliver to the contracting agency or institution, on or before request for final payment, evidence and certification of compliance (subject only to insubstantial shortfalls and to shortfalls arising from subcontractor default) with the SWaM procurement plan. Final payment under the contract in question may be withheld until such certification is delivered and, if necessary, confirmed by the agency or institution, or other appropriate penalties may be assessed in lieu of withholding such payment. 4. The Commonwealth of Virginia encourages contractors and subcontractors to accept electronic and credit card payments.

PRECEDENCE OF TERMS

The following General Terms and Conditions VENDORS MANUAL, APPLICABLE LAWS AND COURTS, ANTI-DISCRIMINATION, ETHICS IN PUBLIC CONTRACTING, IMMIGRATION REFORM AND CONTROL ACT OF 1986, DEBARMENT STATUS, ANTITRUST, MANDATORY USE OF STATE FORM AND TERMS AND CONDITIONS, CLARIFICATION OF TERMS, PAYMENT shall apply in all instances. In the event there is a conflict between any of the other General Terms and Conditions and any Special Terms and Conditions in this solicitation, the Special Terms and Conditions shall apply.

QUALIFICATIONS OF BIDDERS

The Commonwealth may make such reasonable investigations as deemed proper and necessary to determine the ability of the bidder to perform the services/furnish the goods and the bidder shall furnish to the Commonwealth all such information and data for this purpose as may be requested. The Commonwealth reserves the right to inspect bidder's physical facilities prior to award to satisfy questions regarding the bidder's capabilities. The Commonwealth further reserves the right to reject any bid if the evidence submitted by, or investigations of, such bidder fails to satisfy the Commonwealth that such bidder is properly qualified to carry out the obligations of the contract and to provide the services and/or furnish the goods contemplated therein.

TESTING AND INSPECTION

The Commonwealth reserves the right to conduct any test/inspection it may deem advisable to assure goods and services conform to the specifications.

ASSIGNMENT OF CONTRACT

A contract shall not be assignable by the contractor in whole or in part without the written consent of the Commonwealth.

CHANGES TO THE CONTRACT

Changes can be made to the contract in any of the following ways: 1. The parties may agree in writing to modify the terms, conditions, or scope of the contract. Any additional goods or services to be provided shall be of a sort that is ancillary to the contract goods or services, or within the same broad product or service categories as were included in the contract award. Any increase or decrease in the price of the contract resulting from such modification shall be agreed to by the parties as a part of their written agreement to modify the scope of the contract. 2. The Purchasing Agency may order changes within the general scope of the contract at any time by written notice to the contractor. Changes within the scope of the contract include, but are not limited to, things such as services to be performed, the method of packing or shipment, and the place of delivery or installation. The contractor shall comply with the notice upon receipt, unless the contractor intends to claim an adjustment to compensation, schedule, or other contractual impact that would be caused by complying with such notice, in which case the contractor shall, in writing, promptly notify the Purchasing Agency of the adjustment to be sought, and before proceeding to comply with the notice, shall await the Purchasing Agency's written decision affirming, modifying, or revoking the prior written notice. If the Purchasing Agency decides to issue a notice that requires an adjustment to compensation, the contractor shall be compensated for any additional costs incurred as the result of such order and shall give the Purchasing Agency a credit for any savings. Said compensation shall be determined by one of the following methods: a. By mutual agreement between the parties in writing; or b. By agreeing upon a unit price or using a unit price set forth in the contract, if the work to be done can be expressed in units, and the contractor accounts for the number of units of work performed, subject to the Purchasing Agency's right to audit the contractor's records and/or to determine the correct number of units independently; or c. By ordering the contractor to proceed with the work and keep a record of all costs incurred and savings realized. A markup for overhead and profit may be allowed if provided by the contract. The same markup shall be used for determining a decrease in price as the result of savings realized. The contractor shall present the Purchasing Agency with all vouchers and records of expenses incurred and savings realized. The Purchasing Agency shall have the right to audit the records of the contractor as it deems necessary to determine costs or savings. Any claim for an adjustment in price under this provision must be asserted by written notice to the Purchasing Agency within thirty (30) days from the date of receipt of the written order from the Purchasing Agency. If the parties fail to agree on an amount of adjustment, the question of an increase or decrease in the contract price or time for performance shall be resolved in accordance with the procedures for resolving disputes provided by the Disputes Clause of this contract or, if there is none, in accordance with the disputes provisions of the Commonwealth of Virginia Vendors Manual. Neither the existence of a claim nor a dispute resolution process, litigation or any other provision of this contract shall excuse the contractor from promptly complying with the changes ordered by the Purchasing Agency or with the performance of the contract generally.

DEFAULT

In case of failure to deliver goods or services in accordance with the contract terms and conditions, the Commonwealth, after due oral or written notice, may procure them from other sources and hold the contractor responsible for any resulting additional purchase and administrative costs. This remedy shall be in addition to any other remedies which the Commonwealth may have.

TAXES

Sales to the Commonwealth of Virginia are normally exempt from State sales tax. State sales and use tax certificates of exemption, Form ST-12, will be issued upon request. Deliveries against this contract shall usually be free of Federal excise and transportation taxes. The Commonwealth's excise tax exemption registration number is 54-73-0076K. If sales or deliveries against the contract are not exempt, the contractor shall be responsible for the payment of such taxes unless the tax law specifically imposes the tax upon the buying entity and prohibits the contractor from offering a tax-included price.

USE OF BRAND NAMES

Unless otherwise provided in this solicitation, the name of a certain brand, make or manufacturer does not restrict bidders to the specific brand, make or manufacturer named, but conveys the general style, type, character, and quality of the article desired. Any article which the public body, in its sole discretion, determines to be the equivalent of that specified, considering quality, workmanship, economy of operation, and suitability for the purpose intended, shall be accepted. The bidder is responsible to clearly and specifically identify the product being offered and to provide sufficient descriptive literature, catalog cuts and technical detail to enable the Commonwealth to determine if the product offered meets the requirements of the solicitation. This is required even if offering the exact brand, make or manufacturer specified. Normally in competitive sealed bidding only the information furnished with the bid will be considered in the evaluation. Failure to furnish adequate data for evaluation purposes may result in declaring a bid nonresponsive. Unless the bidder clearly indicates in its bid that the product offered is an equivalent product, such bid will be considered to offer the brand name product referenced in the solicitation.

TRANSPORTATION AND PACKAGING

By submitting their bids, all bidders certify and warrant that the price offered for FOB destination includes only the actual freight rate costs at the lowest and best rate and is based upon the actual weight of the goods to be shipped. Except as otherwise specified herein, standard commercial packaging, packing and shipping containers shall be used. All shipping containers shall be legibly marked or labeled on the outside with purchase order number, commodity description, and quantity.

INSURANCE

By signing and submitting a bid under this solicitation, the bidder certifies that if awarded the contract, it will have the following insurance coverage at the time the contract is awarded. For construction contracts, if any subcontractors are involved, the subcontractor will have workers' compensation insurance in accordance with §§ 2.2-4332 and 65.2-800 et seq. of the Code of Virginia. The bidder further certifies that the contractor and any subcontractors will maintain these insurance coverages during the entire term of the contract and that all coverage will be provided by companies authorized to sell insurance in Virginia by the Virginia State Corporation Commission. MINIMUM INSURANCE COVERAGES AND LIMITS: 1. Workers' Compensation - Statutory requirements and benefits. Coverage is compulsory for employers of three or more employees, to include the employer. Contractors who fail to notify the Commonwealth of increases in the number of employees that change their workers' compensation requirements under the Code of Virginia during the course of the contract shall be in noncompliance with the contract. 2. Employer's Liability - $100,000. 3. Commercial General Liability - $1,000,000 per occurrence and $2,000,000 in the aggregate. Commercial General Liability is to include bodily injury and property damage, personal injury and advertising injury, products and completed operations coverage. The Commonwealth of Virginia shall be added as an additional insured to the policy by an endorsement. 4. Automobile Liability - $1,000,000 combined single limit. (Required only if a motor vehicle not owned by the Commonwealth is to be used in the contract. Contractor must assure that the required coverage is maintained by the Contractor (or third party owner of such motor vehicle.) Profession/Service Limits Accounting $1,000,000 per occurrence, $3,000,000 aggregate Architecture $2,000,000 per occurrence, $6,000,000 aggregate Asbestos Design, Inspection or Abatement Contractors $1,000,000 per occurrence, $3,000,000 aggregate Health Care Practitioner (to include Dentists, Licensed Dental Hygienists, Optometrists, Registered or Licensed Practical Nurses, Pharmacists, Physicians, Podiatrists, Chiropractors, Physical Therapists, Physical Therapist Assistants, Clinical Psychologists, Clinical Social Workers, Professional Counselors, Hospitals, or Health Maintenance Organizations.) Code of Virginia § 8.01-581.15 https://law.lis.virginia.gov/vacode/title8.01/chapter21.1/section8.01-581.15/ Insurance/Risk Management $1,000,000 per occurrence, $3,000,000 aggregate Landscape/Architecture $1,000,000 per occurrence, $1,000,000 aggregate Legal $1,000,000 per occurrence, $5,000,000 aggregate Professional Engineer $2,000,000 per occurrence, $6,000,000 aggregate Surveying $1,000,000 per occurrence, $1,000,000 aggregate

ANNOUNCEMENT OF AWARD

Upon the award or the announcement of the decision to award a contract as a result of this solicitation, the purchasing agency will publicly post such notice in eVA (www.eva.virginia.gov) for a minimum of 10 days.

DRUG-FREE WORKPLACE

Applicable for all contracts over $10,000: During the performance of this contract, the contractor agrees to (i) provide a drug-free workplace for the contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the contractor that the contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor. For the purposes of this section, "drug-free workplace" means a site for the performance of work done in connection with a specific contract awarded to a contractor, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract.

NONDISCRIMINATION

A bidder or contractor shall not be discriminated against in the solicitation or award of this contract because of race, religion, color, sex, sexual orientation, gender identity, national origin, age, disability, faith-based organizational status, any other basis prohibited by state law relating to discrimination in employment or because the bidder employs ex-offenders unless the state agency, department or institution has made a written determination that employing ex-offenders on the specific contract is not in its best interest. If the award of this contract is made to a faith-based organization and an individual, who applies for or receives goods, services, or disbursements provided pursuant to this contract objects to the religious character of the faith-based organization from which the individual receives or would receive the goods, services, or disbursements, the public body shall offer the individual, within a reasonable period of time after the date of his objection, access to equivalent goods, services, or disbursements from an alternative provider.

eVA VENDOR REGISTRATION

The eVA Internet electronic procurement solution, web site portal www.eVA.virginia.gov, streamlines and automates government purchasing activities in the Commonwealth. The eVA portal is the gateway for vendors to conduct business with state agencies and public bodies. All vendors desiring to provide goods and/or services to the Commonwealth shall participate in the eVA Internet e-procurement solution by completing the free eVA Vendor Registration. All bidders must register in eVA and pay the Vendor Transaction Fees specified below; failure to register will result in the bid being rejected. Vendor transaction fees are determined by the date the original purchase order is issued and the current fees are as follows: a. For orders issued July 1, 2014, and after, the Vendor Transaction Fee is: (i) DSBSD-certified Small Businesses: 1%, capped at $500 per order. (ii) Businesses that are not DSBSD-certified Small Businesses: 1%, capped at $1,500 per order. b. Refer to Special Term and Condition "eVA Orders and Contracts" to identify the number of purchase orders that will be issued as a result of this solicitation with the eVA transaction fee specified above assessed for each order. For orders issued prior to July 1, 2014, the vendor transaction fees can be found at www.eVA.virginia.gov.*The specified vendor transaction fee will be invoiced, by the Commonwealth of Virginia Department of General Services, typically within 60 days of the order issue date. Any adjustments (increases/decreases) will be handled through purchase order changes.

AVAILABILITY OF FUNDS

It is understood and agreed between the parties herein that the agency shall be bound hereunder only to the extent that the legislature has appropriated funds that are legally available or may hereafter become legally available for the purpose of this agreement.

SET-ASIDES AWARD PRIORITY

This solicitation is set-aside for award priority to DSBSD-certified micro businesses or small businesses when designated as "Micro Business Set-Aside Award Priority" or "Small Business Set-Aside Award Priority" accordingly in the solicitation. DSBSD-certified micro businesses or small businesses also includes DSBSD-certified women-owned and minority-owned businesses when they have received the DSBSD small business certification. For purposes of award, bidders shall be deemed micro businesses or small businesses if and only if they are certified as such by DSBSD on the due date for receipt of bids.

BID PRICE CURRENCY

Unless stated otherwise in the solicitation, bidders shall state bid prices in US dollars.

AUTHORIZATION TO CONDUCT BUS.

A contractor organized as a stock or nonstock corporation, limited liability company, business trust, or limited partnership or registered as a registered limited liability partnership shall be authorized to transact business in the Commonwealth as a domestic or foreign business entity if so required by Title 13.1 or Title 50 of the Code of Virginia or as otherwise required by law. Any business entity described above that enters into a contract with a public body pursuant to the Virginia Public Procurement Act shall not allow its existence to lapse or its certificate of authority or registration to transact business in the Commonwealth, if so required under Title 13.1 or Title 50, to be revoked or cancelled at any time during the term of the contract. A public body may void any contract with a business entity if the business entity fails to remain in compliance with the provisions of this section.

CIVILITY IN STATE WORKPLACES

The contractor shall take all reasonable steps to ensure that no individual, while performing work on behalf of the contractor or any subcontractor in connection with this agreement (each, a “Contract Worker”), shall engage in 1) harassment (including sexual harassment), bullying, cyber-bullying, or threatening or violent conduct, or 2) discriminatory behavior on the basis of race, sex, color, national origin, religious belief, sexual orientation, gender identity or expression, age, political affiliation, veteran status, or disability. The contractor shall provide each Contract Worker with a copy of this Section and will require Contract Workers to participate in agency training on civility in the State workplace if contractor’s (and any subcontractor’s) regular mandatory training programs do not already encompass equivalent or greater expectations. Upon request, the contractor shall provide documentation that each Contract Worker has received such training. For purposes of this Section, “State workplace” includes any location, permanent or temporary, where a Commonwealth employee performs any work-related duty or is representing his or her agency, as well as surrounding perimeters, parking lots, outside meeting locations, and means of travel to and from these locations. Communications are deemed to occur in a State workplace if the Contract Worker reasonably should know that the phone number, email, or other method of communication is associated with a State workplace or is associated with a person who is a State employee. The Commonwealth of Virginia may require, at its sole discretion, the removal and replacement of any Contract Worker who the Commonwealth reasonably believes to have violated this Section. This Section creates obligations solely on the part of the contractor. Employees or other third parties may benefit incidentally from this Section and from training materials or other communications distributed on this topic , but the Parties to this agreement intend this Section to be enforceable solely by the Commonwealth and not by employees or other third parties.

Acknowledge & Sign Statement

In compliance with this Invitation For Bids (IFB) and all conditions imposed in this IFB, the undersigned firm hereby offers and agrees to furnish all goods and services required by this IFB at the prices indicated in the pricing schedule, and the undersigned firm hereby certifies that all information provided below and in any schedule attached hereto is true, correct, and complete.

* Name of Firm: GILLIG LLC	* Date: OCTOBER 6, 2022
* Street: 451 DISCOVERY DRIVE	* Authorized Signature:
Street:	* Printed Name & Title: DEREK MAUNUS, PRESIDENT & CEO
* City: LIVERMORE	* DUNS: 06-655-7182
* State/Province: CA	* Vendor ID:
* ZIP Code: 94551	* Phone (xxx) xxx-xxxx: 800-735-1500
* Email Address: SALES@GILLIG.COM	Fax (xxx) xxx-xxxx: 510-785-6819

*GILLIG WILL COMPLY WITH THE REPORTING REQUIREMENTS AS APPROVED BY THE COMMONWEALTH OF VIRGINIA DURING THE APPROVED EQUALS PROCESS, SEE ATTACHED.

GILLIG

PRICING CLARIFICATION

All the following general comments and clarifications may not apply to your specific procurement, but they are included so as to avoid misunderstandings, so they should not be construed as making this a conditional bid. These comments do not change the quoted pricing for the initial order and build.

TAX/FEE STATEMENT

The prices quoted for this procurement are for the specified deliverables only and **exclude** (unless specifically noted by buyer or seller) any Local, City, County, State, Franchise or Income or Value Added(VAT) taxes, tariffs, fees, business licenses, or other licenses, that may need to be paid as part of the performance of this contract, or any option of it. If any additional fees are required, they will be noted and added to the appropriate invoice.

PAYMENT

All prices are in U.S. Dollars and payments are only accepted on U.S. bank checks or via electronic funds transfers, (no credit, debit or bank cards) and any applicable transaction fees would be the responsibility of the buyer.

EMISSIONS AND OTHER REGULATED OR MANDATED CHANGES

The prices quoted for the initial build quantity are for vehicles meeting all applicable Federal and State regulations (including EPA, CARB, or NHTSA requirements) **currently known to be in effect at the time of delivery of those vehicles.** Changes caused by or related to future regulations, any subsequently enacted regulations, or technologies necessitating revisions from the currently proposed vehicle configuration (e.g. component change/availability due to emission or other regulations, requirements or mandates), may require a price adjustment, which would be subject to negotiation and agreement by both GILLIG and the buyer. This latter statement applies to future builds only that may need to use different components or currently unknown or unavailable technology, to meet regulations or requirements in effect at the time(s) of those optional deliveries.

OPTIONAL BUILD PRICING

Most bids include a PPI adjuster to determine pricing for future builds, and this is to clarify that bus pricing for such future build quantities may be different from the PPI adjusted price because of the above regulated/mandated changes and/or due to customer initiated change notices.

GILLIG LLC

By: ______________________

DEREK MAUNUS

Title: PRESIDENT & CEO

Date: OCTOBER 6, 2022

GILLIG LLC

LOW FLOOR TRANSIT COACH

STANDARD LIMITED WARRANTY & EXTENDED COVERAGE FOR DIESEL, CNG & HYBRID BUSES

COMMONWEALTH OF VIRGINIA – RICHMOND, VA
IFB 6447 – OCTOBER 2022

GILLIG LLC warrants to the original purchaser, that its transit coaches, save and except for those major component assemblies and other parts described below which are separately warranted by their respective manufacturer's (OEM's), will be **FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP UNDER NORMAL USE AND SERVICE**, for the distance or time periods specified in the attached, and agrees to REPAIR or REPLACE the defective parts AT NO COST TO THE PURCHASER. This is a limited warranty subject to the provisions stated below and is referred to as GILLIG's Standard Limited Warranty.

This warranty **DOES NOT COVER** malfunction or failure resulting from the purchaser's or its agents or employees alteration, misuse, abuse, accident, neglect or failure to perform normal preventive maintenance as outlined in GILLIG's Service Manual, nor does it cover components or assemblies not originally provided by GILLIG. Further, this warranty **DOES NOT APPLY** to normal replacement items such as light bulbs, seals, filters or bushings, nor to consumable items such as belts, tires, brake linings or drums.

PURCHASER'S SOLE REMEDIES FOR LIABILITY OF ANY KIND WITH RESPECT TO THE PRODUCTS FURNISHED UNDER THIS WARRANTY AND ANY OTHER PERFORMANCE BY GILLIG UNDER OR PURSUANT TO THIS WARRANTY, OR WITH RESPECT TO PURCHASER'S USE THEREOF, INCLUDING NEGLIGENCE, SHALL BE LIMITED TO THE REMEDIES PROVIDED IN THIS WARRANTY AND SHALL IN NO EVENT INCLUDE ANY INCIDENTAL, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES OR LOSS OF USE, REVENUE OR PROFIT. IN NO EVENT SHALL GILLIG'S LIABILITY FOR DAMAGES WITH RESPECT TO ANY OF THE PRODUCTS COVERED UNDER THIS WARRANTY EXCEED THE AMOUNT PAID BY THE PURCHASER TO GILLIG FOR SUCH PRODUCTS.

GILLIG **DOES NOT WARRANT** some major component assemblies (such as the engines, transmissions and air conditioning systems) which are warranted by their respective manufacturers (OEM's) and identified as Category 3 items on page three (3) of this Warranty. **Warranty coverage for these items is as defined in those manufacturer's own warranty documents** and per their terms and conditions, and as administered by their own support networks.

GILLIG makes **NO OTHER WARRANTIES,** except as stated herein, and GILLIG's obligation under this warranty is **LIMITED AND FULLY DESCRIBED HEREIN**. Determination of warrantable defects is at GILLIG's (or the OEM's) discretion and will require inspection of failed components. Correction or compensation under this warranty for Category 1 and Category 2 items cannot be made unless requested on a GILLIG Application for Warranty Claim form and in accordance with the claim procedure established by GILLIG.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTY EXPRESSED OR IMPLIED, but if such has legal status, it **CANNOT EXCEED THE DURATIONS STATED HEREIN**. This warranty gives the purchaser specific legal rights and some state statutes may include other rights.

This is GILLIG's sole warranty with respect to its transit coaches. **GILLIG MAKES NO OTHER WARRANTY OF ANY KIND WHATEVER, EXPRESS OR IMPLIED; AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEED THE AFORESAID OBLIGATION ARE HEREBY DISCLAIMED BY GILLIG AND EXCLUDED FROM THIS AGREEMENT.**

GILLIG LLC

LOW FLOOR TRANSIT COACH

STANDARD LIMITED WARRANTY & EXTENDED COVERAGE FOR DIESEL, CNG & HYBRID BUSES

COMMONWEALTH OF VIRGINIA – RICHMOND, VA
IFB 6447 – OCTOBER 2022

GILLIG's Standard Limited Warranty which covers Category 1 and Category 2 parts, components and assemblies, covers the following systems, components or assemblies for the period specified, and includes 100% PARTS AND LABOR to repair or replace the defective components as determined by GILLIG. (See Page 3 for explanation of notes (1)-(7).)

CATEGORY 1

Includes GILLIG manufactured or assembled components and systems as well as some purchased assemblies. Warranty and warranty claims administration provided by GILLIG.

	Coverage Period (1)	
	Months	Miles
FULL COACH WARRANTY (2) (3) (7)	12	50,000
BODY STRUCTURE WARRANTY (4)	36	150,000
CORROSION & STRUCTURAL INTEGRITY WARRANTY (5)	144	500,000
TOWING	12	50,000

CATEGORY 2

Includes major components purchased and installed by GILLIG. Warranty provided by component OEM's. Warranty claims administration provided by GILLIG.

	Months	Miles
AXLE		
Meritor Front Steering	60	300,000
Meritor Rear Driving	84	350,000
BRAKE SYSTEM		
(Excludes Friction Material)		
Meritor Brakes	12	Unlimited
RADIATOR & CHARGE AIR COOLER		
Modine	36	100,000

GILLIG LLC

LOW FLOOR TRANSIT COACH

STANDARD LIMITED WARRANTY & EXTENDED COVERAGE FOR DIESEL, CNG & HYBRID BUSES

COMMONWEALTH OF VIRGINIA – RICHMOND, VA
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Major components listed below under "Category 3" are covered by warranties or extended coverages(6), for the miles and/or months indicated, provided by the manufacturer (OEM's) of those components. Purchasers should refer to specific OEM warranty documents for details. Warranty claims are and will be administered by the respective manufacturers (OEM's) and all warranty claims must be made directly to said manufacturers. GILLIG will assist purchasers in dealing with these OEM's and warranty issues that may arise from time to time.

CATEGORY 3

	Coverage Period (1)	
	Months	Miles
ENGINE (7)		
Cummins L9, L9N, B6.7	24	Unlimited
ENGINE ACCESSORIES		
Delco Starter	36	350,000
Niehoff Alternator	24	Unlimited
Air Compressor	24	Unlimited
TRANSMISSION		
Voith D867.8	24	Unlimited
HYBRID DRIVE		
Allison eGenFlex	24	Unlimited
BAE HDS200	24	Unlimited
AIR CONDITIONING SYSTEM		
Thermo King	24	Unlimited
WHEELCHAIR RAMP		
Lift-U LU18	24	Unlimited
DOOR SYSTEM (8)		
Vapor	36	150,000
INTERIOR LIGHTING		
I/O Controls	144	500,000
FIRE SUPPRESSION		
Amerex	36	Unlimited

Low Floor Transit Coach Emission Warranty

GILLIG warrants to the ultimate purchaser and each subsequent purchaser that the new vehicle is designed, built and equipped so it conforms at the time of sale to the ultimate purchaser with all U.S. federal emissions regulations applicable at the time of manufacture and that it is free from defects in materials or workmanship which would cause the vehicle to fail to not meet these regulations within five years or 100,000 miles of operation, whichever occurs first, as measured from the date the vehicle is placed into service. In no case may this period be less than the Standard Limited Warranty where applicable to emission warrantable parts. If the ultimate purchaser registers the vehicle in the state of California (or any other state following the applicable California Air Resources Board regulations) a separate California Emissions Warranty applies.

GILLIG LLC

LOW FLOOR TRANSIT COACH

STANDARD LIMITED WARRANTY & EXTENDED COVERAGE FOR DIESEL, CNG & HYBRID BUSES

COMMONWEALTH OF VIRGINIA – RICHMOND, VA
IFB 6447 – OCTOBER 2022

GILLIG warrants to the ultimate purchaser that registers the vehicle in the state of California (or any other state following the applicable California Air Resources Board regulations), and each subsequent purchaser, that the new vehicle is designed, built and equipped so it conforms at the time of sale to the ultimate purchaser with all applicable regulations adopted by the California Air Resources Board at the time of manufacture and that it is free from defects in materials or workmanship which would cause the vehicle to fail to not meet these regulations within five years, 100,000 miles or 3000 hours of operation, whichever occurs first, as measured from the date the vehicle is placed into service. In no case may this period be less than the basic mechanical warranty provided to the purchaser of the engine.

GILLIG warrants to the ultimate purchaser and each subsequent purchaser that the tires on this vehicle conform at the time of sale to the ultimate purchaser with all U.S federal emissions regulations and all applicable regulations adopted by the California Air Resources Board at the time of manufacture and are free from defects in materials or workmanship which would cause the vehicle to fail to not meet these regulations for a period of 2 years or 24,000 miles, whichever occurs first.

This list of emission control parts may be covered by the Emission Warranty under certain failure modes.

- Ambient Air Temperature Sensor
- Charge Air Cooler and associated plumbing
- Wire harness circuits connected at both ends to emissions warrantable components
- Exhaust gas pipes from turbocharger out to the last after treatment device
- Urea quality sensor
- Urea tank, heating element, level sensor, temperature sensor, coolant control valve
- Urea lines and line heater controls
- On-Board Diagnostic (OBD) Malfunction Indicator Lamp (MIL)
- Diesel Exhaust Fluid (DEF) Lamp
- OBD Connector

NOTES

1) Coverage ceases at the first expiration of the time or distance noted.
2) Full coach warranty includes and applies to electrical, doors, seats, flooring, roof hatches, destination signs, wheelchair ramp, handrails, radio, P.A., etc., but not to IVS systems or special options.
3) Fleet defect coverage is for a maximum of 12 months or 50,000 miles and includes all warrantable components and assemblies on the vehicle.
4) Basic body structure warranty includes and applies to structural members in the body and undercarriage including the structural members in the suspensions.
5) The corrosion and structural integrity guarantee covers against a significant loss of structural integrity of the assembly or its functional performance, resulting from a pertinent loss of cross-section due to corrosion caused by normal environmental elements but excludes corrosion caused by aggressive road de-icers such as Magnesium Chloride or equivalents, unless Gillig approved preventative measures are taken (see Service Manual).
6) Extended coverage may not duplicate Standard Limited warranty coverage. Note: Please refer to OEM warranty documents for details.
7) Use of non-ASTM biodiesel blends from non-BQ9000 suppliers in excess of B20 may void the engine manufacturer's warranty on fuel related components, and also may void warranties of hoses, seals and fittings in contact with the fuel.
8) For consumable components like brushes, seals, air wave switches and related wear items a one year parts and labor warranty applies

GILLIG LLC

LOW FLOOR TRANSIT COACH

STANDARD LIMITED WARRANTY & EXTENDED COVERAGE FOR BATTERY ELECTRIC BUSES

COMMONWEALTH OF VIRGINIA – RICHMOND, VA
IFB 6227 – OCTOBER 2022

GILLIG LLC warrants to the original purchaser, that its transit coaches, save and except for those major component assemblies and other parts described below which are separately warranted by their respective manufacturer's (OEM's), will be **FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP UNDER NORMAL USE AND SERVICE**, for the distance or time periods specified in the attached, and agrees to REPAIR or REPLACE the defective parts AT NO COST TO THE PURCHASER. This is a limited warranty subject to the provisions stated below and is referred to as GILLIG's Standard Limited Warranty.

This warranty **DOES NOT COVER** malfunction or failure resulting from the purchaser's or its agents or employees alteration, misuse, abuse, accident, neglect or failure to perform normal preventive maintenance as outlined in GILLIG's Service Manual, nor does it cover components or assemblies not originally provided by GILLIG. Further, this warranty **DOES NOT APPLY** to normal replacement items such as light bulbs, seals, filters or bushings, nor to consumable items such as belts, tires, brake linings or drums.

PURCHASER'S SOLE REMEDIES FOR LIABILITY OF ANY KIND WITH RESPECT TO THE PRODUCTS FURNISHED UNDER THIS WARRANTY AND ANY OTHER PERFORMANCE BY GILLIG UNDER OR PURSUANT TO THIS WARRANTY, OR WITH RESPECT TO PURCHASER'S USE THEREOF, INCLUDING NEGLIGENCE, SHALL BE LIMITED TO THE REMEDIES PROVIDED IN THIS WARRANTY AND SHALL IN NO EVENT INCLUDE ANY INCIDENTAL, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES OR LOSS OF USE, REVENUE OR PROFIT. IN NO EVENT SHALL GILLIG'S LIABILITY FOR DAMAGES WITH RESPECT TO ANY OF THE PRODUCTS COVERED UNDER THIS WARRANTY EXCEED THE AMOUNT PAID BY THE PURCHASER TO GILLIG FOR SUCH PRODUCTS.

GILLIG **DOES NOT WARRANT** some major component assemblies (such as the engines, transmissions and air conditioning systems) which are warranted by their respective manufacturers (OEM's) and identified as Category 3 items on page three (3) of this Warranty. **Warranty coverage for these items is as defined in those manufacturer's own warranty documents** and per their terms and conditions, and as administered by their own support networks.

GILLIG makes **NO OTHER WARRANTIES,** except as stated herein, and GILLIG's obligation under this warranty is **LIMITED AND FULLY DESCRIBED HEREIN**. Determination of warrantable defects is at GILLIG's (or the OEM's) discretion and will require inspection of failed components. Correction or compensation under this warranty for Category 1 and Category 2 items cannot be made unless requested on a GILLIG Application for Warranty Claim form and in accordance with the claim procedure established by GILLIG.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTY EXPRESSED OR IMPLIED, but if such has legal status, it **CANNOT EXCEED THE DURATIONS STATED HEREIN**. This warranty gives the purchaser specific legal rights and some state statutes may include other rights.

This is GILLIG's sole warranty with respect to its transit coaches. **GILLIG MAKES NO OTHER WARRANTY OF ANY KIND WHATEVER, EXPRESS OR IMPLIED; AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEED THE AFORESAID OBLIGATION ARE HEREBY DISCLAIMED BY GILLIG AND EXCLUDED FROM THIS AGREEMENT.**

GILLIG LLC

LOW FLOOR TRANSIT COACH

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COMMONWEALTH OF VIRGINIA – RICHMOND, VA
IFB 6227 – OCTOBER 2022

GILLIG's Standard Limited Warranty which covers Category 1 and Category 2 parts, components and assemblies, covers the following systems, components or assemblies for the period specified, and includes 100% PARTS AND LABOR to repair or replace the defective components as determined by GILLIG. (See Page 3 for explanation of notes (1)-(7).)

CATEGORY 1

Includes GILLIG manufactured or assembled components and systems as well as some purchased assemblies. Warranty and warranty claims administration provided by GILLIG.

	Coverage Period (1)	
	Months	Miles
FULL COACH WARRANTY (2) (3) (7)	12	50,000
BODY STRUCTURE WARRANTY (4)	36	150,000
CORROSION & STRUCTURAL INTEGRITY WARRANTY (5)	144	500,000
TOWING	12	50,000

CATEGORY 2

Includes major components purchased and installed by GILLIG. Warranty provided by component OEM's. Warranty claims administration provided by GILLIG.

	Months	Miles
AXLE		
Meritor Front Steering	60	300,000
Meritor Rear Driving	60	300,000
BRAKE SYSTEM		
(Excludes Friction Material)		
Meritor Brakes	12	Unlimited
ELECTRONIC COOLING PACKAGE		
Modine System	36	Unlimited

Major components listed below under "Category 3" are covered by warranties or extended coverages[6], for the miles and/or months indicated, provided by the manufacturer (OEM's) of those components. Purchasers should refer to specific OEM warranty documents for details. Warranty claims are and will be administered by the respective manufacturers (OEM's) and all warranty claims must be made directly to said manufacturers. GILLIG will assist purchasers in dealing with these OEM's and warranty issues that may arise from time to time.

CATEGORY 3

	Coverage Period [1]	
	Months	Miles
POWERTRAIN [7]		
CUMMINS TM4	36	100,000
Energy Storage System	72	300,000
See Akasol Battery Warranty page for further details		
AIR CONDITIONING SYSTEM		
Thermo King – TE18 ALL ELECTRIC	24	Unlimited
WHEELCHAIR RAMP		
Lift-U LU18	24	Unlimited
DOOR SYSTEM [7]		
Vapor	36	150,000
INTERIOR LIGHTING		
I/O Controls	144	500,000
FIRE SUPPRESSION		
Amerex	36	Unlimited

Low Floor Transit Coach Emission Warranty

GILLIG warrants to the ultimate purchaser and each subsequent purchaser that the new vehicle is designed, built and equipped so it conforms at the time of sale to the ultimate purchaser with all U.S. federal emissions regulations applicable at the time of manufacture and that it is free from defects in materials or workmanship which would cause the vehicle to fail to not meet these regulations within five years or 100,000 miles of operation, whichever occurs first, as measured from the date the vehicle is placed into service. In no case may this period be less than the Standard Limited Warranty where applicable to emission warrantable parts. If the ultimate purchaser registers the vehicle in the state of California (or any other state following the applicable California Air Resources Board regulations) a separate California Emissions Warranty applies.

GILLIG LLC

LOW FLOOR TRANSIT COACH

STANDARD LIMITED WARRANTY & EXTENDED COVERAGE FOR BATTERY ELECTRIC BUSES

COMMONWEALTH OF VIRGINIA – RICHMOND, VA
IFB 6227 – OCTOBER 2022

GILLIG warrants to the ultimate purchaser that registers the vehicle in the state of California (or any other state following the applicable California Air Resources Board regulations), and each subsequent purchaser, that the new vehicle is designed, built and equipped so it conforms at the time of sale to the ultimate purchaser with all applicable regulations adopted by the California Air Resources Board at the time of manufacture and that it is free from defects in materials or workmanship which would cause the vehicle to fail to not meet these regulations within five years, 100,000 miles or 3000 hours of operation, whichever occurs first, as measured from the date the vehicle is placed into service. In no case may this period be less than the basic mechanical warranty provided to the purchaser of the engine.

GILLIG warrants to the ultimate purchaser and each subsequent purchaser that the tires on this vehicle conform at the time of sale to the ultimate purchaser with all U.S federal emissions regulations and all applicable regulations adopted by the California Air Resources Board at the time of manufacture and are free from defects in materials or workmanship which would cause the vehicle to fail to not meet these regulations for a period of 2 years or 24,000 miles, whichever occurs first.

This list of emission control parts may be covered by the Emission Warranty under certain failure modes.

- Ambient Air Temperature Sensor
- Wire harness circuits connected at both ends to emissions warrantable components
- On-Board Diagnostic (OBD) Malfunction Indicator Lamp (MIL)
- OBD Connector

NOTES

1) Coverage ceases at the first expiration of the time or distance noted.
2) Full coach warranty includes and applies to electrical, doors, seats, flooring, roof hatches, destination signs, wheelchair ramp, handrails, radio, P.A., etc., but not to IVS systems or special options.
3) Fleet defect coverage is for a maximum of 12 months or 50,000 miles and includes all warrantable components and assemblies on the vehicle.
4) Basic body structure warranty includes and applies to structural members in the body and undercarriage including the structural members in the suspensions.
5) The corrosion and structural integrity guarantee covers against a significant loss of structural integrity of the assembly or its functional performance, resulting from a pertinent loss of cross-section due to corrosion caused by normal environmental elements but excludes corrosion caused by aggressive road de-icers such as Magnesium Chloride or equivalents, unless Gillig approved preventative measures are taken (see Service Manual).
6) Extended coverage may not duplicate Standard Limited warranty coverage. Note: Please refer to OEM warranty documents for details.
7) For consumable components like brushes, seals, air wave switches and related wear items a one year parts and labor warranty applies.

GILLIG

GILLIG BATTERY ELECTRIC BUS
AKASOL BATTERY WARRANTY
5 pack 490 kWh
6 pack 598 kWh
7 pack 686 kWh

BASE WARRANTY

Available Depth of Discharge		90%
Warranty End of Life (SOH)		75%
Warranty Term	Time	72 Months
(whichever	Low Power Charging (up to 65A / pack)	175 MWh / pack
comes first)	High Power Charging (up to 120A / pack)	150 MWh / pack

VENDOR DATA SHEET

The following information is required as part of the Bidder's response to this solicitation. Failure to complete and provide this sheet may result in bid being declared nonresponsive. (In the case of a Combined Two-Step IFB, it may cause the Technical Proposal to be determined to be not acceptable.)

1. Qualification: The Bidder must have the capability and capacity in all respects to satisfy fully all of the contractual requirements.

2. Bidder's Primary Contact:
   Name: DEREK MAUNUS, PRESIDENT & CEO Phone: 800-785-1500 Email: SALES@GILLIG.COM

3. Years in Business: Indicate the length of time Bidder has been in business providing this type of good or service:
   14 Years 2 Months GILLIG LLC*

4. eVA Vendor ID or DUNS Number: 06-655-7182

5. Indicate below a listing of at least four (4) current or recent accounts, either commercial or governmental, that the Bidder is servicing, has serviced, or has provided similar goods/services. Include the length of service and the name, address, and telephone number of the point of contact.

   A. Company: CDTA - ALBANY, NY Contact: CARM BASILE, CEO
      Phone: (518) 437-8310 Email: CARM@CDTA.ORG
      Dates of Service: 1/2022-1/2027 5YR CONTRACT $ Value: $55MM

   B. Company SCTAPA - LANCASTER, PA Contact: GREG DOWNING, EXECUTIVE DIRECTOR
      Phone: (717) 358-1925 Email: GDOWNING@SCTAPA.COM
      Dates of Service: 11/2020-11/2025 5YR CONTRACT $ Value: $165MM

   C. Company: AC TRANSIT - OAKLAND, CA Contact: SALVADOR LLAMAS, COO
      Phone: (510) 577-8803 Email: SLLAMAS@ACTRANSIT.ORG
      Dates of Service: 2022 DIESEL & BEB SINGLE PURCHASES $ Value: 47.1MM

   D. Company: MTS - SAN DIEGO, CA Contact: SHARON COONEY, CEO
      Phone: (619) 557-4513 Email: SHARON.COONEY@SDMTS.COM
      Dates of Service: 10/2017-10/2022 5YR CONTRACT $ Value: $205MM

I certify the accuracy of this information.

Signed: ______________ Title: DEREK MAUNUS, PRESIDENT & CEO Date: 10/6/2022

*GILLIG CORPORATION 1978-2008
GILLIG BROS. 1890-1978

SMALL BUSINESS SUBCONTRACTING PLAN

It is the goal of the Commonwealth that over 42% of its purchases be made from small businesses. All potential bidders are required to submit the subcontractor plan by one of the following methods in order to be considered responsive:

A. Complete the subcontractor plan as specified in the electronic response; or
B. Download the "paper response" form, complete the subcontractor plan section, and submit as an attachment with the bid response.

Small Business: "Small business (including micro)" means a business which holds a certification as such by the Virginia Department of Small Business and Supplier Diversity (DSBSD) on the due date for proposals. This shall also include DSBSD-certified women- owned and minority-owned businesses and businesses with DSBSD service disabled veteran owned status when they also hold a DSBSD certification as a small business on the proposal due date. Currently, DSBSD offers small business certification and micro business designation to firms that qualify.

Certification applications are available through DSBSD online at www.SBSD.virginia.gov (Customer Service).

GILLIG IS NOT A "SMALL BUSINESS".

GILLIG DOES NOT SUBCONTRACT THE MANUFACTURE OF OUR TRANSIT VEHICLES. WE MANUFACTURE THE ENTIRE VEHICLE AT OUR MANUFACTURING PLANT IN HAYWARD, CA.

GILLIG CONFIRMS THAT WE COMPLY WITH THE FEDERAL REGULATIONS 49 CFR PART 26 GOVERNING THE UTILIZATION OF DBE/WBE MATERIAL SUPPLIER FIRMS. WE SUBMIT
DBE/WBE INFORMATION DIRECTLY TO THE FTA FOR THEIR REVIEW, UTILIZING THE FTA REQUIRED REPORTING DOCUMENTS AND SCHEDULES.

REFERENCE OUR ATTACHED CERTIFICATION

GILLIG

DBE/MBE CERTIFICATION OF COMPLIANCE

DISADVANTAGED/MINORITY BUSINESS ENTERPRISE (DBE/MBE)

GILLIG LLC, 451 Discovery Drive, Livermore California 94551, hereby certifies that GILLIG LLC has complied with the requirements of 49 CFR Part 26 of the Transportation Assistance Act of 1982, and submitted the required documents to the Federal Transit Administration (FTA).

The FTA advised that GILLIG has obtained 49 C.F.R. Part 26.49 certification and we are eligible to bid on federally funded contracts in FY2022. Transit customers may call the FTA DBE Team for verification.

The list of eligible Transit Vehicle Manufacturers may be viewed at https://www.transit.dot.gov/regulations-and-guidance/civil-rights-ada/eligible-transit-vehicle-manufacturers

FEDERAL TRANSIT ADMINISTRATION
Office of Civil Rights
1200 New Jersey Avenue SE
Washington, DC 20590
Phone: 888-446-4511
E-mail: FTATVMSubmissions@dot.gov

GILLIG LLC

By: ______________________

DEREK MAUNUS

Title: PRESIDENT & CEO

Date: OCTOBER 6, 2022

STATE CORPORATION COMMISSION FORM

The following information is required as part of the Bidder's response to this solicitation. Failure to complete and provide this form may result in bid being declared nonresponsive. (In the case of a Combined Two-Step IFB, it may cause the Technical Proposal to be determined to be not acceptable.)

Virginia State Corporation Commission ("SCC") registration information: The Bidder:

☐ is a corporation or other business entity with the following SCC identification number: ____________

-OR-

☐ is not a corporation, limited liability company, limited partnership, registered limited liability partnership, or business trust

-OR-

☐ is an out-of-state business entity that does not regularly and continuously maintain as part of its ordinary and customary business any employees, agents, offices, facilities, or inventories in Virginia (not counting any employees or agents in Virginia who merely solicit orders that require acceptance outside Virginia before they become contracts, and not counting any incidental presence of the Bidder in Virginia that is needed in order to assemble, maintain, and repair goods in accordance with the contracts by which such goods were sold and shipped into Virginia from Bidder's out-of-state location)

-OR-

**☒ is an out-of-state business entity that is including with this bid an opinion of legal counsel which accurately and completely discloses the undersigned Bidder's current contacts with Virginia and describes why those contacts do not constitute the transaction of business in Virginia within the meaning of § 13.1-757 or other similar provisions in Titles 13.1 or 50 of the Code of Virginia.

****NOTE** >>** Check the following box if you have not completed any of the foregoing options but currently have pending before the SCC an application for authority to transact business in the Commonwealth of Virginia and wish to be considered for a waiver to allow you to submit the SCC identification number after the due date for bids (the Commonwealth reserves the right to determine in its sole discretion whether to allow such waiver): ☐

Signature: ______________________ Date: OCTOBER 6, 2022

Name: DEREK MAUNUS
Print

Title: PRESIDENT & CEO

Name of Firm: GILLIG LLC

** GILLIG LLC IS REGISTERED AS A FOREIGN LIMITED LIABLITY COMPANY OUR SCC ID IS T0469900

NDAA 2020 Section 7613 Compliance Form

Regarding compliance with Section 7613 of the National Defense Authorization Act for Fiscal Year 2020 (NDAA 2020), subsection 49 U.S.C. § 5323 (u), the undersigned Bidder:

☒ **IS COMPLIANT** with the provisions of this subsection and certifies the manufacturer is not "owned or controlled by, is a subsidiary of, or is otherwise related legally or financially to a corporation based in" certain foreign countries covered by the restrictions outlined.

☐ **IS NOT COMPLIANT** with the provisions of this subsection and certifies the manufacturer is "owned or controlled by, is a subsidiary of, or is otherwise related legally or financially to a corporation based in" certain foreign countries covered by the restrictions outlined.

For more information regarding the restriction criteria and the provisions of subsection 49 U.S.C. § 5323 (u), visit the FTA Frequently-Asked-Questions for Section 7613 at the following link: https://www.transit.dot.gov/funding/procurement/frequently-asked-questions-regarding-section-7613-national-defense

PLEASE NOTE: Failure to provide this information, may result in your bid being declared non-responsive

Signature: ____________________ **Date:** OCTOBER 6, 2022

Name: DEREK MAUNUS
Print

Title: PRESIDENT & CEO

Name of Firm: GILLIG LLC

Attachment J
IFB6447

Federal Certifications

CERTIFICATION AND RESTRICTIONS ON LOBBYING

I, DEREK MAUNUS, PRESIDENT & CEO hereby certify
(Name and title of official)

On behalf of GILLIG LLC that:
(Name of Bidder/Company Name)

- No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, and officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any federal grant, the making of any federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any federal contract, grant, loan, or cooperative agreement.
- If any funds other than federal appropriated funds have been paid or will be paid to any person influencing or attempting to influence an officer or employee of any agency, a Member of Congress, and officer or employee of Congress, or an employee of a Member of Congress in connection with the federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form — LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
- The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including sub-contracts, sub-grants and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. § 1352 (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

The undersigned certifies or affirms the truthfulness and accuracy of the contents of the statements submitted on or with this certification and understands that the provisions of 31 U.S.C. Section 3801, et seq., are applicable thereto.

Name of Bidder/Company Name: GILLIG LLC

Type or print name: DEREK MAUNUS, PRESIDENT & CEO

Signature of authorized representative: Date 10 / 06 / 2022

Signature of notary and SEAL: See attached

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of ALAMEDA

Subscribed and sworn to (or affirmed) before me on this 6TH day of OCTOBER, 20 22, by DEREK MAUNUS ______,
proved to me on the basis of satisfactory evidence to be the person(s) who appeared before me.

MIRUBENAT TAPIA
COMM. NO. 2319245
NOTARY PUBLIC - CALIFORNIA
ALAMEDA COUNTY
MY COMM. EXPIRES JAN. 19, 2024

(Seal) Signature ______
MIRUBENAT TAPIA
NOTARY PUBLIC

My commission number: 2319245
My commission expires: JANUARY 19, 2024

DESCRIPTION OF ATTACHED DOCUMENT

Type or Title of Document: FEDERAL CERTIFICATIONS

Signer's Name: DEREK MAUNUS

Document Date: OCTOBER 6, 2022

GOVERNMENT-WIDE DEBARMENT AND SUSPENSION (NONPROCUREMENT)

Instructions for Certification By signing and submitting this bid or proposal, the prospective lower tier participant is providing the signed certification set out below.

(1) It will comply and facilitate compliance with U.S. DOT regulations, "Nonprocurement Suspension and Debarment," 2 CFR part 1200, which adopts and supplements the U.S. Office of Management and Budget (U.S. OMB) "Guidelines to Agencies on Governmentwide Debarment and Suspension (Nonprocurement)," 2 CFR part 180,

(2) To the best of its knowledge and belief, that its Principals and Subrecipients at the first tier:

a. Are eligible to participate in covered transactions of any Federal department or agency and are not presently:

1. Debarred,
2. Suspended,
3. Proposed for debarment,
4. Declared ineligible,
5. Voluntarily excluded, or
6. Disqualified,

b. Its management has not within a three-year period preceding its latest application or proposal been convicted of or had a civil judgment rendered against any of them for:

1. Commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction, or contract under a public transaction,
2. Violation of any Federal or State antitrust statute, or,
3. Commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making any false statement, or receiving stolen property,

C. It is not presently indicted for, or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses listed in the preceding subsection 2.b of this Certification,

d. It has not had one or more public transactions (Federal, State, or local) terminated for cause or default within a three-year period preceding this Certification,

e. If, at a later time, it receives any information that contradicts the statements of subsections 2.a —2.d above, it will promptly provide that information to FTA,

f. It will treat each lower tier contract or lower tier subcontract under its Project as a covered lower tier contract for purposes of 2 CFR part 1200 and 2 CFR part 180 if it:

1. Equals or exceeds $25,000,
2. Is for audit services, or,
3. Requires the consent of a Federal official, and

g. It will require that each covered lower tier contractor and subcontractor:

1. Comply and facilitate compliance with the Federal requirements of 2 CFR parts 180 and 1200, and
2. Assure that each lower tier participant in its Project is not presently declared by any Federal department or agency to be:

   a. Debarred from participation in its federally funded Project,
   b. Suspended from participation in its federally funded Project,
   c. Proposed for debarment from participation in its federally funded Project,
   d. Declared ineligible to participate in its federally funded Project,
   e. Voluntarily excluded from participation in its federally funded Project, or
   f. Disqualified from participation in its federally funded Project, and

3. It will provide a written explanation as indicated on a page attached in FTA's TrAMS platform or the Signature Page if it or any of its principals, including any of its first tier Subrecipients or its Third-Party Participants at a lower tier, is unable to certify compliance with the preceding statements in this Certification Group.

(3) It will provide a written explanation as indicated on a page attached in FTA's TrAMS platform or the Signature Page if it or any of its principals, including any of its first tier Subrecipients or its Third-Party Participants at a lower tier, is unable to certify compliance with the preceding statements in this Certification Group.

Certification

Contractor: SEE ATTACHED SIGNED CER 8.2 DEBARMENT AND SUSPENSION CERTIFICATIONS FOR PROSPECTIVE CONTRACTOR.

Signature of Authorized Official: ____________________ Date ___/___/___

Name and Title of Contractor's Authorized Official: ____________________

GILLIG DOES NOT SUBCONTRACT THE MANUFACTURE OF OUR TRANSIT BUSES.
WE MANUFACTURE ALL OF OUR VEHICLES AT ONE LOCATION IN LIVERMORE, CA.

CER 8.2 Debarment and Suspension Certification for Prospective Contractor

Primary covered transactions must be completed by Proposer for contract value over $25,000.

Choose one alternative:

☒ The Proposer, GILLIG LLC ~~[insert name]~~, certifies to the best of its knowledge and belief that it and its principals:

1. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any federal department or agency;
2. Have not within a three-year period preceding this Proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (federal, state or local) transaction or Contract under a public transaction; violation of federal or state antitrust statutes or commission or embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
3. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (federal, state, or local) with commission of any of the offenses enumerated in Paragraph 2 of this certification; and
4. Have not within a three-year period preceding this Proposal had one or more public transactions (federal, state or local) terminated for cause or default.

OR

☐ The Proposer is unable to certify to all of the statements in this certification, and attaches its explanation to this certification. (In explanation, certify to those statements that can be certified to and explain those that cannot.)

The Proposer certifies or affirms the truthfulness and accuracy of the contents of the statements submitted on or with this certification and understands that the provisions of Title 31 USC § Sections 3801 are applicable thereto.

Executed in [insert city and state]. LIVERMORE, CA

Name: DEREK MAUNUS, PRESIDENT & CEO

[signature]	OCTOBER 6, 2022
Authorized signature	Date

Attachment J
IFB6447

BUS TESTING CERTIFICATION

The undersigned bidder [Contractor/Manufacturer] certifies that the vehicle model or vehicle models offered in this bid submission complies with 49 CFR Part 665.

A copy of the test report (for each bid ITEM) prepared by the Federal Transit Administration's (FTA) Altoona, Pennsylvania Bus Testing Center is attached to this certification and is a true and correct copy of the test report as prepared by the facility.

The undersigned understands that misrepresenting the testing status of a vehicle acquired with Federal financial assistance may subject the undersigned to civil penalties as outlined in the U.S. Department of Transportation's regulation on Program Fraud Civil Remedies, 49 CFR Part 31. In addition, the undersigned understands that FTA may suspend or debar a manufacturer under the procedures in 49 CFR Part 29.

Name of Bidder/Company Name: GILLIG LLC

Type or print name: DEREK MAUNUS, PRESIDENT & CEO

Signature of authorized representative: [signature]

Signature of notary and SEAL: See attached.

Date of Signature: 10 / 06 / 2022

REFERENCE OUR ATTACHED CERTIFICATION.

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of ALAMEDA

Subscribed and sworn to (or affirmed) before me on this 6TH day of OCTOBER, 20 22, by DEREK MAUNUS
______________________________,
proved to me on the basis of satisfactory evidence to be the person(s) who appeared before me.

HRS2
MIRUBENAT TAPIA
COMM. NO. 2319245
NOTARY PUBLIC - CALIFORNIA
ALAMEDA COUNTY
MY COMM. EXPIRES JAN. 19, 2024
HRS2

(Seal) Signature ______________________
MIRUBENAT TAPIA
NOTARY PUBLIC

My commission number: 2319245

My commission expires: JANUARY 19, 2024

DESCRIPTION OF ATTACHED DOCUMENT

Type or Title of Document: BUS TESTING CERTIFICATIONS

Signer's Name: DEREK MAUNUS

Document Date: OCTOBER 6, 2022

GILLIG

ALTOONA TEST CERTIFICATION

This is to certify that the bus model proposed for your procurement complies with the bus testing regulations required by the Surface Transportation and Uniform Relocation Assistance Act of 1987 as defined in the Interim Final Rulemaking (IFR) by the FTA in the Federal Register 49 CFR Part 665, dated July 28, 1992 and the Final Rule in the Federal Register 49 CFR part 665, dated August 1, 2016.

This statement means that the proposed vehicle complies with one or more of the clauses below, as required by the above IFR:

- was in mass transportation service prior to September 30, 1988, or
- is the same vehicle model that has been previously tested in PTI (Altoona), and that
- any new component(s) has (have) been tested at PTI (Altoona), or
- the installation of any new component(s) did not result in significant structural modification to the vehicle; or
- the installation of the component(s) did not result in a significant change in the data obtained from previous testing of the vehicle model.
- is a new bus model or a bus produced with a major change in components or configuration and shall provide a copy of the final test report to the recipient prior to the recipient's final acceptance of the first vehicle.

GILLIG LLC

By: ______________________

DEREK MAUNUS

Title: PRESIDENT & CEO

Date: OCTOBER 6, 2022

Attachment J
IFB6447

TRANSIT VEHICLE MANUFACTURER (TVM) CERTIFICATION

Pursuant to the provisions of Section 105(f) of the Surface Transportation Assistance Act of 1982, each bidder for this contract must certify that it has complied with the requirements of 49 CFR Part 26.49, regarding the participation of Disadvantaged Business Enterprises (DBE) in FTA assisted procurements of transit vehicles. Absent this certification, properly completed and signed, a bid shall be deemed non-responsive.

Certification'

I hereby certify, for the bidder named below, that it has complied with the provisions of 49 CFR Part 26.49 and that I am duly authorized by said bidder to make this certification.

BIDDER/COMPANY

Name of Bidder/Company GILLIG LLC

Signature of Representative

Type or Print Name DEREK MAUNUS

Title PRESIDENT & CEO Date 10 / 06 / 2022

NOTARY

Type or Print Name

Signature of Notary See attached.

Place Notary SEAL Here:

REFERENCE OUR ATTACHED CERTIFICATION.

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of ALAMEDA

Subscribed and sworn to (or affirmed) before me on this 6TH day of OCTOBER, 20 22, by DEREK MAUNUS

______________________,
proved to me on the basis of satisfactory evidence to be the person(s) who appeared before me.

MIRUBENAT TAPIA
COMM. NO. 2319245
NOTARY PUBLIC - CALIFORNIA
ALAMEDA COUNTY
MY COMM. EXPIRES JAN. 19, 2024
HRS2

(Seal) Signature

MIRUBENAT TAPIA
NOTARY PUBLIC

My commission number: 2319245

My commission expires: JANUARY 19, 2024

DESCRIPTION OF ATTACHED DOCUMENT

Type or Title of Document: TVM CERTIFICATIONS

Signer's Name: DEREK MAUNUS

Document Date: OCTOBER 6, 2022

GILLIG

DBE/MBE CERTIFICATION OF COMPLIANCE

DISADVANTAGED/MINORITY BUSINESS ENTERPRISE (DBE/MBE)

GILLIG LLC, 451 Discovery Drive, Livermore California 94551, hereby certifies that GILLIG LLC has complied with the requirements of 49 CFR Part 26 of the Transportation Assistance Act of 1982, and submitted the required documents to the Federal Transit Administration (FTA).

The FTA advised that GILLIG has obtained 49 C.F.R. Part 26.49 certification and we are eligible to bid on federally funded contracts in FY2022. Transit customers may call the FTA DBE Team for verification.

The list of eligible Transit Vehicle Manufacturers may be viewed at https://www.transit.dot.gov/regulations-and-guidance/civil-rights-ada/eligible-transit-vehicle-manufacturers

FEDERAL TRANSIT ADMINISTRATION
Office of Civil Rights
1200 New Jersey Avenue SE
Washington, DC 20590
Phone: 888-446-4511
E-mail: FTATVMSubmissions@dot.gov

GILLIG LLC

By: ______________________

DEREK MAUNUS

Title: PRESIDENT & CEO

Date: OCTOBER 6, 2022

CER 8. Federal Certifications

CER 8.1 Buy America Certification

This form is to be submitted with an offer exceeding the small purchase threshold for federal assistance programs, currently set at $100,000.

Certificate of Compliance

The Proposer hereby certifies that it will comply with the requirements of 49 USC Section 5323(j)(2)(C), Section 165(b)(3) of the Surface Transportation Assistance Act of 1982, as amended, and the regulations of 49 CFR 661.11:

Name and title: DEREK MAUNUS, PRESIDENT & CEO
Company: GILLIG LLC

OCTOBER 6, 2022

Authorized signature — Date

Certificate of Non-Compliance

The Proposer hereby certifies that it cannot comply with the requirements of 49 USC Section 5323(j)(2)(C) and Section 165(b)(3) of the Surface Transportation Assistance Act of 1982, as amended, but may qualify for an exception to the requirements consistent with 49 USC Sections 5323(j)(2)(B) or (j)(2)(D), Sections 165(b)(2) or (b)(4) of the Surface Transportation Assistance Act, as amended, and regulations in 49 CFR 661.7.

Name and title:
Company:

Authorized signature — Date

VIRGINIA DEPARTMENT OF RAIL AND PUBLIC TRANSPORTATION
STATE OF VIRGINIA
PRE-AWARD BUY AMERICA CERTIFICATE
FORTY FOOT ELECTRIC LOW FLOOR TRANSIT BUSES (QTY: TBD, SN: TBD, BID/CONTRACT# State of Virginia - IFB #6447)
5-Oct-22

GILLIG IS ONE OF THE MOST "AMERICAN" BUS MANUFACTURERS IN THE WORLD. Gillig is 100% U.S. owned and operated. ALL OF OUR FACILITIES are located in the U.S.A. ALL OF OUR MANUFACTURING is done in the U.S.A. and we have a policy that stresses the use of products produced in the U.S.A.

We certify full compliance with the FTA's "Buy America" regulations (Section 49 CFR Part 663) and submit the following abbreviated listing as evidence of this compliance.

COMPONENT	MANUFACTURER	COUNTRY OF ORIGIN	PERCENT OF TOTAL COST
A/C TRANSITION DUCTS	THERMAL STRUCTURES, INC	U.S.A.	0.06%
AIR COMPRESSOR	POWEREX	U.S.A.	1.69%
AIR CONDITIONING SYSTEM	THERMO-KING CORPORATION	U.S.A.	5.70%
BULKHEAD ASSEMBLY	ALVA-GWYN INC	U.S.A.	0.09%
CEILING PANELS	WILSONART INTERNATIONAL	U.S.A.	0.19%
COMPOSITE FLOORING	MILWAUKEE COMPOSITES	U.S.A.	0.70%
COOLANT PUMPS	GORMAN RUPP INDUSTRIES	U.S.A.	0.37%
DESTINATION SIGNS	HANOVER DISPLAYS, INC	U.S.A.	0.91%
DOOR CONTROLS & PANELS - FRONT	VAPOR BUS INTERNATIONAL	U.S.A.	0.42%
DOOR CONTROLS & PANELS - REAR	VAPOR BUS INTERNATIONAL	U.S.A.	0.37%
DRIVER'S BARRIER	MC CLARIN PLASTICS LLC	U.S.A.	0.06%
DRIVER'S SEAT	RECARO NORTH AMERICA	U.S.A.	0.28%
ELECTRICAL HARNESSES & CABLES	LACO INCORPORATED	U.S.A.	1.27%
ELECTRICAL HARNESSES, CABLES & PANELS	COMPASS COMPONENTS, INC.	U.S.A.	0.33%
ELECTRICAL HARNESSES, CABLES & PANELS	RESQ MANUFACTURING	U.S.A.	3.18%
ELECTRIFIED POWER SYSTEM	AKASOL, INC	U.S.A.	32.55%
EXTERIOR MIRRORS	SAFE FLEET	U.S.A.	0.16%
EXTRUSIONS	HYDRO EXTRUSION USA, LLC	U.S.A.	0.67%
FABRICATIONS-BAYFAB METALS	BAYFAB METALS INC	U.S.A.	0.64%
FABRICATIONS-DIE & TOOL PRODUCTS	DIE & TOOL PRODUCTS, INC	U.S.A.	0.88%
FABRICATIONS-EAST BAY MACHINE	EAST BAY MACHINE	U.S.A.	0.64%
FABRICATIONS-GCM	G C M	U.S.A.	0.65%
FABRICATIONS-GOLDEN PLASTICS	GOLDEN PLASTICS CORP	U.S.A.	0.15%
FABRICATIONS-HOGAN MANUFACTURING	HOGAN MFG. INC.	U.S.A.	4.82%
FABRICATIONS-IMPERIAL FABRICATORS	IMPERIAL FABRICATORS	U.S.A.	1.16%
FABRICATIONS-MASTER METAL PROCUCTS	MASTER METAL PRODUCTS CO.	U.S.A.	0.37%
FABRICATIONS-RON NUNES	RON NUNES ENTERPRISES	U.S.A.	0.57%
FRONT AND REAR AXLE ASSEMBLIES	MERITOR AUTOMOTIVE	U.S.A.	2.56%
FRONT AND REAR BUMPER ASSEMBLIES	DYNATECT - RO-LAB	U.S.A.	0.43%
FRONT CAP	MC CLARIN PLASTICS LLC	U.S.A.	0.54%
HEATER ASSEMBLIES	MOBILE CLIMATE CONTROL	U.S.A.	0.31%
INTERIOR LIGHTING KIT	I/O CONTROLS - LIGHTS	U.S.A.	0.66%
MISCELLANEOUS-KD SPECIALTIES	KD SPECIALTIES	U.S.A.	0.07%
MISCELLANEOUS-I/O CONTROL	I/O CONTROLS - LIGHTS	U.S.A.	0.18%
PASSENGER SEAT ASSEMBLIES	AMERICAN SEATING	U.S.A.	3.29%
PIPING & TUBING	S.F. TUBE	U.S.A.	1.64%
REAR CAP ASSEMBLY	PERFORMANCE COMPOSTIES	U.S.A.	0.12%
REAR SUSPENSION	HENDRICKSON USA L.L.C.	U.S.A.	0.32%
WHEELCHAIR RAMP	LIFT-U DIVISION OF HOGAN MFG.,INC	U.S.A.	1.15%
WHEELS	ADVANCED WHEELS SALES	U.S.A.	0.43%
WHEELWELL COVERS	MC CLARIN PLASTICS LLC	U.S.A.	0.20%
WINDOW ASSEMBLIES	AROW GLOBAL	U.S.A.	2.20%
SPECIFICALLY IDENTIFIED U.S. COMPONENTS AS A % OF TOTAL MATERIALS			72.97% *
FINAL ASSEMBLY - ALL VEHICLE ASSEMBLY OPERATIONS, STARTING WITH THE UNDERSTRUCTURE THROUGH TO FINAL ROAD TEST ARE DONE IN LIVERMORE, CA	GILLIG	U.S.A.	100.00%

GILLIG LLC
LIVERMORE, CALIFORNIA

DESCRIPTION AND COST
OF FINAL ASSEMBLY
FOR 35’ & 40’ ELECTRIC BUSES
FY 2022

Gillig LLC certifies that final assembly of its buses occurs at its manufacturing plant in Livermore, California. The final assembly process consists of the assembly of the chassis; the installation and interconnection of the engine (traction motor, energy storage system, traction inverter), transmission, axles, including the cooling and braking systems; the installation and interconnection of the heating and air conditioning equipment; the installation of pneumatic and electrical systems; mounting of the body structure to the chassis; installation of door systems; painting of the vehicle; installation of destination signs, windows, passenger seats, passenger grab rails, and wheelchair lifts; wheel alignment, dynamometer and road testing; final inspection, repairs and preparation of the vehicles for delivery.

The cost of the above mentioned activities for this order has been estimated to be $20,399.53 per bus.

451 Discovery Drive, Livermore, CA 94551 | www.gillig.com | 510.264.5000

VIRGINIA DEPARTMENT OF RAIL AND PUBLIC TRANSPORTATION
STATE OF VIRGINIA
PRE-AWARD BUY AMERICA CERTIFICATE
FORTY FOOT LOW FLOOR TRANSIT BUSES (QTY: TBD, SN: TBD, BID/CONTRACT# State of Virginia - IFB #6447)
5-Oct-22

GILLIG IS ONE OF THE MOST "AMERICAN" BUS MANUFACTURERS IN THE WORLD. Gillig is 100% U.S. owned and operated. ALL OF OUR FACILITIES are located in the U.S.A. ALL OF OUR MANUFACTURING is done in the U.S.A. and we have a policy that stresses the use of products produced in the U.S.A.

We certify full compliance with the FTA's "Buy America" regulations (Section 49 CFR Part 663) and submit the following abbreviated listing as evidence of this compliance.

COMPONENT	MANUFACTURER	COUNTRY OF ORIGIN	PERCENT OF TOTAL COST
A/C TRANSITION DUCTS	THERMAL STRUCTURES, INC	U.S.A.	0.11%
AIR CONDITIONING SYSTEM	THERMO-KING CORPORATION	U.S.A.	6.64%
AIR DRYER ASSEMBLY	SKF USA, INC	U.S.A.	0.16%
ALTERNATOR	C.E. NIEHOFF & CO.	U.S.A.	0.82%
BULKHEAD ASSEMBLY	ALVA-GWYN INC	U.S.A.	0.16%
CEILING PANELS	WILSONART INTERNATIONAL	U.S.A.	0.35%
COMPOSITE FLOORING	MILWAUKEE COMPOSITES	U.S.A.	0.42%
COOLANT PUMP	ENGINEERED MACHINE PRODUCTS	U.S.A.	0.12%
DESTINATION SIGNS	HANOVER DISPLAYS, INC	U.S.A.	1.66%
DOOR CONTROLS & PANELS - FRONT	VAPOR BUS INTERNATIONAL	U.S.A.	0.77%
DOOR CONTROLS & PANELS - REAR	VAPOR BUS INTERNATIONAL	U.S.A.	0.67%
DRIVER'S BARRIER	MC CLARIN PLASTICS LLC	U.S.A.	0.12%
DRIVER'S SEAT	RECARO NORTH AMERICA	U.S.A.	0.50%
ELECTRICAL HARNESSES & CABLES	LACO INCORPORATED	U.S.A.	1.69%
ELECTRICAL HARNESSES, CABLES & PANELS	COMPASS COMPONENTS, INC.	U.S.A.	0.91%
ELECTRICAL HARNESSES, CABLES & PANELS	RESQ MANUFACTURING	U.S.A.	3.92%
ENGINE & AFTERTREATMENT SYSTEM	CUMMINS, INC	U.S.A.	14.97%
EXTERIOR MIRRORS	SAFE FLEET	U.S.A.	0.27%
EXTRUSIONS	HYDRO EXTRUSION USA, LLC	U.S.A.	1.00%
FABRICATIONS-BAYFAB METALS	BAYFAB METALS INC	U.S.A.	0.19%
FABRICATIONS-COMMERCIAL PATTERN	COMMERCIAL PATTERN	U.S.A.	0.03%
FABRICATIONS-DETENTION DEVICES	DETENTION DEVICE SYSTEMS	U.S.A.	0.14%
FABRICATIONS-DIE & TOOL PRODUCTS	DIE & TOOL PRODUCTS, INC	U.S.A.	1.29%
FABRICATIONS-EAST BAY MACHINE	EAST BAY MACHINE	U.S.A.	0.75%
FABRICATIONS-GCM	G C M	U.S.A.	0.98%
FABRICATIONS-GOLDEN PLASTICS	GOLDEN PLASTICS CORP	U.S.A.	0.27%
FABRICATIONS-HOGAN MANUFACTURING	HOGAN MFG. INC.	U.S.A.	2.06%
FABRICATIONS-IMPERIAL FABRICATORS	IMPERIAL FABRICATORS	U.S.A.	4.43%
FABRICATIONS-MASTER METAL PROCUCTS	MASTER METAL PRODUCTS CO.	U.S.A.	0.43%
FABRICATIONS-RON NUNES	RON NUNES ENTERPRISES	U.S.A.	0.50%
FRONT AND REAR AXLE ASSEMBLIES	MERITOR AUTOMOTIVE	U.S.A.	4.64%
FRONT AND REAR BUMPER ASSEMBLIES	DYNATECT - RO-LAB	U.S.A.	0.78%
FRONT CAP	MC CLARIN PLASTICS LLC	U.S.A.	0.60%
HEATER ASSEMBLIES	MOBILE CLIMATE CONTROL	U.S.A.	0.54%
INTERIOR LIGHTING KIT	I/O CONTROLS - LIGHTS	U.S.A.	1.20%
MISCELLANEOUS-KD SPECIALTIES	KD SPECIALTIES	U.S.A.	0.23%
MISCELLANEOUS-I/O CONTROL	I/O CONTROLS - LIGHTS	U.S.A.	0.42%
PASSENGER SEAT ASSEMBLIES	AMERICAN SEATING	U.S.A.	5.83%
PIPING & TUBING	S.F. TUBE	U.S.A.	1.35%
RADIATOR PACKAGE	MODINE MFG CO	U.S.A.	1.63%
REAR CAP ASSEMBLY	PERFORMANCE COMPOSTIES	U.S.A.	0.21%
REAR SUSPENSION	HENDRICKSON USA L.L.C.	U.S.A.	0.49%
ROOF HATCH	SPECIALTY MANUFACTURING INC	U.S.A.	0.13%
ROOF SKIN	CRANE COMPOSITES	U.S.A.	0.15%
TORQUE RODS	THE PULLMAN COMPANY	U.S.A.	0.14%
VOLTAGE REGULATOR	VANNER, INC.	U.S.A.	0.14%
WHEELCHAIR RAMP	LIFT-U DIVISION OF HOGAN MFG.,INC	U.S.A.	2.09%
WHEELS	ADVANCED WHEELS SALES	U.S.A.	0.77%
WHEELWELL COVERS	MC CLARIN PLASTICS LLC	U.S.A.	0.36%
WINDOW ASSEMBLIES	AROW GLOBAL	U.S.A.	3.93%
SPECIFICALLY IDENTIFIED U.S. COMPONENTS AS A % OF TOTAL MATERIALS			71.96% *
FINAL ASSEMBLY - ALL VEHICLE ASSEMBLY OPERATIONS, STARTING WITH THE UNDERSTRUCTURE THROUGH TO FINAL ROAD TEST ARE DONE IN LIVERMORE, CA	GILLIG	U.S.A.	100.00%

G I L L I G L L C
LIVERMORE, CALIFORNIA

DESCRIPTION AND COST
OF FINAL ASSEMBLY
FOR 35' & 40' LOW FLOOR BUSES
FY 2022

Gillig LLC certifies that final assembly of its buses occurs at its manufacturing plant in Livermore, California. The final assembly process consists of the assembly of the chassis; the installation and interconnection of the engine, transmission, axles, including the cooling and braking systems; the installation and interconnection of the heating and air conditioning equipment; the installation of pneumatic and electrical systems; mounting of the body structure to the chassis; installation of door systems; painting of the vehicle; installation of destination signs, windows, passenger seats, passenger grab rails, and wheelchair lifts; wheel alignment, dynamometer and road testing; final inspection, repairs and preparation of the vehicles for delivery.

The cost of the above mentioned activities for this order has been estimated to be $16,543.31 per bus.

VIRGINIA DEPARTMENT OF RAIL AND PUBLIC TRANSPORTATION
STATE OF VIRGINIA
PRE-AWARD BUY AMERICA CERTIFICATE
FORTY FOOT (CNG) LOW FLOOR TRANSIT BUSES (QTY: TBD, SN: TDB, BID/CONTRACT# State of Virginia - IFB #6447)
5-Oct-22

GILLIG IS ONE OF THE MOST "AMERICAN" BUS MANUFACTURERS IN THE WORLD. Gillig is 100% U.S. owned and operated. ALL OF OUR FACILITIES are located in the U.S.A. ALL OF OUR MANUFACTURING is done in the U.S.A. and we have a policy that stresses the use of products produced in the U.S.A.

We certify full compliance with the FTA's "Buy America" regulations (Section 49 CFR Part 663) and submit the following abbreviated listing as evidence of this compliance.

COMPONENT	MANUFACTURER	COUNTRY OF ORIGIN	PERCENT OF TOTAL COST
AIR CONDITIONING SYSTEM	THERMO-KING CORPORATION	U.S.A.	5.75%
AIR DRYER ASSEMBLY	SKF USA, INC	U.S.A.	0.14%
ALTERNATOR	C.E. NIEHOFF & CO.	U.S.A.	0.71%
BULKHEAD ASSEMBLY	ALVA-GWYN INC	U.S.A.	0.14%
CEILING PANELS	WILSONART INTERNATIONAL	U.S.A.	0.30%
COMPOSITE FLOORING	MILWAUKEE COMPOSITES	U.S.A.	0.37%
DESTINATION SIGNS	HANOVER DISPLAYS, INC	U.S.A.	1.43%
DOOR CONTROLS & PANELS - FRONT	VAPOR BUS INTERNATIONAL	U.S.A.	0.67%
DOOR CONTROLS & PANELS - REAR	VAPOR BUS INTERNATIONAL	U.S.A.	0.58%
DRIVER'S SEAT	RECARO NORTH AMERICA	U.S.A.	0.43%
ELECTRICAL HARNESSES & CABLES	LACO INCORPORATED	U.S.A.	1.46%
ELECTRICAL HARNESSES, CABLES & PANELS	COMPASS COMPONENTS, INC.	U.S.A.	0.84%
ELECTRICAL HARNESSES, CABLES & PANELS	RESQ MANUFACTURING	U.S.A.	3.49%
ENGINE & AFTERTREATMENT SYSTEM	CUMMINS, INC	U.S.A.	14.82%
EXTERIOR MIRRORS	SAFE FLEET	U.S.A.	0.23%
EXTRUSIONS	HYDRO EXTRUSION USA, LLC	U.S.A.	0.89%
FABRICATIONS-DIE & TOOL PRODUCTS	DIE & TOOL PRODUCTS, INC	U.S.A.	1.08%
FABRICATIONS-EAST BAY MACHINE	EAST BAY MACHINE	U.S.A.	0.78%
FABRICATIONS-GCM	G C M	U.S.A.	1.31%
FABRICATIONS-HOGAN MANUFACTURING	HOGAN MFG. INC.	U.S.A.	1.80%
FABRICATIONS-IMPERIAL FABRICATORS	IMPERIAL FABRICATORS	U.S.A.	3.36%
FABRICATIONS-MASTER METAL PROCUCTS	MASTER METAL PRODUCTS CO.	U.S.A.	0.41%
FABRICATIONS-RON NUNES	RON NUNES ENTERPRISES	U.S.A.	0.44%
FRONT AND REAR AXLE ASSEMBLIES	MERITOR AUTOMOTIVE	U.S.A.	4.02%
FRONT AND REAR BUMPER ASSEMBLIES	DYNATECT - RO-LAB	U.S.A.	0.67%
FRONT CAP	MC CLARIN PLASTICS LLC	U.S.A.	0.52%
FUEL SYSTEM	AGILITY FUEL SYSTEMS	U.S.A.	8.95%
HEATER ASSEMBLIES	MOBILE CLIMATE CONTROL	U.S.A.	0.41%
INTERIOR LIGHTING KIT	I/O CONTROLS - LIGHTS	U.S.A.	1.04%
MISCELLANEOUS-I/O CONTROL	I/O CONTROLS - LIGHTS	U.S.A.	0.37%
PASSENGER SEAT ASSEMBLIES	AMERICAN SEATING	U.S.A.	5.05%
PIPING & TUBING	S.F. TUBE	U.S.A.	1.20%
RADIATOR PACKAGE	MODINE MFG CO	U.S.A.	1.50%
REAR CAP ASSEMBLY	PERFORMANCE COMPOSTIES	U.S.A.	0.18%
REAR SUSPENSION	HENDRICKSON USA L.L.C.	U.S.A.	0.42%
TRANSMISSION	ALLISON TRANSMISSION	U.S.A.	4.34%
WHEELCHAIR RAMP	LIFT-U DIVISION OF HOGAN MFG.,INC	U.S.A.	1.81%
WHEELS	ADVANCED WHEELS SALES	U.S.A.	0.67%
WHEELWELL COVERS	MC CLARIN PLASTICS LLC	U.S.A.	0.31%
SPECIFICALLY IDENTIFIED U.S. COMPONENTS AS A % OF TOTAL MATERIALS			72.88% *
FINAL ASSEMBLY - ALL VEHICLE ASSEMBLY OPERATIONS, STARTING WITH THE UNDERSTRUCTURE THROUGH TO FINAL ROAD TEST ARE DONE IN LIVERMORE, CA	GILLIG	U.S.A.	100.00%

G I L L I G L L C
LIVERMORE, CALIFORNIA

DESCRIPTION AND COST
OF FINAL ASSEMBLY
FOR 35’ & 40’ CNG BUSES
FY 2022

Gillig LLC certifies that final assembly of its buses occurs at its manufacturing plant in Livermore, California. The final assembly process consists of the assembly of the chassis; the installation and interconnection of the engine, transmission, axles, including the cooling and braking systems; the installation and interconnection of the heating and air conditioning equipment; the installation of pneumatic and electrical systems; mounting of the body structure to the chassis; installation of door systems; painting of the vehicle; installation of destination signs, windows, passenger seats, passenger grab rails, and wheelchair lifts; wheel alignment, dynamometer and road testing; final inspection, repairs and preparation of the vehicles for delivery.

The cost of the above mentioned activities for this order has been estimated to be $17,930.37 per bus.

VIRGINIA DEPARTMENT OF RAIL AND PUBLIC TRANSPORTATION
STATE OF VIRGINIA
PRE-AWARD BUY AMERICA CERTIFICATE
FORTY FOOT HYBRID (EGEN) LOW FLOOR TRANSIT BUSES (QTY: TBD, SN: TDB, BID/CONTRACT# State of Virginia - IFB #6447)
5-Oct-22

GILLIG IS ONE OF THE MOST "AMERICAN" BUS MANUFACTURERS IN THE WORLD. Gillig is 100% U.S. owned and operated. ALL OF OUR FACILITIES are located in the U.S.A. ALL OF OUR MANUFACTURING is done in the U.S.A. and we have a policy that stresses the use of products produced in the U.S.A.

We certify full compliance with the FTA's "Buy America" regulations (Section 49 CFR Part 663) and submit the following abbreviated listing as evidence of this compliance.

COMPONENT	MANUFACTURER	COUNTRY OF ORIGIN	PERCENT OF TOTAL COST
AIR CONDITIONING SYSTEM	THERMO-KING CORPORATION	U.S.A.	4.63%
COMPOSITE FLOORING	MILWAUKEE COMPOSITES	U.S.A.	0.31%
DESTINATION SIGNS	HANOVER DISPLAYS, INC	U.S.A.	1.11%
DOOR CONTROLS & PANELS - FRONT	VAPOR BUS INTERNATIONAL	U.S.A.	0.52%
DOOR CONTROLS & PANELS - REAR	VAPOR BUS INTERNATIONAL	U.S.A.	0.45%
DRIVER'S SEAT	RECARO NORTH AMERICA	U.S.A.	0.33%
ELECTRIC DRIVE HYBIRD PROPULSION SYSTEM	ALLISON TRANSMISSION	U.S.A.	33.28%
ELECTRICAL HARNESSES, CABLES & PANELS	COMPASS COMPONENTS, INC.	U.S.A.	0.49%
ELECTRICAL HARNESSES, CABLES & PANELS	RESQ MANUFACTURING	U.S.A.	3.33%
ENGINE & AFTERTREATMENT SYSTEM	CUMMINS, INC	U.S.A.	6.22%
EXTRUSIONS	HYDRO EXTRUSION USA, LLC	U.S.A.	0.67%
FABRICATIONS-BAYFAB METALS	BAYFAB METALS INC	U.S.A.	0.33%
FABRICATIONS-DIE & TOOL PRODUCTS	DIE & TOOL PRODUCTS, INC	U.S.A.	0.89%
FABRICATIONS-EAST BAY MACHINE	EAST BAY MACHINE	U.S.A.	0.70%
FABRICATIONS-GCM	G C M	U.S.A.	0.77%
FABRICATIONS-HOGAN MANUFACTURING	HOGAN MFG. INC.	U.S.A.	2.14%
FABRICATIONS-IMPERIAL FABRICATORS	IMPERIAL FABRICATORS	U.S.A.	2.83%
FABRICATIONS-MASTER METAL PROCUCTS	MASTER METAL PRODUCTS CO.	U.S.A.	0.60%
FABRICATIONS-RON NUNES	RON NUNES ENTERPRISES	U.S.A.	0.53%
FRONT AND REAR AXLE ASSEMBLIES	MERITOR AUTOMOTIVE	U.S.A.	3.11%
FRONT AND REAR BUMPER ASSEMBLIES	DYNATECT - RO-LAB	U.S.A.	0.52%
FRONT CAP	MC CLARIN PLASTICS LLC	U.S.A.	0.40%
HIGH VOLTAGE CABLES	ROCHESTER INDS. CONTROL	U.S.A.	2.28%
HEATER ASSEMBLIES	MOBILE CLIMATE CONTROL	U.S.A.	0.31%
INTERIOR LIGHTING KIT	I/O CONTROLS - LIGHTS	U.S.A.	0.84%
MISCELLANEOUS-I/O CONTROL	I/O CONTROLS - LIGHTS	U.S.A.	0.28%
PIPING & TUBING	S.F. TUBE	U.S.A.	0.88%
POWER DISTRIBUTION BOX	ROCHESTER INDS. CONTROL	U.S.A.	0.88%
REAR SUSPENSION	HENDRICKSON USA L.L.C.	U.S.A.	0.33%
TRANSMISSION	ALLISON TRANSMISSION	U.S.A.	3.36%
WHEELCHAIR RAMP	LIFT-U DIVISION OF HOGAN MFG.,INC	U.S.A.	1.40%
WHEELS	ADVANCED WHEELS SALES	U.S.A.	0.52%
WHEELWELL COVERS	MC CLARIN PLASTICS LLC	U.S.A.	0.24%
SPECIFICALLY IDENTIFIED U.S. COMPONENTS AS A % OF TOTAL MATERIALS			75.49% *
FINAL ASSEMBLY - ALL VEHICLE ASSEMBLY OPERATIONS, STARTING WITH THE UNDERSTRUCTURE THROUGH TO FINAL ROAD TEST ARE DONE IN LIVERMORE, CA	GILLIG	U.S.A.	100.00%

GILLIG LLC
LIVERMORE, CALIFORNIA

DESCRIPTION AND COST OF FINAL ASSEMBLY FOR 35' & 40' HYBRID BUSES FY 2022

Gillig LLC certifies that final assembly of its buses occurs at its manufacturing plant in Livermore, California. The final assembly process consists of the assembly of the chassis; the installation and interconnection of the engine, transmission, axles, including the cooling and braking systems; the installation and interconnection of the heating and air conditioning equipment; the installation of pneumatic and electrical systems; mounting of the body structure to the chassis; installation of door systems; painting of the vehicle; installation of destination signs, windows, passenger seats, passenger grab rails, and wheelchair lifts; wheel alignment, dynamometer and road testing; final inspection, repairs and preparation of the vehicles for delivery.

The cost of the above mentioned activities for this order has been estimated to be $18,425.42 per bus.

VIRGINIA DEPARTMENT OF RAIL AND PUBLIC TRANSPORTATION
STATE OF VIRGINIA
PRE-AWARD BUY AMERICA CERTIFICATE
FORTY FOOT HYBRID (BAE) LOW FLOOR TRANSIT BUSES (QTY: TBD, SN: TBD, BID/CONTRACT# State of Virginia - IFB #6447)
5-Oct-22

GILLIG IS ONE OF THE MOST "AMERICAN" BUS MANUFACTURERS IN THE WORLD. Gillig is 100% U.S. owned and operated. ALL OF OUR FACILITIES are located in the U.S.A. ALL OF OUR MANUFACTURING is done in the U.S.A. and we have a policy that stresses the use of products produced in the U.S.A.

We certify full compliance with the FTA's "Buy America" regulations (Section 49 CFR Part 663) and submit the following abbreviated listing as evidence of this compliance.

COMPONENT	MANUFACTURER	COUNTRY OF ORIGIN	PERCENT OF TOTAL COST
AIR CONDITIONING SYSTEM	THERMO-KING CORPORATION	U.S.A.	4.43%
CEILING PANELS	WILSONART INTERNATIONAL	U.S.A.	0.22%
COMPOSITE FLOORING	MILWAUKEE COMPOSITES	U.S.A.	0.30%
DESTINATION SIGNS	HANOVER DISPLAYS, INC	U.S.A.	1.06%
DOOR CONTROLS & PANELS - FRONT	VAPOR BUS INTERNATIONAL	U.S.A.	0.49%
DOOR CONTROLS & PANELS - REAR	VAPOR BUS INTERNATIONAL	U.S.A.	0.43%
DRIVER'S SEAT	RECARO NORTH AMERICA	U.S.A.	0.32%
ELECTRIC DRIVE HYBIRD PROPULSION SYSTEM	BAE SYSTEMS	U.S.A.	36.22%
ELECTRICAL HARNESSES & CABLES	LACO INCORPORATED	U.S.A.	1.11%
ELECTRICAL HARNESSES, CABLES & PANELS	COMPASS COMPONENTS, INC.	U.S.A.	0.47%
ELECTRICAL HARNESSES, CABLES & PANELS	RESQ MANUFACTURING	U.S.A.	3.19%
ENGINE & AFTERTREATMENT SYSTEM	CUMMINS, INC	U.S.A.	5.95%
EXTRUSIONS	HYDRO EXTRUSION USA, LLC	U.S.A.	0.64%
FABRICATIONS-BAYFAB METALS	BAYFAB METALS INC	U.S.A.	0.31%
FABRICATIONS-DIE & TOOL PRODUCTS	DIE & TOOL PRODUCTS, INC	U.S.A.	0.85%
FABRICATIONS-EAST BAY MACHINE	EAST BAY MACHINE	U.S.A.	0.67%
FABRICATIONS-GCM	G C M	U.S.A.	0.74%
FABRICATIONS-IMPERIAL FABRICATORS	IMPERIAL FABRICATORS	U.S.A.	2.71%
FABRICATIONS-MASTER METAL PROCUCTS	MASTER METAL PRODUCTS CO.	U.S.A.	0.58%
FABRICATIONS-RON NUNES	RON NUNES ENTERPRISES	U.S.A.	0.51%
FRONT AND REAR AXLE ASSEMBLIES	MERITOR AUTOMOTIVE	U.S.A.	2.97%
FRONT AND REAR BUMPER ASSEMBLIES	DYNATECT - RO-LAB	U.S.A.	0.50%
FRONT CAP	MC CLARIN PLASTICS LLC	U.S.A.	0.39%
HIGH VOLTAGE CABLES	ROCHESTER INDS. CONTROL	U.S.A.	2.18%
HEATER ASSEMBLIES	MOBILE CLIMATE CONTROL	U.S.A.	0.30%
INTERIOR LIGHTING KIT	I/O CONTROLS - LIGHTS	U.S.A.	0.80%
MISCELLANEOUS-I/O CONTROL	I/O CONTROLS - LIGHTS	U.S.A.	0.27%
PASSENGER SEAT ASSEMBLIES	AMERICAN SEATING	U.S.A.	3.73%
POWER DISTRIBUTION BOX	ROCHESTER INDS. CONTROL	U.S.A.	0.84%
REAR SUSPENSION	HENDRICKSON USA L.L.C.	U.S.A.	0.31%
WHEELCHAIR RAMP	LIFT-U DIVISION OF HOGAN MFG.,INC	U.S.A.	1.34%
WHEELS	ADVANCED WHEELS SALES	U.S.A.	0.49%
WHEELWELL COVERS	MC CLARIN PLASTICS LLC	U.S.A.	0.23%
SPECIFICALLY IDENTIFIED U.S. COMPONENTS AS A % OF TOTAL MATERIALS			75.53% *
FINAL ASSEMBLY - ALL VEHICLE ASSEMBLY OPERATIONS, STARTING WITH THE UNDERSTRUCTURE THROUGH TO FINAL ROAD TEST ARE DONE IN LIVERMORE, CA	GILLIG	U.S.A.	100.00%

G I L L I G L L C
LIVERMORE, CALIFORNIA

DESCRIPTION AND COST
OF FINAL ASSEMBLY
FOR 35’ & 40’ HYBRID BUSES
FY 2022

Gillig LLC certifies that final assembly of its buses occurs at its manufacturing plant in Livermore, California. The final assembly process consists of the assembly of the chassis; the installation and interconnection of the engine, transmission, axles, including the cooling and braking systems; the installation and interconnection of the heating and air conditioning equipment; the installation of pneumatic and electrical systems; mounting of the body structure to the chassis; installation of door systems; painting of the vehicle; installation of destination signs, windows, passenger seats, passenger grab rails, and wheelchair lifts; wheel alignment, dynamometer and road testing; final inspection, repairs and preparation of the vehicles for delivery.

The cost of the above mentioned activities for this order has been estimated to be $18,425.42 per bus.

GILLIG

FMVSS CERTIFICATION

FEDERAL MOTOR VEHICLE SAFETY STANDARDS CERTIFICATION

GILLIG, LLC, 451 Discovery Drive, Livermore California 94551, hereby certifies that GILLIG, LLC has complied with all applicable requirements of the Federal Motor Vehicle Safety Standard (FMVSS) as required by the Federal Transit Administration (FTA) and the Department of Transportation (DOT), and described in Title 49 CFR Chapter V, part 571-FMVSS, last revised on October 1, 1998.

GILLIG LLC

By: ______________________

DEREK MAUNUS

Title: PRESIDENT & CEO

Date: OCTOBER 6, 2022

REVISIONS

LTR	DWN	ZONE	DESCRIPTION	REL	DATE
A	RAW		RELEASED FOR PRODUCTION	115460	10/04/16

MANUFACTURED BY GILLIG LLC

LIVERMORE, CALIFORNIA **DATE: ____________**

GVWR: ______ kg ______ lb

GAWR: FRONT ______ kg ______ lb

WITH ____ TIRES,

__________ RIMS AT ____ kPa ____ psi COLD SINGLE

GAWR: REAR ______ kg ______ lb

WITH ____ TIRES,

__________ RIMS AT ____ kPa ____ psi COLD DUAL

THIS VEHICLE CONFORMS TO ALL APPLICABLE U.S.
FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT
ON THE DATE OF MANUFACTURE SHOWN ABOVE.

VEHICLE I.D. NO.: ____________________ MODEL: ____________

TYPE OF VEHICLE: BUS

ENGINE NUMBER: __________

UNLADEN WEIGHT: ______ lb

59-35132-007

NOTES:

1. ALL TEXT HEIGHT MUST BE GREATER THAN 3/32" TALL
2. PRINT USING ZEBRA ZT410 LABEL PRINTER
3. MINIMUM QUALITY SETTING OF 600DPI
4. MEDIA TYPE IS THERMAL TRANSFER
5. DARKNESS SETTING IS 28
6. SPEED IS 2 INCHES PER SECOND
7. DITHERING IS SMOOTH

ITEM NO	DESCRIPTION	QTY
	MAKE FROM: 59-52697-001	1

GILLIG
GILLIG LLC
HAYWARD, CA

MARK PART W/PN PER GIL DB #370.002

TITLE: DECAL-DATA PLATE
GILLIG LLC, LIVERMORE LOCATION

DWN: RAW DATE: 10/04/16

STD NO 302

115460

SIZE: A DRAWING NO: 59-35132-007

CER 8.4 Non-Collusion Affidavit

This affidavit is to be filled out and executed by the Proposer; if a corporation makes the bid, then by its properly executed agent. The name of the individual swearing to the affidavit should appear on the line marked "Name of Affiant." The affiant's capacity, when a partner or officer of a corporation, should be inserted on the line marked "Capacity." The representative of the Proposer should sign his or her individual name at the end, not a partnership or corporation name, and swear to this affidavit before a notary public, who must attach his or her seal.

State of CALIFORNIA, County of ALAMEDA

I, DEREK MAUNUS, being first duly sworn, do hereby state that
(Name of Affiant)

I am PRESIDENT & CEO of GILLIG LLC
(Capacity) (Name of Firm, Partnership or Corporation)

whose business is MANUFACTURE AND SALES OF HEAVY DUTY TRANSIT BUSES

and who resides at 451 DISCOVERY DRIVE, LIVERMORE, CA 94551

and that GILLIG LLC
(Give names of all persons, firms, or corporations interested in the bid)

is/are the only person(s) with me in the profits of the herein contained Contract; that the Contract is made without any connection or interest in the profits thereof with any persons making any bid or Proposal for said Work; that the said Contract is on my part, in all respects, fair and without collusion or fraud, and also that no members of the Board of Trustees, head of any department or bureau, or employee therein, or any employee of the Authority, is directly or indirectly interested therein.

Signature of Affiant — OCTOBER 6, 2022
Date

Sworn to before me this ________ day of ________________, 20____.

See attached.

Notary public — My commission expires

Seal

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of ALAMEDA

Subscribed and sworn to (or affirmed) before me on this 6TH day of OCTOBER, 20 22, by DEREK MAUNUS,

proved to me on the basis of satisfactory evidence to be the person(s) who appeared before me.

MIRUBENAT TAPIA
COMM. NO. 2319245
NOTARY PUBLIC - CALIFORNIA
ALAMEDA COUNTY
MY COMM. EXPIRES JAN. 19, 2024

(Seal) Signature

MIRUBENAT TAPIA
NOTARY PUBLIC

My commission number: 2319245

My commission expires: JANUARY 19, 2024

DESCRIPTION OF ATTACHED DOCUMENT

Type or Title of Document: NON COLLUSION AFFIDAVIT

Signer's Name: DEREK MAUNUS

Document Date: OCTOBER 6, 2022

CER 8.7 DBE Approval Certification

I hereby certify that the Proposer has complied with the requirements of 49 CFR 26, Participation by Disadvantaged Business Enterprises in DOT Programs, and that its goals have not been disapproved by the Federal Transit Administration.

Name and title of the Proposer's authorized official: DEREK MAUNUS, PRESIDENT & CEO

Authorized signature ______________________ OCTOBER 6, 2022
Date

REFERENCE OUR ATTACHED CERTIFICATION.

GILLIG

DBE/MBE CERTIFICATION OF COMPLIANCE

DISADVANTAGED/MINORITY BUSINESS ENTERPRISE (DBE/MBE)

GILLIG LLC, 451 Discovery Drive, Livermore California 94551, hereby certifies that GILLIG LLC has complied with the requirements of 49 CFR Part 26 of the Transportation Assistance Act of 1982, and submitted the required documents to the Federal Transit Administration (FTA).

The FTA advised that GILLIG has obtained 49 C.F.R. Part 26.49 certification and we are eligible to bid on federally funded contracts in FY2022. Transit customers may call the FTA DBE Team for verification.

The list of eligible Transit Vehicle Manufacturers may be viewed at
https://www.transit.dot.gov/regulations-and-guidance/civil-rights-ada/eligible-transit-vehicle-manufacturers

FEDERAL TRANSIT ADMINISTRATION
Office of Civil Rights
1200 New Jersey Avenue SE
Washington, DC 20590
Phone: 888-446-4511
E-mail: FTATVMSubmissions@dot.gov

GILLIG LLC

By: ______________________

DEREK MAUNUS

Title: PRESIDENT & CEO

Date: OCTOBER 6, 2022

CER 8.8 Federal Motor Vehicle Safety Standards

The Proposer and (if selected) Contractor shall submit (1) manufacturer's FMVSS self-certification sticker information that the vehicle complies with relevant FMVSS or (2) manufacturer's certified statement that the contracted buses will not be subject to FMVSS regulations.

Company name: GILLIG LLC
Name of signer: DEREK MAUNUS
Title: PRESIDENT & CEO

Authorized signature OCTOBER 6, 2022
Date

REFERENCE OUR ATTACHED SELF-CERTIFICATION STICKER.

REVISIONS					
SYM	DWN	ZONE	DESCRIPTION	REL	DATE
A	RAW		RELEASED FOR PRODUCTION	115460	10/04/16

MANUFACTURED BY GILLIG LLC

LIVERMORE, CALIFORNIA **DATE: __________**

GVWR: ______ kg ______ lb
GAWR: FRONT ______ kg ______ lb
WITH ______________________________________ TIRES,
__________ RIMS AT ____ kPa ____ psi COLD SINGLE
GAWR: REAR ______ kg ______ lb
WITH ______________________________________ TIRES,
__________ RIMS AT ____ kPa ____ psi COLD DUAL

THIS VEHICLE CONFORMS TO ALL APPLICABLE U.S. FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.

VEHICLE I.D. NO.: __________________ MODEL: __________
TYPE OF VEHICLE: BUS
ENGINE NUMBER: __________
UNLADEN WEIGHT: ______ lb

59-35132-007

NOTES:
1. ALL TEXT HEIGHT MUST BE GREATER THAN 3/32" TALL.
2. PRINT USING ZEBRA ZT410 LABEL PRINTER.
3. MINIMUM QUALITY SETTING OF 600DPI.
4. MEDIA TYPE IS THERMAL TRANSFER.
5. DARKNESS SETTING IS 28.
6. SPEED IS 2 INCHES PER SECOND.
7. DITHERING IS SMOOTH.

ITEM NO	DESCRIPTION	QTY
	MAKE FROM: 59-52697-001	1

GILLIG LLC
HAYWARD, CA

MARK PART W/PN PER GIL DB #370002
LH AS SHOWN, RH OPPOSITE: NONE

PROPRIETARY
THIS DRAWING AND THE INFORMATION CONTAINED THEREON SUBMITTED CONFIDENTIALLY AND IS THE PROPERTY OF GILLIG LLC. USE, REPRODUCTION, OR DISCLOSURE OF THE CONTENT OF THIS DRAWING OR ANY PORTION THEREOF FOR ANY PURPOSE MUST BE APPROVED IN WRITING BY GILLIG LLC.

REMOVE ALL BURRS, BREAK SHARP EDGES

TITLE: DECAL-DATA PLATE
GILLIG LLC, LIVERMORE LOCATION

DWN: RAW DATE: 10/04/16
STD NO 302
ORIG REL #: 115460
SIZE: A DOCUMENT NO: 59-35132-007

SHEET 1 OF 2

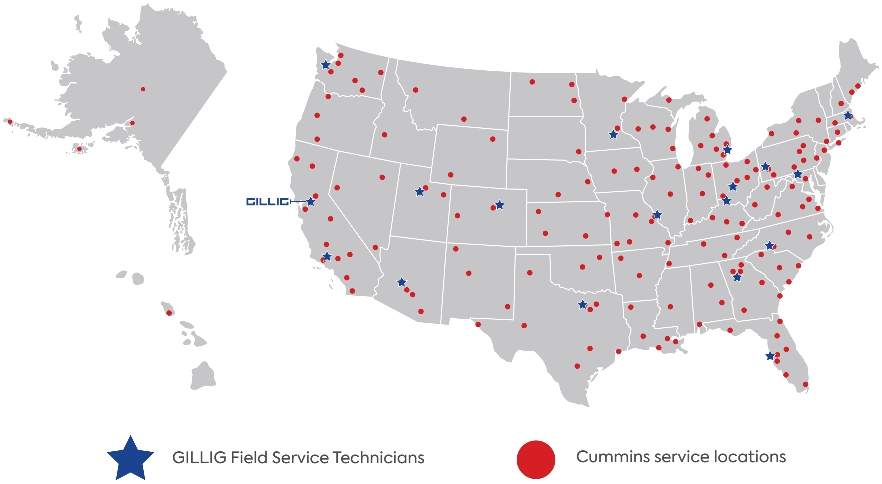
BATTERY ELECTRIC

Built On Experience
Engineered For Performance

The Standard in Zero-Emission Excellence

Cummins Powertrain +

- High-efficiency motor provides **smooth, quiet, and powerful performance**
- Powertrain is backed by **unmatched service and support network**
- Direct drive permanent magnet motor requires **no reoccurring maintenance**
- Motor and inverter proven through **millions of global in-service miles**



Energy Storage System +

- GILLIG's next-generation energy storage system provides a **32% increase** in on-board energy capacity
- Energy-dense cells from a global technology leader provide **longer range**
- **Maximum fleet flexibility** afforded through modular energy storage design

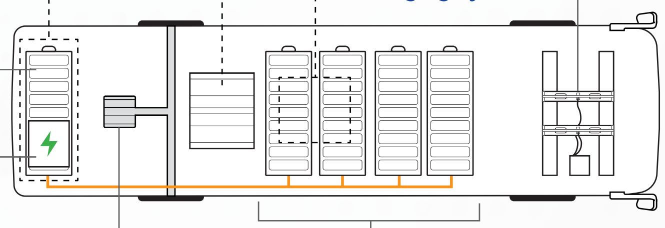
Proven Platform +

- Commonality with existing GILLIG buses affords greater **operator and technician familiarity**
- Standard electronic stability control and engineered weight balancing provide **superior ride quality and handling**
- **Best-in-class** braking performance

Highly Efficient Accessories +

- ThermoKing electric HVAC with integrated thermal management system ensures **passenger comfort** without sacrificing range
- Power management controls provide **optimal performance** and long battery life
- Optional cold weather package for **increased performance in extreme environments**

GILLIG Battery Electric Bus Components



Charging

- GILLIG's experts can provide **full turnkey infrastructure support**, including consulting, project management, and streamlined equipment procurement to support your transition to electric buses
- We offer broad access to state-of-the-art charging technology and expedited lead times from the leading U.S. manufacturers for **plug-in, overhead conductive, and inductive charging solutions**
- Our rigorous testing of non-proprietary chargers assures compatibility and performance, while providing **maximum flexibility to operators**

chargepoint ABB SIEMENS heliox WAVE Wireless Advanced Vehicle Electrification Momentum Wireless Power

Bus Length	35'	40'
Battery Capacity	490 kWh, 588 kWh, 686 kWh	
Motor	Cummins Direct Drive, Permanent Magnet Motor	
Passenger Capacity (Seated / Total)*	31 / 62	38 / 75
Gross Vehicle Weight Rating	48,200 lbs.	48,200 lbs.
Maximum Height	135"	135"

** subject to seating configurations and option selections* www.GILLIG.com

Charging solutions for your
GILLIG battery electric bus.

CHARGER CATALOG

451 Discovery Drive
Livermore, CA 94551

GILLIG

Index

Plug-In Chargers

Overhead Chargers

Inductive Chargers

About GILLIG Charging Solutions

GILLIG is the leading manufacturer of heavy-duty transit buses in the United States and is committed to advancing sustainable transit with the development of our latest battery electric buses.

To support our customers as they transition to zero-emission fleets, GILLIG has established partnerships with the largest and most experienced electric vehicle supply equipment (EVSE) manufacturers in the USA. These companies have developed nationwide manufacturing and support networks for their charging equipment, and have demonstrated a commitment to quality and transit customer success.

Charging equipment from these manufacturers undergoes rigorous testing before it is approved for use with our powertrain and buses, and this approach ensures compatibility and reliability for our transit customers. Approved charging equipment must also meet the latest SAE International, Underwriters Laboratories (UL), and other nationally recognized standards.

GILLIG will work with customers and charging equipment manufacturers to provide the optimal equipment based on duty-cycle and operational needs.

Contact your GILLIG representative to learn more about approved EVSE and other services.

MODEL	TERRA 54HV
Type	Plug-In Charger
Max Output Power	50 kW
Max Output Current	125 A
Output Voltage Range	200 to 920 VDC
Input Voltage	3-phase, 480 VAC, 60 Hz
Input Current	64 A
Cabinet Dimensions (LxWxH)	31″ x 22″ x 75″
Cabinet Weight	775 lbs
Operating Environment	Indoor and Outdoor
Operating Temp	-31 °F to 131 °F
Enclosure Rating	IP54, IK10, NEMA 3R compliant
Max Quantity of Dispensers	1
Dispenser Type(s)	Attached to Cabinet
Connection Standard(s)	SAE J1772, OCPP 1.6
Dispenser Connection Type	CCS Type 1 (plug-in)
Dispenser Dimensions	Non-Applicable
Max Cord Length	20′
Remote Monitoring Service	Option
Sequential Charging	Non-Applicable
Buy-America Compliant	No
UL Compliant	Yes

Product specifications and appearance may vary. GILLIG does not guarantee the availability or performance of the products displayed.

Plug-In Chargers

ABB

MODEL	HVC 100C	HVC 150C
Type	Plug-In Charger	Plug-In Charger
Max Output Power	100 kW	150 kW
Max Output Current	166 A	200 A
Output Voltage Range	150 to 850 VDC	150 to 850 VDC
Input Voltage	3-phase, 480 VAC, 60 Hz	3-phase, 480 VAC, 60 Hz
Input Current	132 A	198 A
Cabinet Dimensions (LxWxH)	46" x 30" x 80"	46" x 30" x 80"
Cabinet Weight	2,954 lbs	2,954 lbs
Operating Environment	Indoor and Outdoor	Indoor and Outdoor
Operating Temp	-31 °F to 131 °F	-31 °F to 131 °F
Enclosure Rating	IP54, IK10, NEMA 3R compliant	IP54, IK10, NEMA 3R compliant
Max Quantity of Dispensers	Up to 3	Up to 3
Dispenser Type(s)	Pedestal, Overhead, Wall Mount	Pedestal, Overhead, Wall Mount
Connection Standard(s)	SAE J1772, OCPP 1.6	SAE J1772, OCPP 1.6
Dispenser Connection Type	CCS Type 1 (plug-in)	CCS Type 1 (plug-in)
Dispenser Dimensions	24" x 8" x 32"	24" x 8" x 32"
Max Cord Length	23'	23'
Remote Monitoring Service	Yes	Yes
Sequential Charging	Option	Option
Buy-America Compliant	Yes	Yes
UL Compliant	Yes	Yes

Product specifications and appearance may vary. GILLIG does not guarantee the availability or performance of the products displayed.

Plug-In Chargers

GILLIG

chargepoint

MODEL	EXPRESS PLUS
Type	Plug-In Charger
Max Output Power	200 kW
Max Output Current	200 A 350 A (option)
Output Voltage Range	200 to 1,000 VDC
Input Voltage	3-phase, 480 VAC, 60 Hz
Input Current	260 A
Cabinet Dimensions (LxWxH)	49″ x 39″ x 87″
Cabinet Weight	1,400 lbs
Operating Environment	Indoor and Outdoor
Operating Temp	-40 °F to 122 °F
Enclosure Rating	IP54, IK10, NEMA 3R compliant
Max Quantity of Dispensers	Up to 8
Dispenser Type(s)	Pedestal, Overhead, Wall Mount
Connection Standard(s)	SAE J1772, OCPP 2.0.1
Dispenser Connection Type	CCS Type 1 (plug-in)
Dispenser Dimensions (LxWxH)	13″ x 6″ x 29″
Cord Length	15′ 30′ (option)
Remote Monitoring Service	Yes
Sequential Charging	Option
Buy-America Compliant	Yes
UL Compliant	Yes

Product specifications and appearance may vary. GILLIG does not guarantee the availability or performance of the products displayed.

MODEL	CPE250
Type	Plug-In Charger
Max Output Power	62.5 kW (single) 125 kW (paired)
Max Output Current	156 A (single) 200 A (paired)
Output Voltage Range	200 to 1,000 VDC
Input Voltage	3-phase, 480 VAC, 60 Hz
Input Current	80 A
Cabinet Dimensions (LxWxH)	28″ x 16″ x 88″
Cabinet Weight	748 lbs
Operating Environment	Indoor and Outdoor
Operating Temp	-40 °F to 122 °F
Enclosure Rating	IP56, IK10, NEMA 3R compliant
Max Quantity of Dispensers	1
Dispenser Type(s)	Attached to Cabinet
Connection Standard(s)	SAE J1772, OCPP 1.6
Dispenser Connection Type	CCS Type 1 (plug-in) CHAdeMO (plug-in)
Dispenser Dimensions	Non-Applicable
Max Cord Length	14′ Horizontal Reach
Remote Monitoring Service	Yes
Sequential Charging	Option
Buy-America Compliant	Yes
UL Compliant	Yes

Product specifications and appearance may vary. GILLIG does not guarantee the availability or performance of the products displayed.

Plug-In Chargers

GILLIG

heliox

MODEL	MOBILE 25 kW	MOBILE 50 kW
Type	Plug-In Charger	Plug-In Charger
Max Output Power	25 kW	50 kW
Max Output Current	40 A	80 A
Output Voltage Range	100 to 1,000 VDC	100 to 1,000 VDC
Input Voltage	3 phase, 480 VAC, 60 Hz	3 phase, 480 VAC, 60 Hz
Input Current	40 A	80 A
Cabinet Dimensions (LxWxH)	H: 20" W: 13", D" 36"	20" x 20" x 36"
Cabinet Weight	200 lbs	270 lbs
Max Quantity of Dispensers	1	1
Dispenser Type(s)	Attached to Cabinet	Attached to Cabinet
Connection Standard(s)	SAE J1772, OCPP 1.6J	SAE J1772, OCPP 1.6J
Dispenser Connection Type	CCS Type 1 (plug-in)	CCS Type 1 (plug-in)
Dispenser Dimensions	Non-Applicable	Non-Applicable
Max Cord Length	Standard: 11.5 ft.	Standard: 11.5 ft.
Remote Monitoring Service	Option	Option
Sequential Charging	Non-Applicable	Non-Applicable
Buy-America Compliant	Yes	Yes
UL Compliant	Yes	Yes

Product specifications and appearance may vary. GILLIG does not guarantee the availability or performance of the products displayed.

Plug-In Chargers

GILLIG

heliox

MODEL	FLEX 180 kW + DC COLUMN
Type	Plug-In Charger
Max Output Power	180 kW
Max Output Current	250 A
Output Voltage Range	150 to 1,000 VDC
Input Voltage	3 phase, 480 VAC, 60 Hz
Input Current	283 A, inrush current limited
Cabinet Dimensions (LxWxH)	64" x 32" x 99"
Cabinet Weight	1,323 lbs
Operating Environment	Indoor and Outdoor
Operating Temp	-13 to 113 °F
Enclosure Rating	IP44, IK10, NEMA 3R compliant
Max Quantity of Dispensers	3
Dispenser Type(s)	Pedestal, Overhead, Wall Mount
Connection Standard(s)	SAE J1772, OCPP 1.6J
Dispenser Connection Type	CCS Type 1 (plug-in)
Dispenser Dimensions	18" x 10" x 55"
Max Cord Length	11.5' 23' (option) 30' (option)
Remote Monitoring Service	Option
Sequential Charging	Option
Buy-America Compliant	Yes
UL Compliant	Yes

Product specifications and appearance may vary. GILLIG does not guarantee the availability or performance of the products displayed.

Plug-In Chargers

GILLIG

SIEMENS

MODEL	SICHARGE UC200
Type	Plug-In Charger
Max Output Power	150 kW
Max Output Current	200 A
Output Voltage Range	100 to 950 VDC
Input Voltage	3-phase, 480 VAC, 60 Hz
Input Current	200 A
Cabinet Dimensions (LxWxH)	43″ x 39″ x 87″
Cabinet Weight	3,307 lbs
Operating Environment	Indoor and Outdoor
Operating Temp	-13 °F to 113 °F
Enclosure Rating	IP54, IK10
Max Quantity of Dispensers	Up to 4
Dispenser Type(s)	Pedestal, Overhead, Wall Mount
Connection Standard(s)	SAE J1772, OCPP 1.6
Dispenser Connection Type	CCS Type 1 (plug-in)
Dispenser Dimensions (LxWxH)	24″ x 12″ x 36″
Cord Length	11.5′ 20′ and 33′ (option)
Remote Monitoring Service	Yes
Sequential Charging	Option
Buy-America Compliant	Yes
UL Compliant	Yes

Product specifications and appearance may vary. GILLIG does not guarantee the availability or performance of the products displayed.

Overhead Chargers

GILLIG

ABB

SPECFCATION	MODEL #1	MODEL #2	MODEL #3
Make	ABB	ABB	ABB
Model	HVC-150PD	HVC-300PD	HVC-450PD
Type	Overhead, Inverted Pantograph Charger	Overhead, Inverted Pantograph Charger	Overhead, Inverted Pantograph Charger
Max Output Power	150 kW	300 kW	450 kW
Max Output Current	250 A	500 A	600 A
Output Voltage Range	150 to 850 VDC	150 to 850 VDC	150 to 850 VDC
Input Voltage	3-phase, 480 VAC, 60 Hz	3-phase, 480 VAC, 60 Hz	3-phase, 480 VAC, 60 Hz
Input Current	1 x 198 A	2 x 198 A	3 x 198 A
Cabinet Dimensions (LxWxH)	46″ x 30″ x 80″	92″ x 30″ x 80″	138″ x 30″ x 80″
Cabinet Weight	2,954 lbs	5,608 lbs	8,863 lbs
Operating Environment	Indoor and Outdoor	Indoor and Outdoor	Indoor and Outdoor
Operating Temp	-31 °F to 131 °F	-31 °F to 131 °F	-31 °F to 131 °F
Enclosure Rating	IP54, IK10, NEMA 3R compliant	IP54, IK10, NEMA 3R compliant	IP54, IK10, NEMA 3R compliant
Max Quantity of Dispensers	1	1	1
Dispenser Type(s)	Mast Mounted Pantograph Pantograph-Only Kit (option)	Mast Mounted Pantograph Pantograph-Only Kit (option)	Mast Mounted Pantograph Pantograph-Only Kit (option)
Connection Standard(s)	SAE J3105-1, OCPP 1.6	SAE J3105-1, OCPP 1.6	SAE J3105-1, OCPP 1.6
Dispenser Connection Type	Conductive Cross-Rail	Conductive Cross-Rail	Conductive Cross-Rail
Dispenser Dimensions (LxWxH)	Mast: 41″ x 12″ x 206″ Arm Length: 184″	Mast: 41″ x 12″ x 206″ Arm Length: 184″	Mast: 41″ x 12″ x 206″ Arm Length: 184″
Max Cord Length	Non-Applicable	Non-Applicable	Non-Applicable
Remote Monitoring Service	Yes	Yes	Yes
Sequential Charging	Non-Applicable	Non-Applicable	Non-Applicable
Buy-America Compliant	Yes	Yes	Yes
UL Compliant	Yes	Yes	Yes

Product specifications and appearance may vary. GILLIG does not guarantee the availability or performance of the products displayed.

Overhead Chargers

MODEL	ULTRA FAST 450 kW
Type	Overhead, Inverted Pantograph Charger
Max Output Power	450 kW
Max Output Current	900 A
Output Voltage Range	460-800 V
Input Voltage	3 phase, 480 VAC, 60 Hz
Input Current	600 A
Cabinet Dimensions (LxWxH)	Line: 189'' x 32'' x 91'' Block: 95" x 95" x 63"
Cabinet Weight	8800 lbs.
Operating Environment	Indoor and Outdoor
Operating Temp	-22 to 122 °F
Enclosure Rating	NEMA 3R
Max Quantity of Dispensers	1
Dispenser Type(s)	Mast Mounted Pantograph Pantograph-Only Kit (option)
Connection Standard(s)	SAE J3105-1, OCPP 1.6J
Dispenser Connection Type	Conductive Cross-Rail
Dispenser Dimensions (LxWxH)	Pantograph: 63" x 42" x 40"
Max Cord Length	Non-Applicable
Remote Monitoring Service	Option
Sequential Charging	Non-Applicable
Buy-America Compliant	Yes
UL Compliant	Yes

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Overhead Chargers

GILLIG

SIEMENS

MODEL	SICHARGE UC600 INVERTED PANTOGRAPH
Type	Overhead, Inverted Pantograph Charger
Max Output Power	450 kW
Max Output Current	600 A
Output Voltage Range	100 to 1,000 VDC
Input Voltage	3-phase, 480 VAC, 60 Hz
Input Current	3 x 198 A
Cabinet Dimensions (LxWxH)	130″ x 39″ x 87″
Cabinet Weight	9,921 lbs
Operating Environment	Indoor and Outdoor
Operating Temp	14 °F to 122 °F -31 °F to 122 °F (option)
Enclosure Rating	IP54, IK10
Max Quantity of Dispensers	1
Dispenser Type(s)	Mast Mounted Pantograph
Connection Standard(s)	SAE J3105-1, OCPP 1.6
Dispenser Connection Type	Conductive Cross-Rail
Dispenser Dimensions (LxWxH)	Mast: 37″ x 12″ x 229″ Arm Length: 156″
Max Cord Length	Non-Applicable
Remote Monitoring Service	Yes
Sequential Charging	Non-Applicable
Buy-America Compliant	Yes
UL Compliant	Yes

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Inductive Chargers

GILLIG

Momentum®
Wireless EV Charging

MODEL	MOMENTUM DYNAMICS 75 KW WIRELESS CHARGING SYSTEM	MOMENTUM DYNAMICS 150 KW WIRELESS CHARGING SYSTEM	MOMENTUM DYNAMICS 300 KW WIRELESS CHARGING SYSTEM
Type:	Wireless Inductive	Wireless Inductive	Wireless Inductive
Max Output Power:	72.5 kW	145 kW	290 kW
Max Output Current:	100 A	200 A	400 A
Output Voltage Range:	300 to 800 VDC	300 to 800 VDC	300 to 800 VDC
Input Voltage:	3-phase, 480 VAC	3-phase, 480 VAC	3-phase, 480 VAC
Input Current:	1 x 103A + 1 x 18A 1-phase	2 x 103A + 1 x 18A 1-phase	4 x 103A + 1 x 16A 1-phase
"Cabinet Dimensions LxWxH (in.): "	39" x 64" x 72"	39" x 64" x 72"	39" x 88" x 72"
Pad Dimensions LxWxD (in.):	40" x 37" x 20"	40" x 67" x 20"	71" x 67" x 20"
Operating Environment:	Indoor and Outdoor	Indoor and Outdoor	Indoor and Outdoor
Operating Temperature:	-31 °F to 122 °F	-31 °F to 122 °F	-31 °F to 122 °F
Enclosure Rating:	IP55, NEMA 3R or NEMA 4, IP69 (Pad)	IP55, NEMA 3R or NEMA 4, IP69 (Pad)	IP55, NEMA 3R or NEMA 4, IP69 (Pad)
Quantity of Pads:	1	2	4
Remote Monitoring Service:	Yes	Yes	Yes
Buy America Compliant:	Yes	Yes	Yes
UL Compliant:	Yes	Yes	Yes

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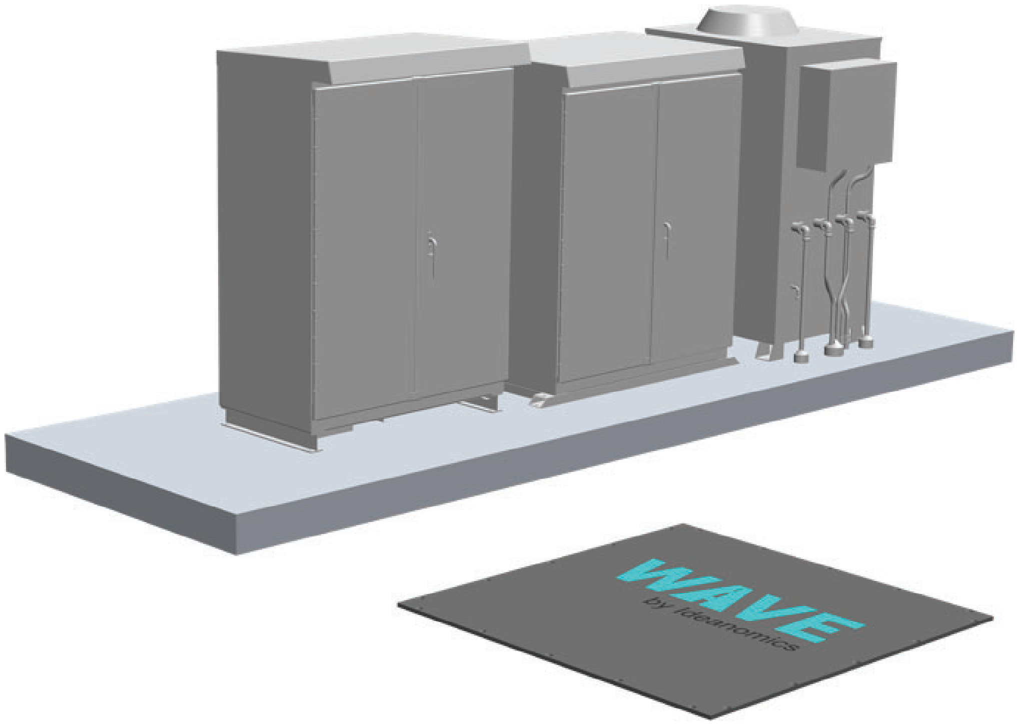

WAVE
by Ideanomics

MODEL	WAVE 250 kW WIRELESS CHARGING SYSTEM
Type:	Wireless Inductive
Max Output Power:	250 kW
Max Output Current:	500 A
Output Voltage Range:	500 to 850 VDC
Input Voltage:	3-phase, 480 VAC
Input Current:	330 A
Charging Pad Dimensions LxWxH (in.):	71″ x 71″ x 4.5″
Operating Environment:	Indoor and Outdoor
Operating Temperature:	14 °F to 122 °F
Enclosure Rating:	Enclosure: IP54 Pad: IP67, NEMA 3R compliant
Max. Quantity of Pads:	1
Remote Monitoring Service:	Yes
Buy America Compliant:	Yes
UL Compliant:	Yes

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GILLIG

www.GILLIG.com

05.12.2022

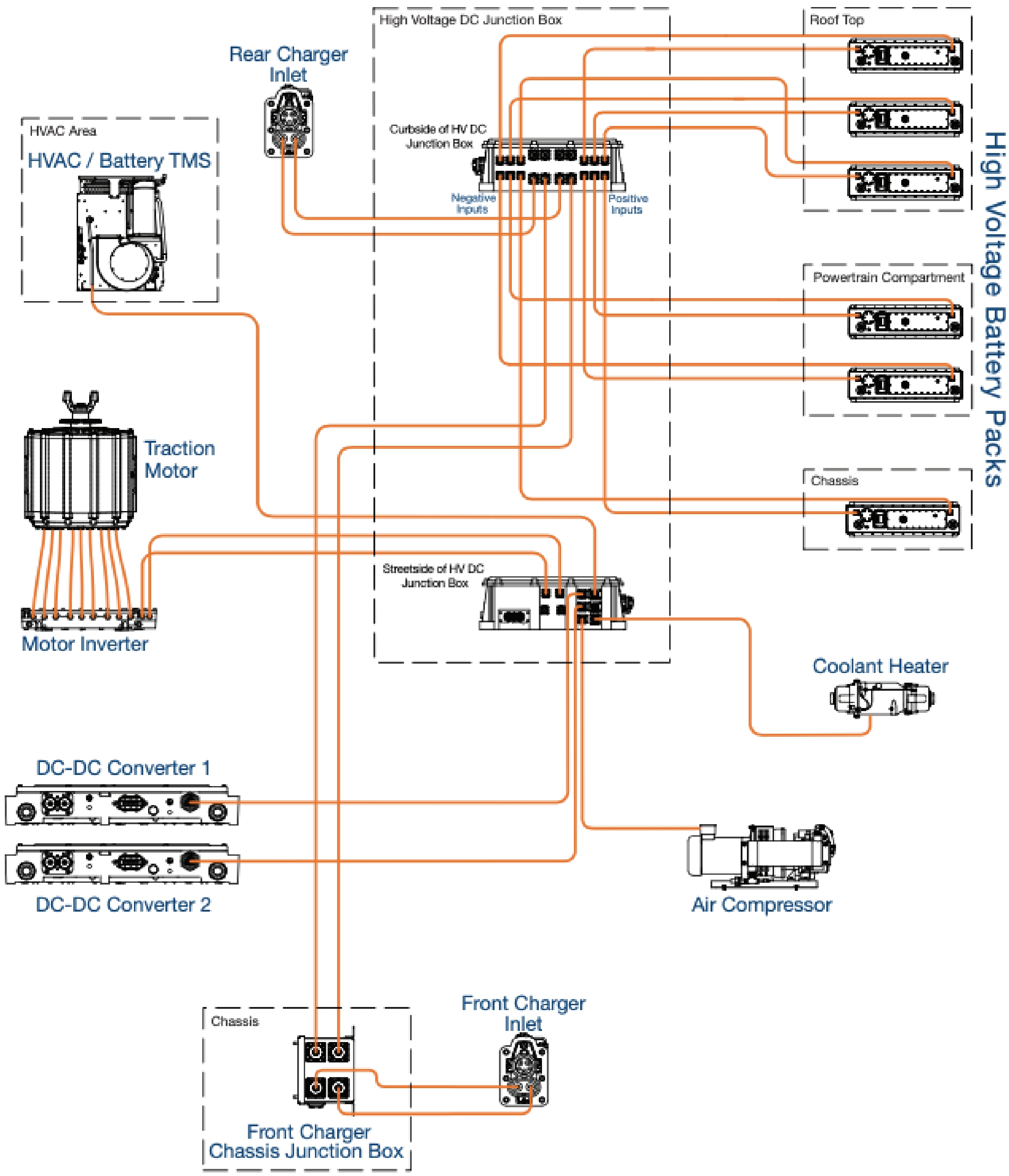
BATTERY ELECTRIC BUS VEHICLE CONFIGURATION

Our Battery Electric Bus represents the culmination of years of hard work and innovation to bring the best-in-class bus to market. Offering a smooth ride and quiet acceleration, our bus enhances the customer experience while providing sustainable public transportation. Based on our proven Low Floor platform, every GILLIG Battery Electric bus is designed, built, and supported in the same facility by the same team that you've come to know and trust. As such, we can ensure parts, training, maintenance, and operations commonality with existing GILLIG fleets for seamless integration. The stainless-steel chassis and aluminum body create a lightweight, high-strength bus, while the integrated crash barrier protects riders from side impacts during a collision. In addition, Altoona testing has proven our buses to be the safest, highest quality, and most reliable bus on the market.

In developing our all-electric powertrain, GILLIG performed an exhaustive search for systems and components that maximize performance, durability, reliability, and cost-effectiveness. Additionally, we sought a partner who could provide world-class aftermarket service, support, and training for the new powertrain. We are proud to partner with Cummins Inc. on the electrified powertrain based on their extensive experience with U.S. transit operations, their vast support infrastructure, and their cross-industry focus on developing efficient, reliable, and cost-effective components.

BATTERY ELECTRIC BUS VEHICLE CONFIGURATION

Our zero-emission battery electric transit bus has an all-electric drive system with a single chassis-mounted traction motor powered by on-board high-voltage batteries. The high-voltage energy storage system consists of high-voltage battery packs connected in parallel to the high-voltage junction box. This provides power for the traction motor inverter, which in turn supplies power to the traction motor and to high-voltage DC-powered accessories.



The modular high-voltage battery system allows for various capacity configurations, with battery-mounting locations on the roof, in the rear powertrain compartment, and on the chassis. Depending on customer specifications, battery capacity can provide a full day of driving range on a single charge. Alternatively, high-voltage battery configurations can be set up to use opportunity charging to allow for lower capacity, cost, and weight.

Industry standard J1772-Combo Charging System (CCS), also known as CCS-Type 1, DC plug-in charging is provided on every GILLIG Battery Electric bus. Optional roof-mounted charging rails and chassis-mounted inductive charging solutions are available as an option.

The system control module (SCM) controls the vehicle's motor speed, torque, and direction, depending on driver request and operating conditions. This is a low-voltage electronic module that connects to the throttle and other systems and communicates with the traction motor inverter to propel the bus.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2022 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: **GILLIG LLC**
(U.S. Manufacturer or Importer)

Certificate Number: NGLG2VOCVEV1-001

Effective Date: 01/01/2022

Expiration Date: 12/31/2022

Byron J. Bunker, Division Director
Compliance Division

Issue Date: 07/12/2021

Revision Date: 07/12/2021

Model Year: 2022
Vehicle Family: NGLG2VOCVEV1
Vehicle Regulatory Sub-category: Transit and other bus
Averaging Set: Transit and Other bus
This family includes advanced technologies.

CO_2 Emission Standard (g CO_2/ton-mile): 300
Highest Projected CO_2 Family Emission Limit (g/ton-mile): 0
Lowest Projected CO_2 Family Emission Limit (g/ton-mile): 0

Pursuant to Section 206 of the Clean Air Act (42 U.S.C. section 7525), 40 CFR Part 1037 and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test vehicle which represents the vehicle family, and is subject to the terms and conditions prescribed in those provisions. This certificate of conformity covers only those new motor vehicles which conform in all material respects to the design specifications that applied to those vehicles described in the documentation required by 40 CFR Part 1037 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 1037.

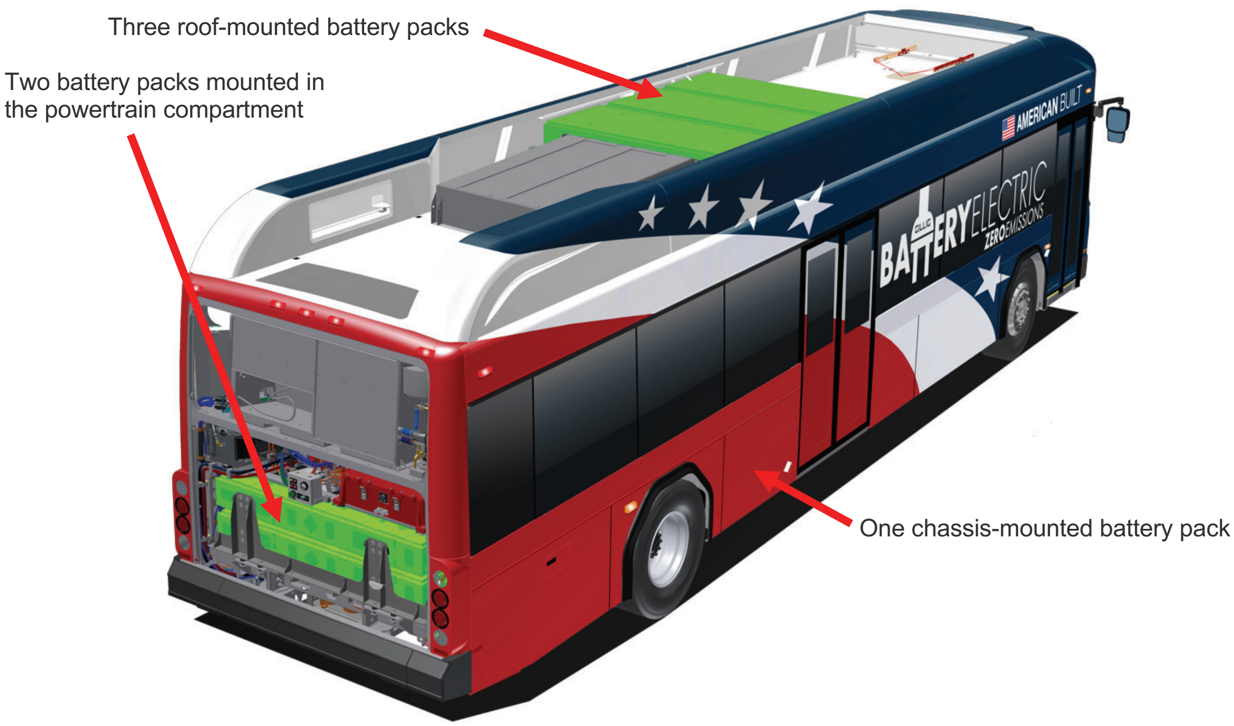
This certificate of conformity is conditional upon compliance of said manufacturer with the averaging, banking and trading provisions of 40 CFR Part 1037, Subpart H. Failure to comply with these provisions may render this certificate void *ab initio*.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 1068. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 1068.

This certificate does not cover vehicles sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

The energy storage system (ESS) consists of multiple high-voltage battery packs connected in parallel to achieve the required system energy storage capacity and includes the battery management system to control the discharging and charging of all the battery packs.

Up to six battery packs can be provided, as shown below: up to three roof-mounted battery packs; up to two battery packs in the powertrain compartment; up to one battery pack chassis-mounted forward of the rear axle. These batteries use a high-energy nickel-manganese-cobalt (NMC) cell chemistry, which was selected because its lifespan, specific power, and safety characteristics make it ideal for a heavy-duty application. The battery packs are liquid-cooled and kept at optimal operative temperature through the battery thermal management system, which provides both heating and cooling as necessary.



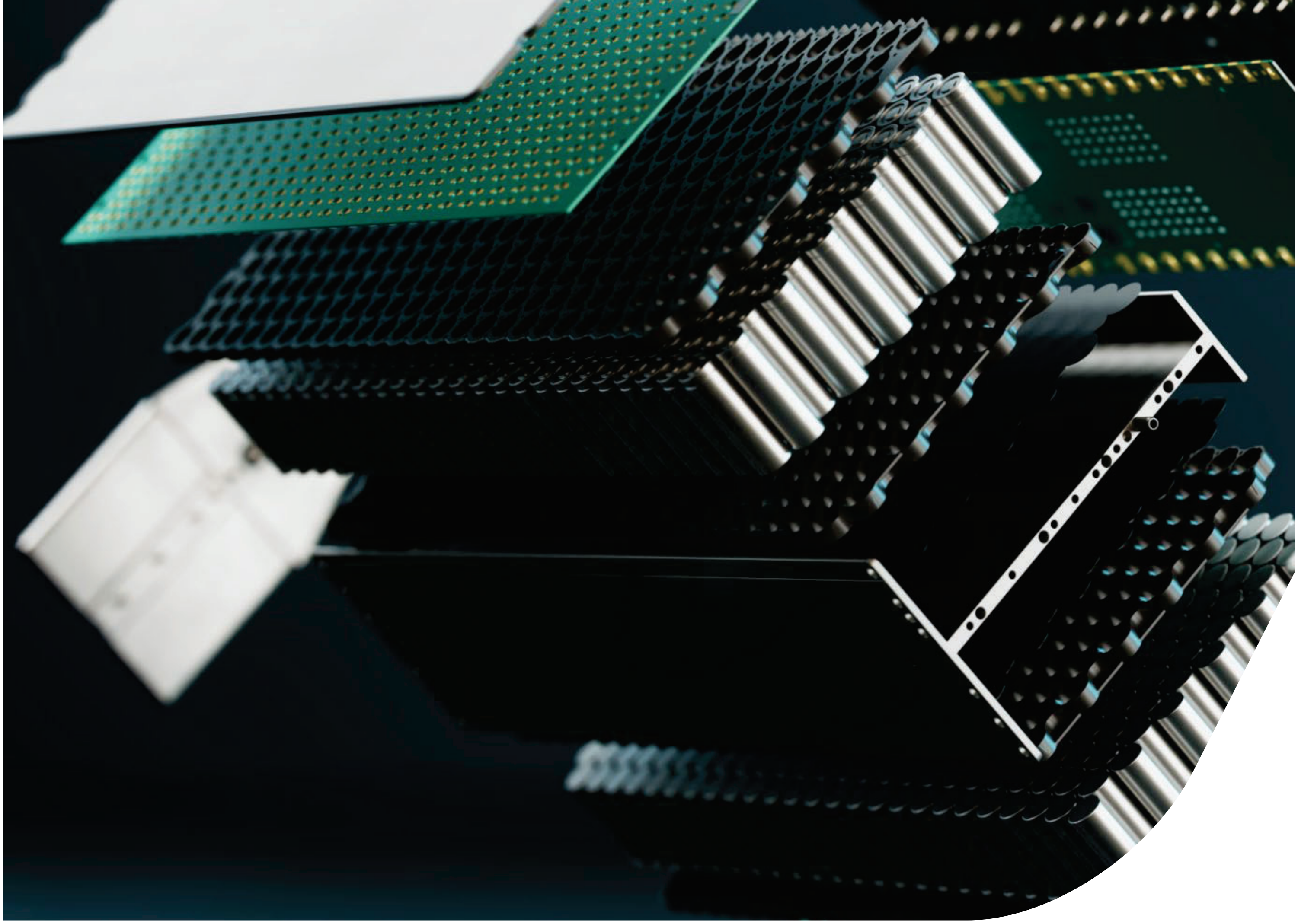
The architecture of the ESS provides full system operating voltage at each battery pack and utilizes parallel battery connections. This means that the vehicle level voltage is achieved regardless of the number of packs connected and therefore each additional pack simply increases the energy storage capacity. This also means that should a single battery pack experience an issue which requires it to be taken off-line, the bus would still be able to operate on the remaining packs.

All battery packs are the same in size, capacity, and electrical connections so one common battery pack can be used in any location. This interchange-able design simplifies replacement and inventory requirements.

AKASOL's Battery Systems
Safe. Powerful. Durable. Proven.

PRODUCED IN USA

THE E IN MOBILITY



The AKASystem is designed to be the safest, most energy efficient, and best performing lithium-ion battery system on the commercial EV market.

A **fast-charging, flexible and freely scalable system**, which can be configured as required with several systems.

Maximum safety

- Multi-level system architecture ensures highest safety standards
- Extensive, rigorous and robust battery system and durability tests; SL certified
- Stainless steel battery casing

Unmatched performance

- Best efficiency combined with the most energy storage for the longest range on the market
- Partnership with GILLIG offers up to 686 kWh of available energy in its transit bus, the largest capacity in a North American transit bus

Proven technology platform

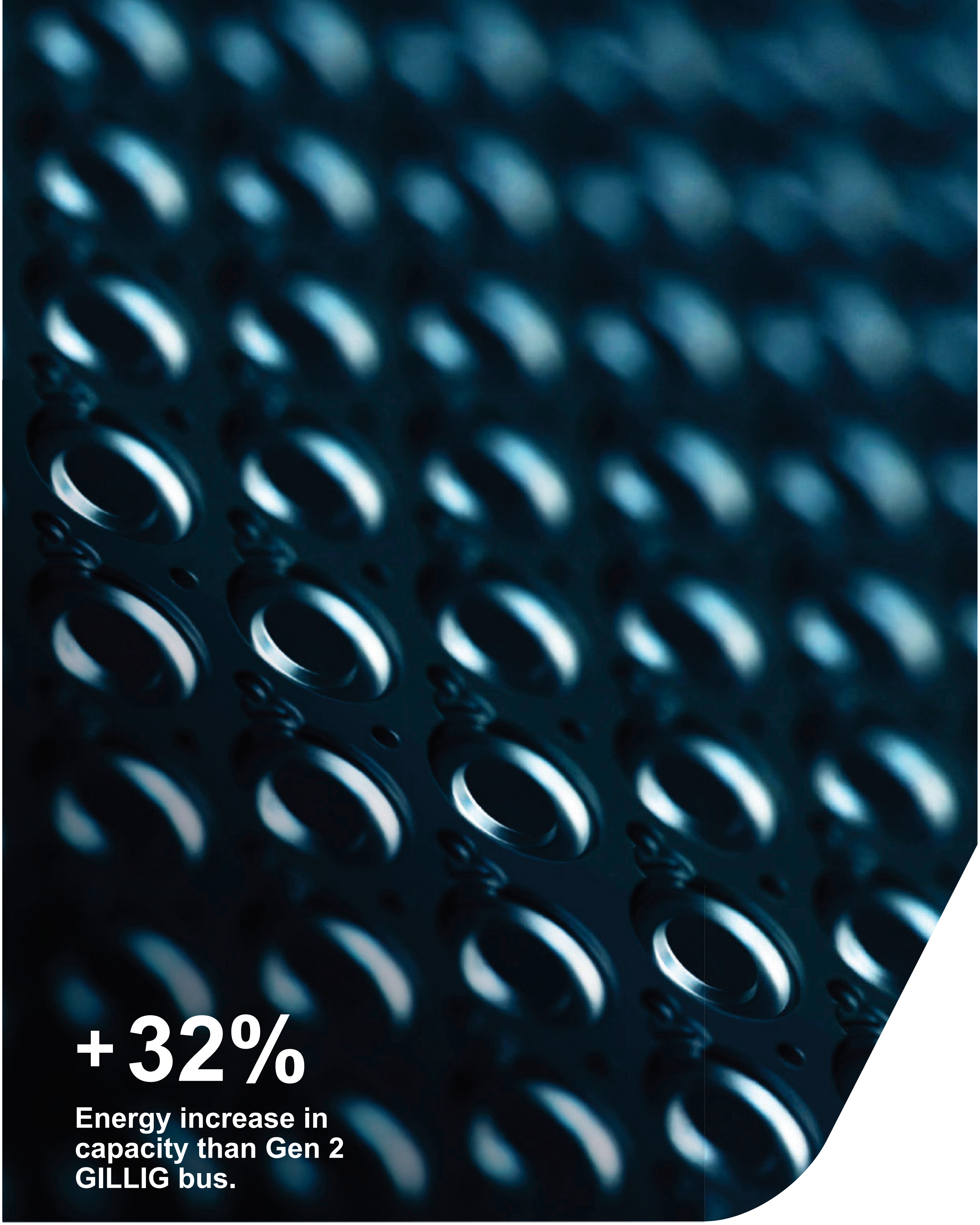
- Global automotive and commercial vehicle leader for over 100 years
- Full line of electric vehicle products with complete systems knowledge
- AKASOL's Battery Management System (BMS) ensures optimal performance and safety

INTELLIGENT, SAFE, AND RELIABLE DESIGN FOR ULTRA-HIGH ENERGY BATTERIES

Selection of premium components and automotive quality standards – functional safety, multi-level safety architecture, scalable battery systems.

ROBUST BATTERY SYSTEM & DURABILITY TESTS

In-house and customer fleet testing before series production. Individual tests for optimized battery application requirements.


+32%
Energy increase in capacity than Gen 2 GILLIG bus.

Ultra-High Energy Battery System

The New AKA**SYSTEM** 9 AKM 150 CYC

The highest energy density available on the market.
Especially suitable for fully electric long-distance commercial vehicles such as bus or truck.

DESIGNED FOR OPTIMAL BATTERY CELL SERVICE LIFE

Enables a **maximization in range up to 50%** compared to conventional systems on the market.

The next-generation battery system delivers a **32% increase in onboard energy capacity and therefore a significantly longer range for a GILLIG electric bus.**

Spare parts available.

AKA**SYSTEM** 9 AKM 150 CYC

1 Cooling system
2 Cell module with 600 cells
3 Housing
4 Battery Management System
5 LV Connection
6 HV Connection

274 Wh/l

Volumetric energy density & energy level

TECHNICAL DATA	AS 9AKM 150AH CYC
Energy (nominal) ***	98 kWh
Weight (typical) *	~ 554 kg
Discharging power cont. **	100 kW
Charging power cont. **	80 kW
Capacity (nominal) ***	147 Ah
Voltage nom.	665V
Cycle life (for typical usage profile)	4,000 cycles
Dimension (L x W x H) in mm	1,720 x 700 x 300

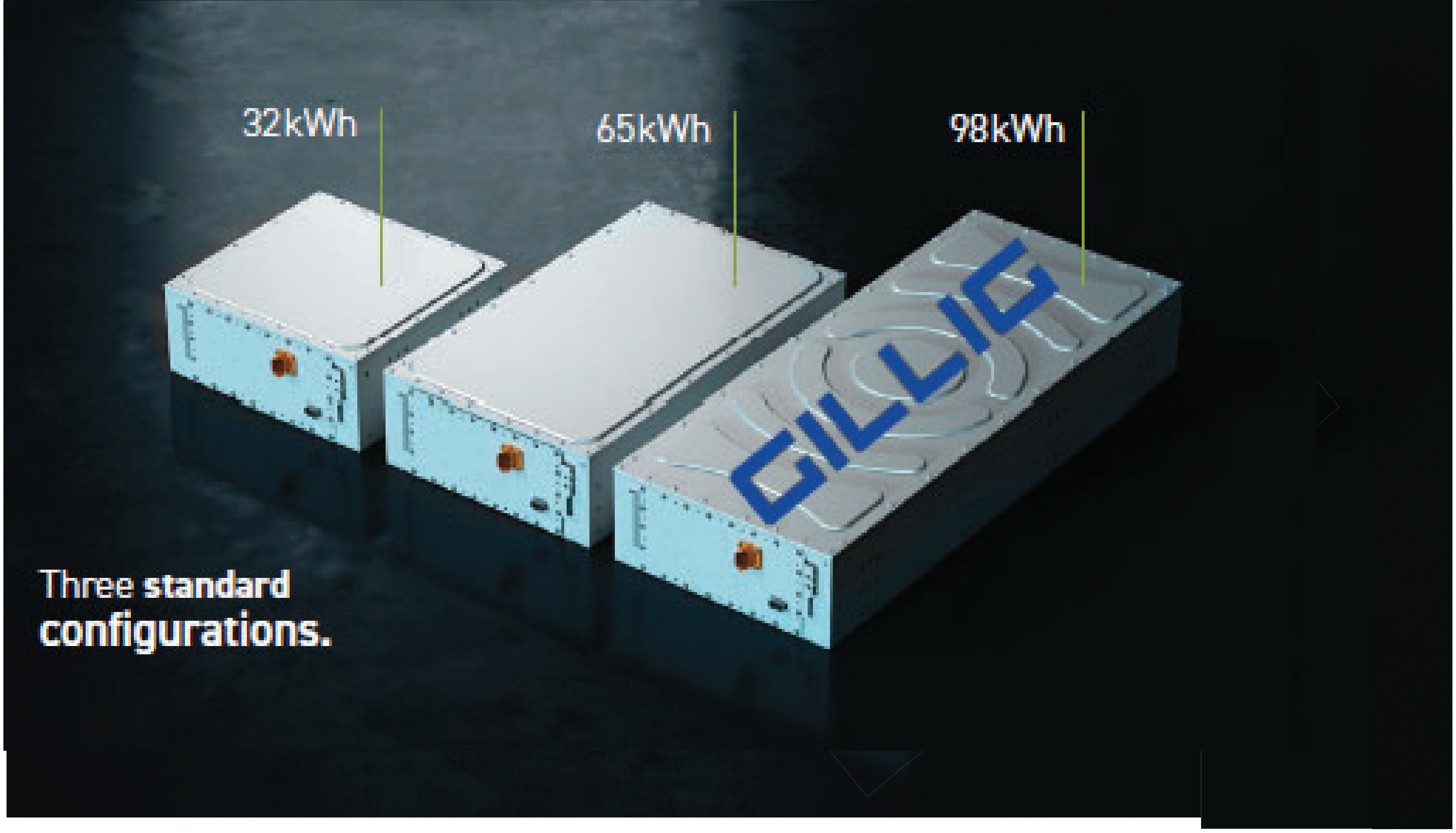
APPLICATION FOCUS

- Solutions for ultra high energy and longe-range applications
- Especially buses, coaches and commercial vehicles with long range requirements

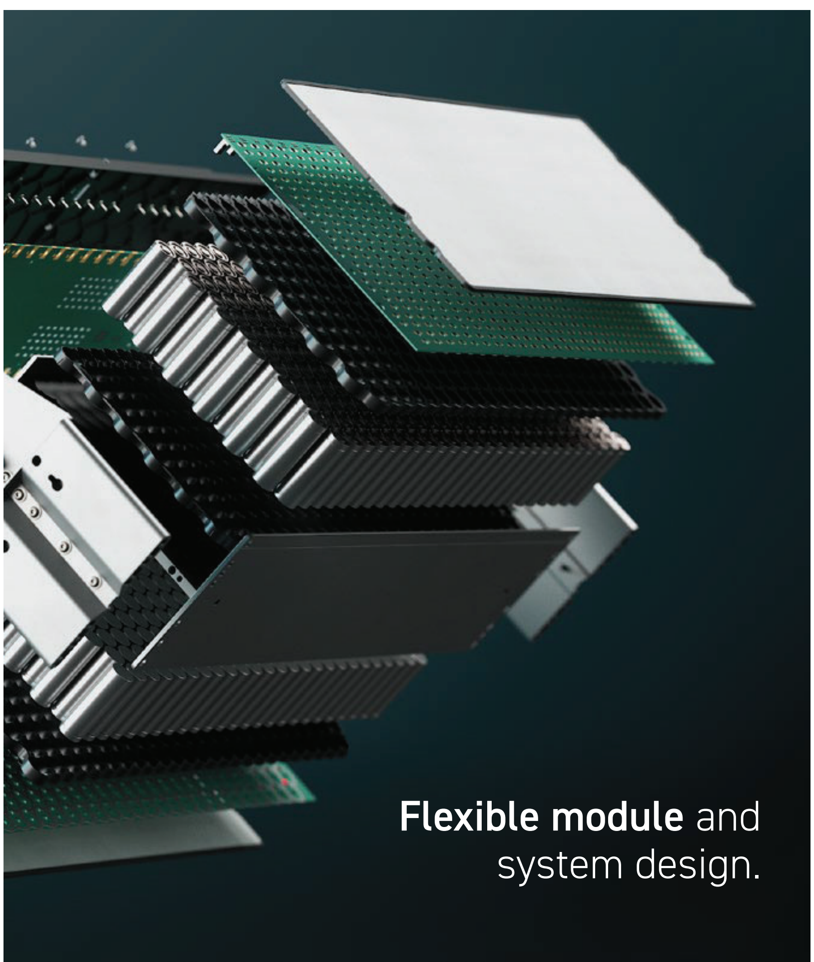
* Depending on housing material
** Depending on cable, connector, SOC, temperature and internal fuse type
*** Nominal energy and capacity of the battery system, based on the datasheet of the cell supplier at 0.2C charge rate and room temperature. This energy content is underlying natural degression because of unavoidable chemical processes, including calendric and cyclic aging of the cells. The cell aging is dependent on usage parameters like temperature, power, state of charge and energy throughput over time.

Flexibility | Performance | Safety

AKA**SYSTEM** AKM CYC

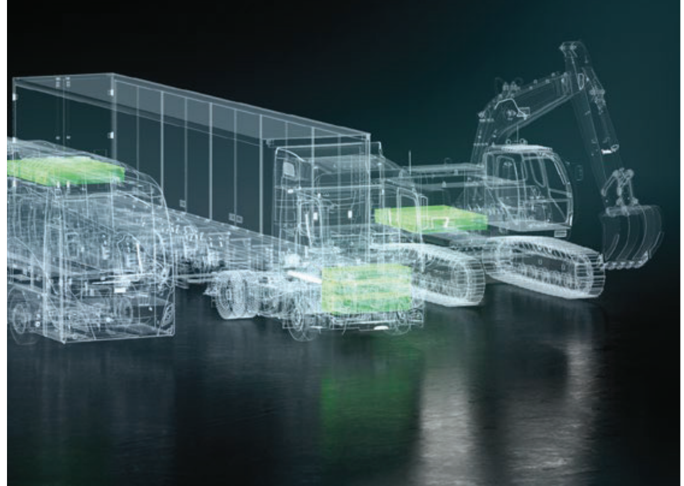


Three **standard**
configurations.

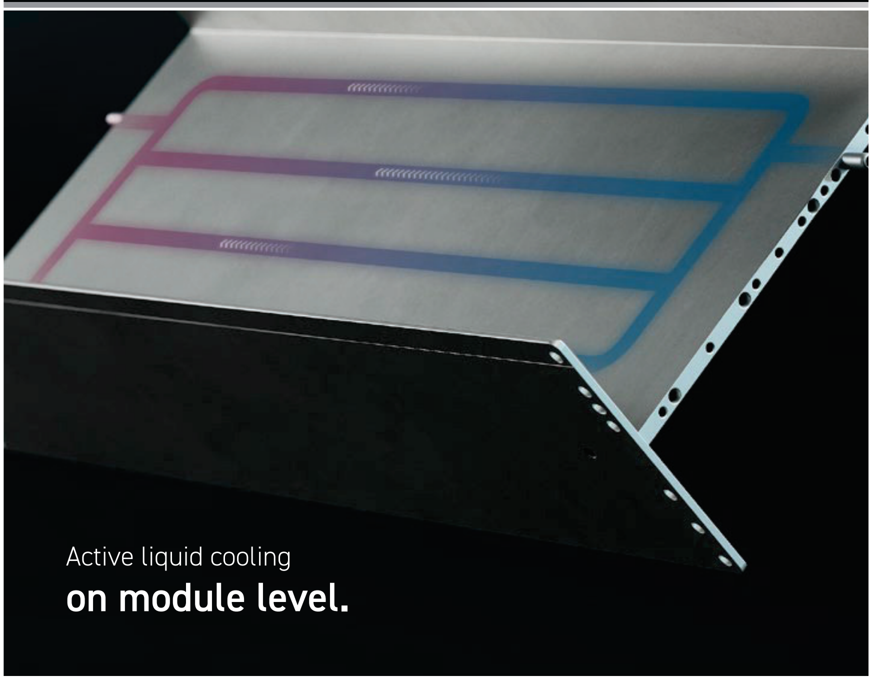


Flexible module and
system design.

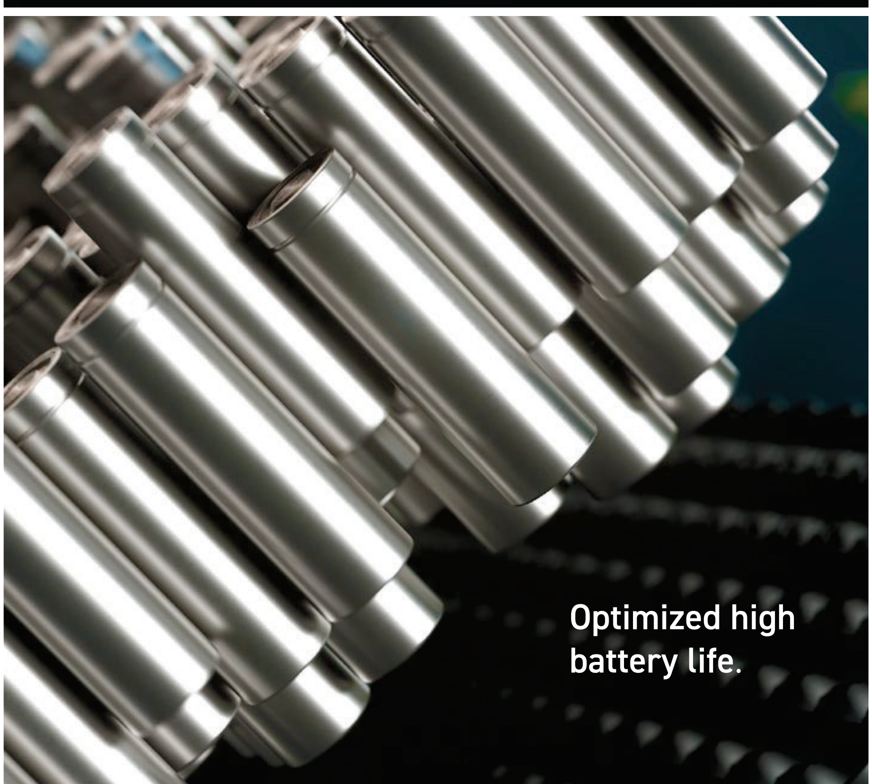
Freely scalable system
for many different applications
and industries with highest
available energy density.



Increased reliability
due to highly redundant cell clusters.

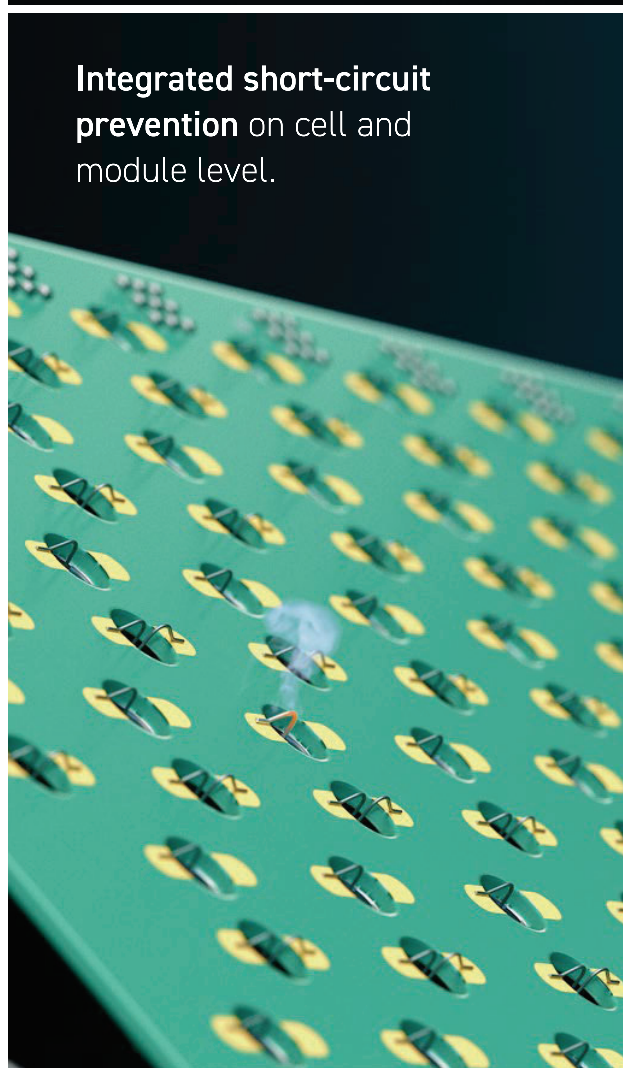


Active liquid cooling
on module level.



Optimized high battery life.

Passive propagation resistant
due to defined cell spacing and special potting compound.



Integrated short-circuit prevention on cell and module level.

AKASystem CYC Battery Safety & Quality
Advantages of Cylindrical Cells

Safety
- Improved usage of space in module
- Mitigates risk of failure
- Small cell format more abuse tolerant than larger pouch cells given reduced thermal energy

Quality
- AKASOL uses only top-tier quality cells, such as LG on GILLIG bus
- Standardized 21700 cell format- established cell type with high availability and supplier base
- Premium cells with integrated overcharge protection and high cycle life

AKASOL Battery Packs

Designed Specifically for Safe Operation in Heavy-Duty Transportation

- Protective, durable enclosure **sealed with stainless steel casing** that can withstand the toughest conditions
- Pack design ensures service technicians and operators are **protected from high voltage components**
- **Liquid cooling for active thermal management** to ensure optimal operation in any climate and temperature
- **Numerous sensors throughout each pack** deliver continuous monitoring and diagnostics, enabling faster service

Propagation Resistant Battery Systems
Prevent Dangerous Situations

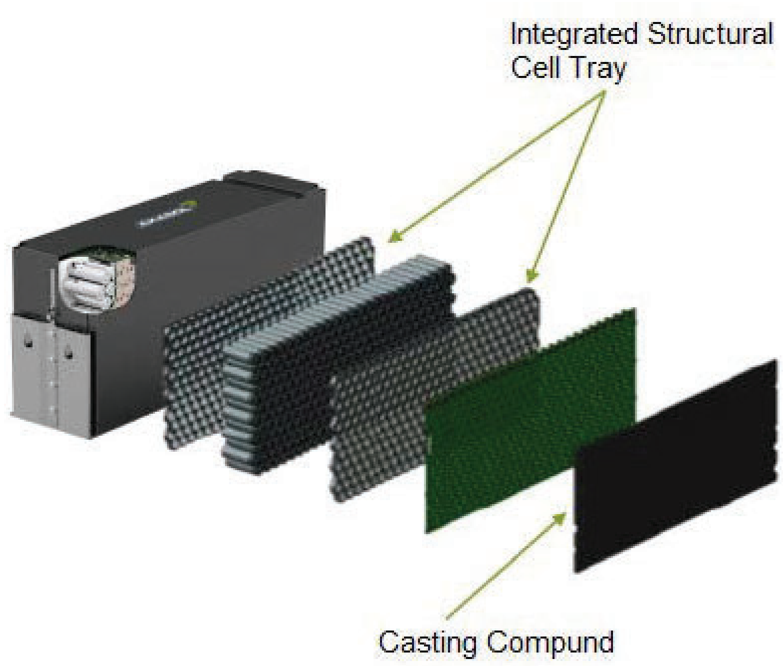
- AKASOL's batteries feature **state-of-the-art safety features,** including cell-level passive propagation resistance
- Cell to cell propagation is based on the standard SAE J2464 on module and system level

- Main design features to prevent cell to cell propagation:

- MODULE LEVEL
- Cell tray with honeycomb pattern to ensure sufficient distance between cells
- Fire resistant casting compound
- Cell balancing within module

SYSTEM LEVEL
- Fire protection layer between modules
- Degassing valve

- **Robust design and pack architecture reduces the risk of a thermal event**



System Safety Features

- **AKASOL battery packs have undergone extensive testing to meet the highest safety standards**
- System design includes multiple safety features, such as two separate CPU cores to increase fail-safety by redundancy
- Battery management with active monitoring of electrical and thermal measurements
- Redundant shutdown paths
- DAE valves to avoid high pressure within pack
- IP67 and IP69K protection classes, high fire protection, dust and sand protection, and high-pressure water protection
- Functional safety according to ISO 26262

Tests performed to account for possible incidents such as:

- Defective cell within pack
- Overcharge of high voltage system
- Coolant flow internal to battery pack
- Vehicle crash
- Rough road vibration and shock
- High and low temperature conditions

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by BorgWarner

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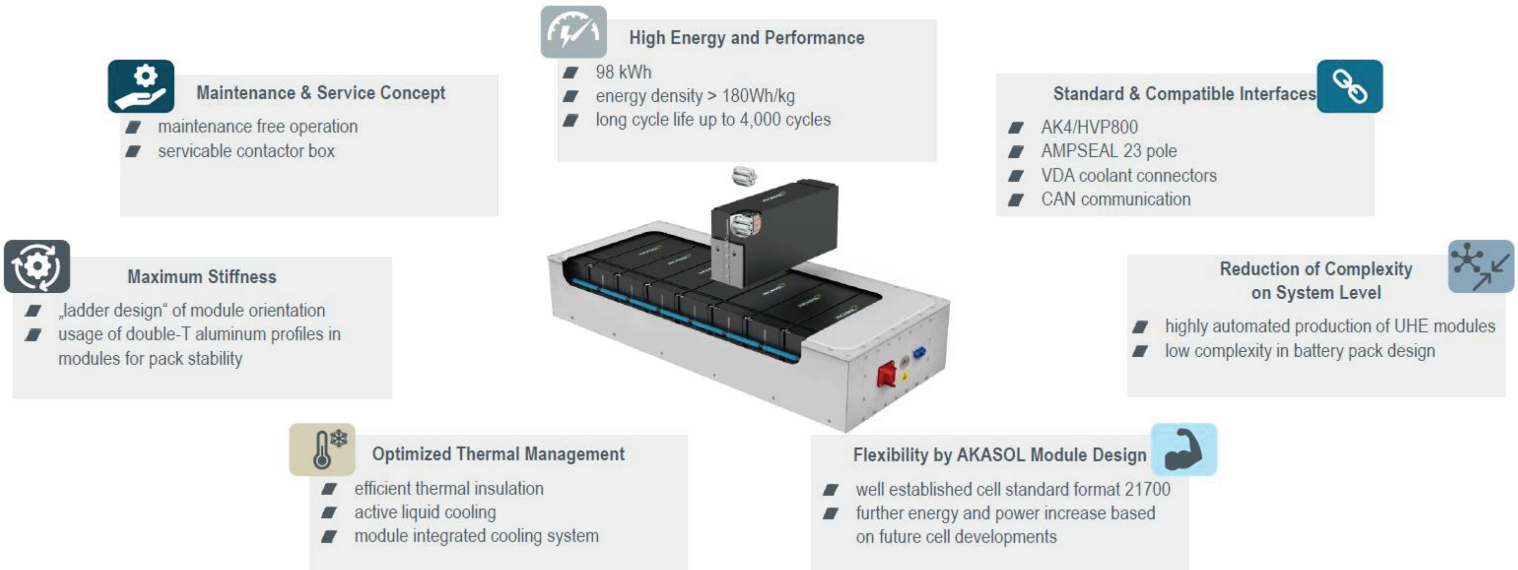
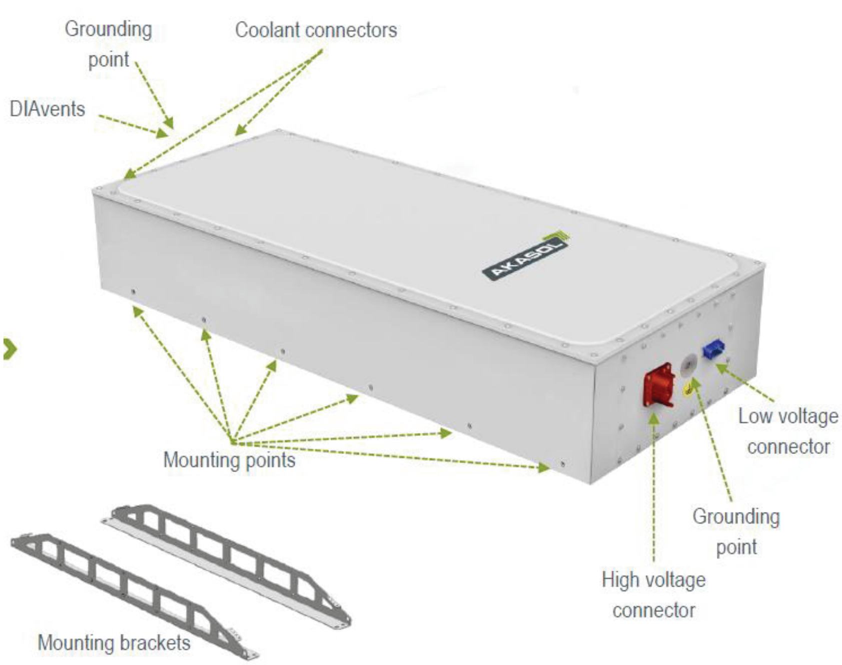
HIGH-VOLTAGE BATTERY PACKS

The AKASOL-designed and American-built 9AKM150CYCUHE high-voltage battery pack utilizes Li-ion technology with a high energy density and proprietary control technology to maintain a high battery performance for a longer zero emission range. A single pack design is utilized for all locations on the bus. This provides reduces the complexity of servicing and inventory requirements.





HIGH-VOLTAGE BATTERY PACKS

Structure: The exterior case is constructed of corrosion resistant stainless steel. Internal double ‘T’ aluminum crossmembers provide structural strength and stiffness. Individual battery modules are secured in place by a ladder frame of aluminum. This design balances the need for the pack to be as light as possible while also providing the strength and rigidity necessary for the harsh duty cycle of a bus. The battery packs meet an IP rating of IP67 & IP6K9K.

Safe service disconnect: In a non-operating mode, all contactors of the battery system are opened so the battery system is voltage free. Additionally, the electrical system within the battery has high voltage interlock loop (HVIL). The HVIL is a continuous low voltage circuit which passes through every high voltage connector so that if a LV or HV connector is unplugged, the circuit will be opened and the HV system will be disconnected by the battery management system. Maintenance on the battery system will be safe when the HV connector is unplugged.

Battery cells: The basic building block of the high-voltage battery pack is the individual cell. AKASOL has conducted a world-wide evaluation to identify the optimal battery cell for the transit duty cycle, and continues to seek out better cells as the technology improves.

Battery module: Cells are combined into battery modules which are connected in series within the pack. Each module also has voltage and temperature sensors that are communicated to a pack battery management module for full pack monitoring and control.

Battery management system: The battery management system (BMS) in each high voltage battery pack monitors all cell voltages, temperature, and other battery conditions and provides detection of any battery faults or damage. The pack BMS connects to the Multi-String Manager (MSM+), which is mounted on the powertrain compartment platform. The MSM+ monitors all the high-voltage battery packs, controls charging and discharging, and provides warnings of battery faults.

Battery cooling system: All high-voltage battery packs are liquid cooled or heated using ethylene glycol coolant. Coolant from the thermal management system is circulated through a cooling plate, which then cools or heats each module. The BMS monitors the battery cell temperatures and uses coolant flow control valves with the battery thermal management system to ensure all packs are maintained at the proper temperatures.

High-power contactors: Each high-voltage battery pack includes high-power electric contactors on both the positive and negative battery outputs. These contactors are used during normal operation to turn the high-voltage batteries on and off. In the event of a high-voltage interlock loop (HVIL) open circuit, these contactors disconnect the pack stored energy from the high-voltage system. When requested and all conditions are functioning properly, the contactors close and allow power to flow from the high-voltage battery. When the 24-volt supply is removed from the contactors—by the driver turning off the bus, by the HVIL system or high-voltage control system detecting a fault, by turning off the low-voltage battery disconnect switch, or by the high-voltage emergency disconnect switch in the rear of the bus—all contactors open to disconnect the high voltage stored energy of the batteries from the system.

Specifications:	
Supplier	AKASOL, Inc.
Rated capacity	98 kWh.
Usable capacity SOL (start of life)	Duty Cycle Dependent TBD
Warranty (see warranty agreement for terms and conditions)	Standard, 6 years (300,000 miles); optional, extended to total 12 years (500,000 miles).

GILLIG BATTERY ELECTRIC BUS
NEXT GENERATION BATTERY PACK SPECIFICATIONS

Chemistry	NMC Lithium Ion
Dimensions	1720 mm x 700 mm x 300 mm (excluding connectors)
Energy Nominal Usable BoL	98 kWh 88 kWh
Time to full charge	For 6 pack setup: 150 kW Plug-In Charge, 0-100% in ~4.5 Hrs 350 kW Plug-In Charge, 0-100% in ~2.5 Hrs 450 kW Pantograph, 0-100% in ~1.5 Hr
Operating voltage	540 – 756 V
Cooling	H_2O & Ethylene Glycol, 50:50
Ingress protection	IP67 / IP6K9K
Charging	Plug In, Pantograph, Inductive **CONFIDENTIAL**

GILLIG

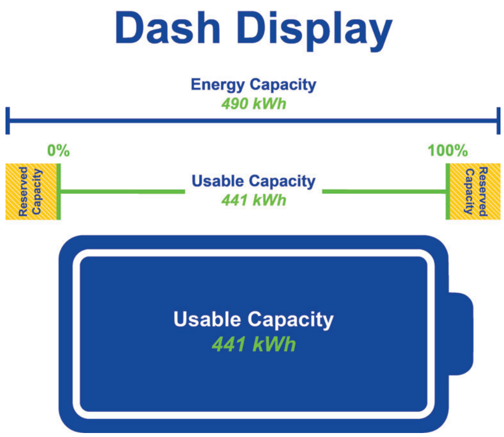
GILLIG BATTERY ELECTRIC BUS
AKASOL BATTERY WARRANTY
5 pack 490 kWh
6 pack 598 kWh
7 pack 686 kWh

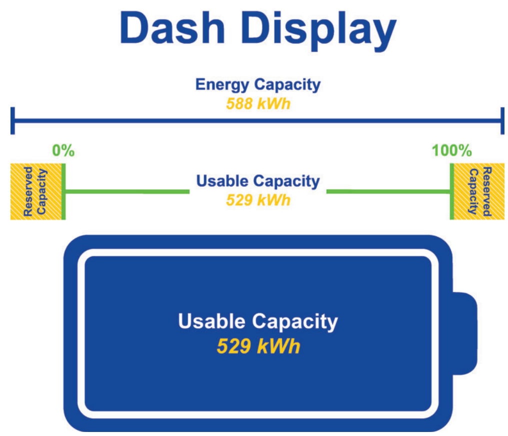
BASE WARRANTY

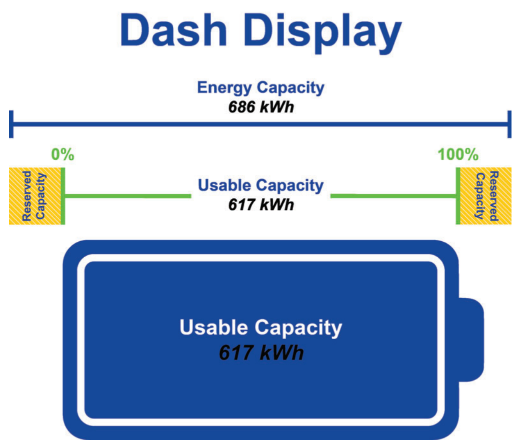
Available Depth of Discharge		90%
Warranty End of Life (SOH)		75%
Warranty Term (whichever comes first)	Time	72 Months
	Low Power Charging (up to 65A / pack)	175 MWh / pack
	High Power Charging (up to 120A / pack)	150 MWh / pack

ENERGY CAPACITY AND RANGE

Many factors determine the real-life range of an electric vehicle, which is derived from the net usable energy (or capacity) and the rate of energy consumption.







Rated Capacity

The rated capacity of a battery is the amount of total energy that can be stored in and discharged from the battery. Battery capacity reduces over the life of the cells as the impact of charging and discharging reduces the ability for the cells to reach full charge. Battery health is monitored by the battery management system and reported via telematics. The State of Health (SOH) is communicated as a percentage of the rated capacity at the start of life.

Reserved Capacity

Battery life is negatively impacted when cells are overcharged or when the depth of discharge is too low. In order to maximize high-voltage battery life, the capacity of the battery is limited to prevent discharge below 10% and charging above 90% of rated capacity. The charge controller prevents the batteries from being charged above the top limit, and derating protocols are in place to prevent the batteries from reaching the bottom limit.

Usable Capacity

The result of reserving some high-voltage battery capacity is that 90% of the rated capacity is available to power the vehicle. This is the usable capacity, and it is used for all calculations. The State of Charge (SOC) reported on the dashboard and via telematics represents the usable capacity remaining until a recharge is necessary.

Energy Consumption

Many factors impact the actual range of electric buses in operation. The duty cycle, route profile, and passenger loading determine how much energy is necessary to drive the traction motor and how much energy is captured through regenerative braking. Drivers can have a significant impact on energy consumption through how effectively they apply throttle and use regenerative braking to slow the bus. The HVAC system is also a significant use of energy on a bus, and settings (temperature set-points, fan speeds, etc.) can be optimized to reduce energy consumption.

Customer-specified equipment (passenger seats, windows, CAD/AVL, and video equipment, etc.) can have a large impact on total vehicle weight, which can also impact energy consumption. GILLIG has developed a Smart Spec that optimizes the range of the bus through component selection. More details are available for discussion during the pre-production meeting.

Range Estimates

Many factors determine the real-life range of an electric vehicle, consumption is derived from the net usable engery (or capacity) and the rate of energy consumption.

Configuration	High-Voltage Battery Packs, Qty	Total Rated Capacity	Range at 2.3 kWh/mile*
5 battery pack	5, each with 98 kWh	490 kWh	192 miles
6 battery pack	6, each with 98 kWh	588 kWh	230 miles
7 battery pack	7, each with 98 kWh	686 kWh	268 miles
*2.3 kWh is a conservative average energy consumption rate.			

GILLIG

Base: 5 Pack 490 kWh Range & Weight

Vehicle Specifications:

- 40’
- 5 pack configuration 490 kWh
- 315 tires
- Gen 3.0 Design
- 90% available depth of discharge

Vehicle Weights:

Curb Weight: 33,340
Seated Weight: 39,190
Gross Weight: 44,740
GVWR: 47,180

5 pack CW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	115	164	192
Ambient 68defF - HVAC On (Minimal)	177	225	218
Ambient 60degF - HVAC Fans Only	197	242	224

5 pack SW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	80	151	187
Ambient 68defF - HVAC On (Minimal)	119	204	227
Ambient 60degF - HVAC Fans Only	131	218	236

5 pack GW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	75	142	199
Ambient 68defF - HVAC On (Minimal)	108	189	245
Ambient 60degF - HVAC Fans Only	118	201	256

COMMON CONFIGURATION

Base: 5 Pack 490 kWh Range & Weight

Vehicle Specifications:

- 35'
- 5 pack configuration 490 kWh
- 315 tires
- Gen 3.0 Design
- 90% available depth of discharge

Vehicle Weights:

Curb Weight: 31,900
Seated Weight: 36,700
Gross Weight: 41,500
GVWR: 47,180

5 pack CW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	117	168	204
Ambient 68defF - HVAC On (Minimal)	182	232	233
Ambient 60degF - HVAC Fans Only	204	250	240

5 pack SW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	83	156	207
Ambient 68defF - HVAC On (Minimal)	125	214	256
Ambient 60degF - HVAC Fans Only	138	230	268

5 pack GW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	80	148	229
Ambient 68defF - HVAC On (Minimal)	119	200	290
Ambient 60degF - HVAC Fans Only	131	214	306

COMMON CONFIGURATION

GILLIG

Base: 6 Pack 588 kWh Range & Weight

Vehicle Specifications:

- 40’
- 6 pack configuration 588 kWh
- 315 tires
- Gen 3.0 Design
- 90% available depth of discharge

Vehicle Weights:

Curb Weight: 35,150
Seated Weight: 40,550
Gross Weight: 46,100
GVWR: 47,180

6 pack CW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	149	214	255
Ambient 68defF - HVAC On (Minimal)	222	285	287
Ambient 60degF - HVAC Fans Only	252	311	298

6pack SW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	139	197	234
Ambient 68defF - HVAC On (Minimal)	199	259	277
Ambient 60degF - HVAC Fans Only	224	281	290

6pack GW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	130	180	229
Ambient 68defF - HVAC On (Minimal)	181	232	270
Ambient 60degF - HVAC Fans Only	201	250	283

GILLIG

Base: 6 Pack 588 kWh Range & Weight

Vehicle Specifications:

- 35’
- 6 pack configuration 588 kWh
- 315 tires
- Gen 3.0 Design
- 90% available depth of discharge

Vehicle Weights:

Curb Weight: 32,900
Seated Weight: 37,700
Gross Weight: 42,480
GVWR: 47,180

6 pack CW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	149	214	255
Ambient 68defF - HVAC On (Minimal)	222	285	287
Ambient 60degF - HVAC Fans Only	252	311	298

6pack SW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	139	197	234
Ambient 68defF - HVAC On (Minimal)	199	259	277
Ambient 60degF - HVAC Fans Only	224	281	290

6pack GW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	130	180	229
Ambient 68defF - HVAC On (Minimal)	181	232	270
Ambient 60degF - HVAC Fans Only	201	250	283

COMMON CONFIGURATION

GILLIG

Base: 7 Pack 686 kWh Range & Weight

Vehicle Specifications:

- 40'
- 7 pack configuration 686 kWh
- 315 tires
- Gen 3.0 Design
- 90% available depth of discharge

Vehicle Weights:

Curb Weight: 36,570
Seated Weight: 41,970
Gross Weight: 47,520
GVWR: 48,200

7 pack CW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	171	242	296
Ambient 68defF - HVAC On (Minimal)	252	322	337
Ambient 60degF - HVAC Fans Only	285	352	349

7 pack SW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	159	223	280
Ambient 68defF - HVAC On (Minimal)	227	291	325
Ambient 60degF - HVAC Fans Only	254	315	340

7 pack GW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	148	204	266
Ambient 68defF - HVAC On (Minimal)	206	262	316
Ambient 60degF - HVAC Fans Only	228	282	332

COMMON CONFIGURATION

Base: 7 Pack 686 kWh Range & Weight

Vehicle Specifications:

- 35’
- 7 pack configuration 686 kWh
- 315 tires
- Gen 3.0 Design
- 90% available depth of discharge

Vehicle Weights:

Curb Weight: 34,270
Seated Weight: 39,100
Gross Weight: 43,900
GVWR: 47,180

7 pack CW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	171	242	296
Ambient 68defF - HVAC On (Minimal)	252	322	337
Ambient 60degF - HVAC Fans Only	285	352	349

7 pack SW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	159	223	280
Ambient 68defF - HVAC On (Minimal)	227	291	325
Ambient 60degF - HVAC Fans Only	254	315	340

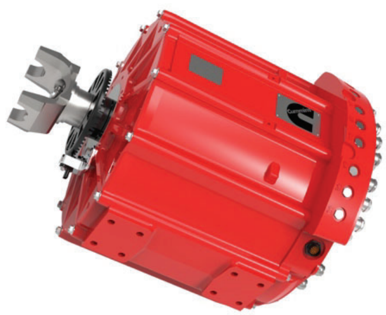
7 pack GW	Manhattan	Orange County	HD-UDDS
Ambient 110degF - HVAC On	148	204	266
Ambient 68defF - HVAC On (Minimal)	206	262	316
Ambient 60degF - HVAC Fans Only	228	282	332

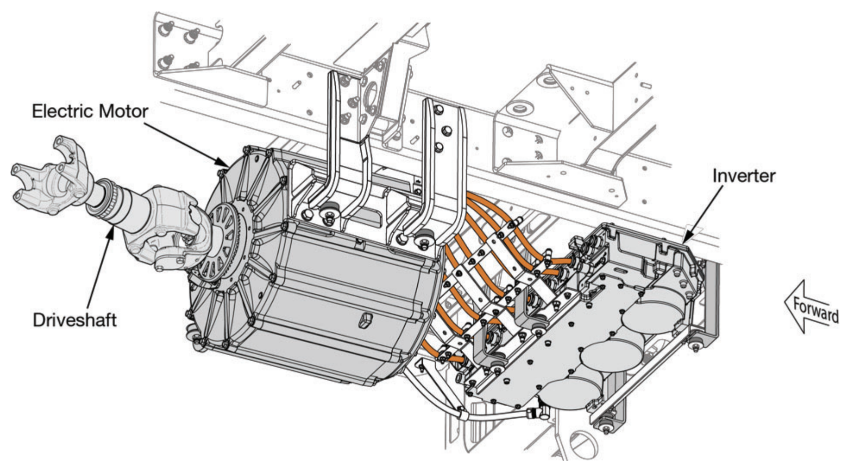
COMMON CONFIGURATION

TRACTION MOTOR

The GILLIG Battery Electric Bus is driven by the Cummins electric traction motor. The high-torque, direct-drive, 9-phase permanent magnet alternating current (PMAC) traction motor drives a single-reduction rear axle and achieves high power density and power efficiency. The electric traction motor is coupled directly to a standard driveline and rear axle to provide traction power and regenerative braking. With the direct drive system, there is no motor-mounted gear reduction or transmission required.

The traction motor is located behind the rear axle to offer easy vertical installation/removal of motor and inverter. It is liquid-cooled by the electronics cooling package using ethylene glycol coolant. It also requires significantly less maintenance than conventional engines—this means no more oil changes, air filter changes, emissions after-treatment services.





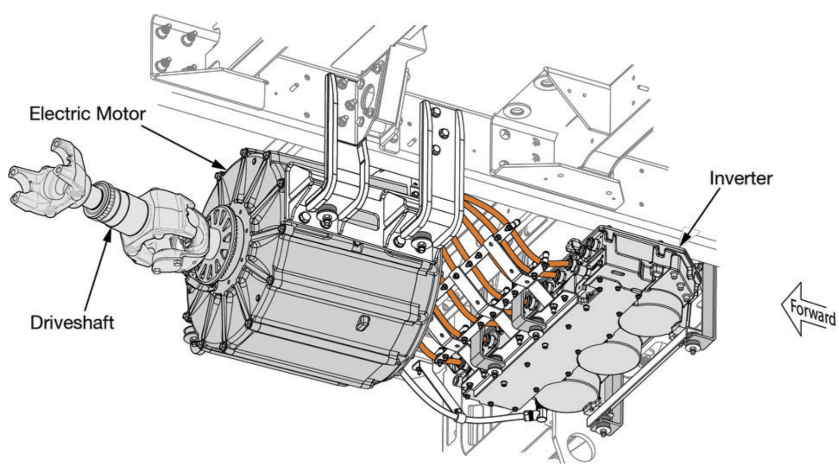
Specifications	
Supplier	Cummins.
Motor type	9-phase permanent magnet alternating current (PMAC).
Drive type	Direct drive.
Operating voltage	Nominal 660 VDC; operating range 610 to 750 VDC.
Maximum mechanical output torque	2,582 ft lb (3,500 N-m) for 30 seconds.
Continuous output torque	1,519 ft lb (2,060 N-m).
Maximum mechanical output power	470 hp (350 kW) for 30 seconds.
Continuous mechanical output power	262 hp (195 kW).
Normal operating range	0 to 3,400 rpm.
Peak power	245 kW (328 hp).
Derating range	3,400 to 3,600 rpm.
Ingress protection	IP67.
Warranty (see warranty agreement for terms and conditions)	Standard: 3 years (100,000 miles).

TRACTION MOTOR INVERTER

The Cummins traction motor inverter controls the motor speed and power per the driver's actions. It converts high-voltage DC power from the batteries, via the junction box, into 9-phase AC power for the traction motor to drive the bus.

The traction motor inverter also works in regenerative braking mode to convert 9-phase AC from the traction motor back to high-voltage DC, which is then used to recharge the high-voltage batteries.

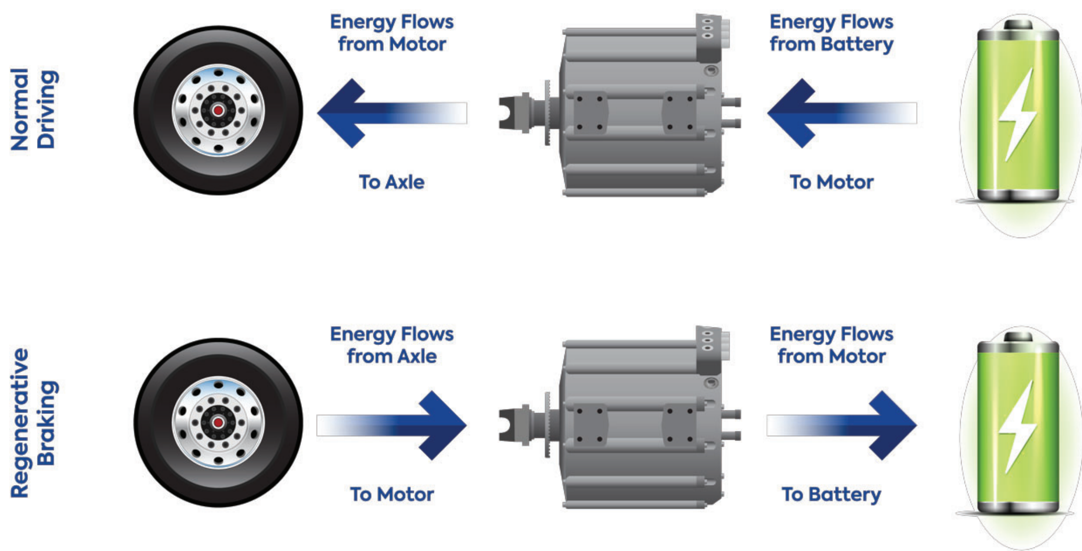
The traction motor inverter has a cast aluminum housing and is chassis-mounted directly behind the traction motor. Cooling of the traction motor inverter is provided by the electronics cooling package (ECP).



REGENERATIVE BRAKING

The GILLIG Battery Electric Bus uses regenerative braking (regen) to extend braking system life as well as to improve vehicle range and efficiency.

Under normal driving conditions, the high-voltage batteries provide energy to the traction motor to propel the bus. During regen, this energy flow is reversed, and the traction motor uses the vehicle's momentum when it is coasting, slowing down, or braking to recover energy. By driving the traction motor with the rear axle, the traction motor functions as a generator and recharges the high-voltage batteries.



This contrasts with conventional braking systems, where the excess kinetic energy is converted to wasted heat in the brakes, and with transmission retarders, where energy is converted to heat and immediately dissipated by the radiator.

Regen is controlled through the throttle pedal position. When the pedal is at the 10% position, the regen begins to apply. The amount of regen increases until the throttle pedal pressure is fully released and 100% of the regen is applied. As the bus coasts, the resistance created by the traction motor as it recovers the energy slows the bus. As a result of this slowing, less energy must be captured by the service brakes and, as such, the life of the braking system on a vehicle utilizing regen is longer than that of an equivalent vehicle without regen.

Regen programming is calibrated to provide the maximum amount of energy recovery while maximizing driveablity and passenger comfort. The driving practices of operators also have a significant impact on how much energy the bus can recover through regen because smooth stops and slow decelerations maximize energy recovery.

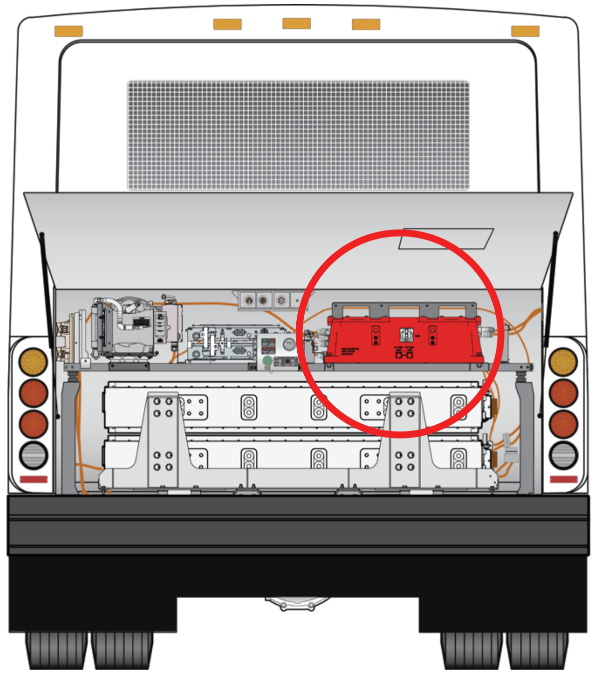
Regen Disable Switch

The regen disable switch allows the driver to deactivate regen when road conditions dictate that its use should be limited. However, use of the regen disable switch should be minimized to take full advantage of the energy recovery benefits of regen.

The regen disable switch is located just rear of the driver's seat on the left dash panel. It is out of the direct view of the driver, providing both ready access as well as a location that discourages use unless required. An indicator lamp on the dash is illuminated when regen is disabled and also tracked through the telematics system for additional monitoring.

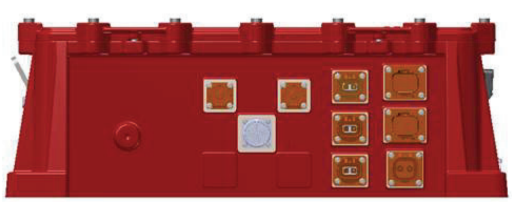
HIGH-VOLTAGE DC JUNCTION BOX

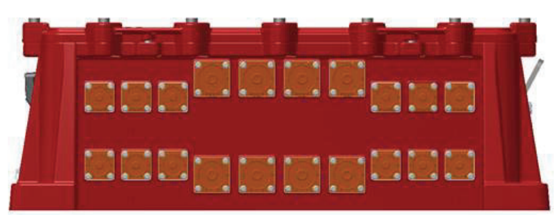
The Cummins-supplied high-voltage DC junction box connects all the high-voltage battery packs in parallel, provides connections to all the charge inlets (plug-in and, if equipped, overhead or chassis-mounted inductive), and distributes high-voltage DC to the traction motor inverter and all high-voltage DC power accessories such as the HVAC, the air compressor, DC/DC converters, and the coolant heater. The box is located in the powertrain compartment.



The cast-aluminum housing has toolless high-voltage DC connectors, which are keyed to prevent incorrect connections. Keyed connections have keys or ribs on the receptacle on the junction box connectors that match keys or ribs on the connectors on the cable.

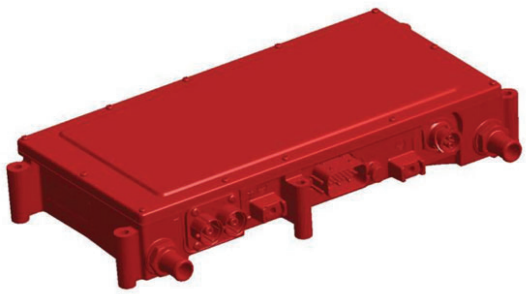
The high-voltage junction box has a high-voltage disconnect switch, which provides a method to manually disconnect the high-voltage batteries in case of an emergency and as part of the lockout/tagout (LOTO) procedure. If required due to an emergency, the switch can safely disconnect the high-voltage batteries under a full load condition. No personal protective equipment is required to operate this two-position rotary switch, with its ON and OFF position.

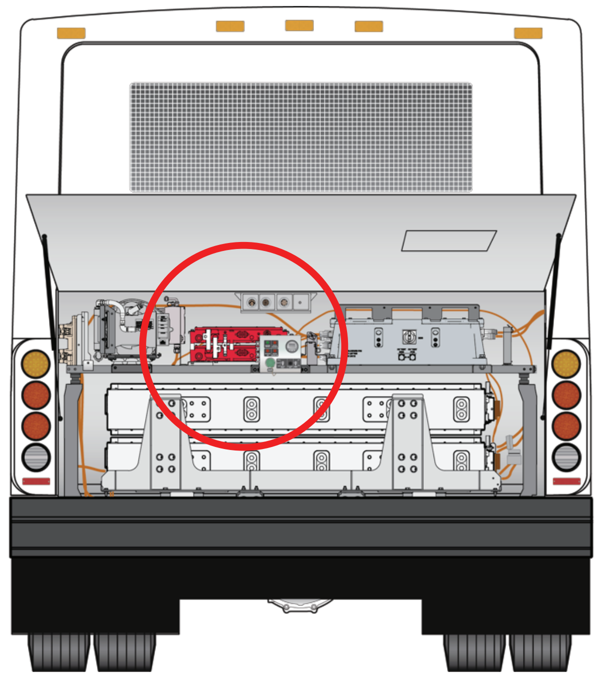




DC/DC CONVERTER

The DC/DC converter converts high-voltage direct current from the high-voltage batteries to low-voltage 24 VDC to supply the 12- and 24-volt systems, such as low-voltage batteries, the power steering pump, and the electronics cooling package (ECP).





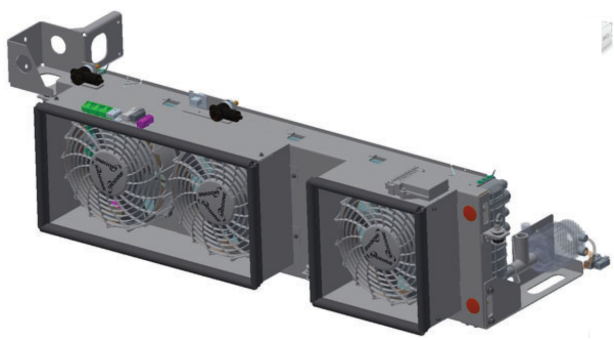
Two DC/DC converters are wired in parallel to provide the required low-voltage system capacity. The DC/DC converters are liquid-cooled by the ECP using ethylene glycol coolant.

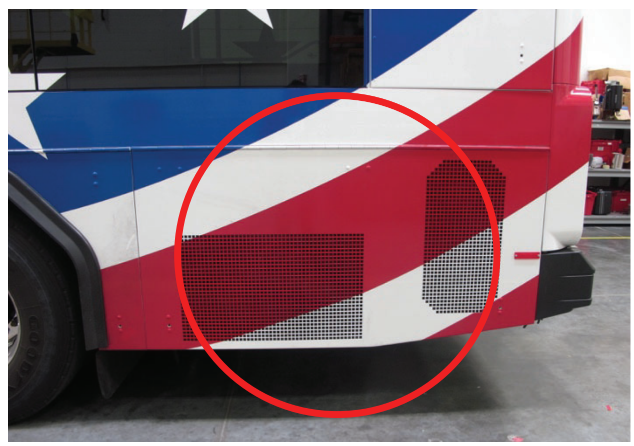
The two units are located together on the powertrain compartment platform.

Specifications	
Supplier	Cummins.
Input	Voltage: 450 to 750 VDC. Current: 10 A each; 20 A for both.
Output	Voltage: Adjustable 27–29 VDC voltage from the DC/DC converters is adjustable to meet the voltage requirements of the low-voltage batteries being used. Power: Continuous, 7.5 kW per converter; 15.0 kW total. Current: 270 A per converter; 540 A total.
Cooling	Liquid cooled by the ECP with ethylene glycol coolant.
IP rating	IP6K9K.
Warranty	3 years/100,000 miles.

The power electronics that convert between AC and DC and various voltages (high voltage, 12 V, 24 V) generate waste heat due to the inefficiencies of the conversion process. In order to cool these components, pressurized coolant is circulated through a streetside, rear-mounted electronics cooling package (ECP). A 24 VDC coolant pump circulates the coolant through the traction motor, traction motor inverter, and DC/DC converters.

The coolant flows through these components capturing the waste heat and is then fed into a single-pass aluminum-core, air-cooled Modine radiator. Hot coolant enters the radiator through the forward tank, circulates through the core, and returns to the pump through the rear tank. The system utilizes three 12-inch, 24 VDC variable-speed brushless electric fans to pull ambient air from outside the bus over the radiator fins to dissipate the heat as directed by the System Control Module. The use of ambient air to cool the coolant rather than via refrigerant decreases overall vehicle energy consumption as less energy is required to run the fans than would be required for an HVAC-style compressor. Furthermore, the variable fan speeds are managed carefully to provide the necessary level of cooling with the least amount of energy required.





The ECP assembly is mounted on chassis outriggers on the streetside of the bus behind the rear axle, where rubber vibration mounts isolate it from chassis vibrations. This location is consistent with the location of the radiator package utilized on GILLIG conventional engine buses and has proven to be an effective location for capturing relatively clean ambient air for this application.

The ECP is built upon Modine's vast experience with engine radiators and electronic cooling. The fans are fully sealed to prevent water intrusion, the aluminum core and body construction are designed to minimize corrosion exposure, and the system is constructed for minimal weight. Similar to conventional radiators, the ECP includes a fan reverse feature to allow for debris to be blown out of the system, and fans are programed to stay on for a minimum of 30 seconds at a time to prevent excessive thermal cycling.

A three-quart, stainless-steel surge tank located behind an access panel above the radiator is integrated into the system to maintain pressure within the system and release excess pressure as the coolant heats. A manual pressure relief valve allows for safe relief of system pressure to perform system maintenance and inspections, and the surge tank can be used to top up coolant levels when the integrated sight tube shows such a fill is necessary. The bus also includes provisions for a pressurized coolant fill when a full system fill is required.

Specifications	
Supplier	Modine.
Radiator core	Modine louvered fin, 14 fin/in., aluminum core face area. Single pass with horizontal coolant flow. Coolant inlet at forward edge, coolant outlet at rear edge.
Surge tank	Remote-mounted, streetside, above ECP. Stainless steel; capacity 3 quarts. Access by hinged door with square key lock.
Coolant	Ethylene glycol.
Electric cooling fans	Pusher type, mounted outside radiator cores, pushing air through core. Electrical specifications: 24 VDC, brushless, variable speed via CAN. Fan diameter: 12 in. Fan quantity: 3.
Coolant fill	Bottom pressure fill. Coolant fill connector: quick coupler type.
Warranty	3 years, parts and labor.

HVAC AND THERMAL MANAGEMENT SYSTEM

During the development of the GILLIG Battery Electric Bus, we identified the HVAC and the high-voltage battery cooling as two systems requiring additional focus, given the significant impact they have on the overall energy consumption of the vehicle. We partnered with Thermo King to develop a single unit that integrates the battery thermal management and HVAC systems. Through this integration, the compressor, condenser, and heating elements can be shared for both systems, reducing redundant components and allowing more efficient use of the systems.

This system provides heating and cooling for both the passenger compartment and the high-voltage battery packs during driving and charge cycles.

The air conditioning and heating system is designed to maintain a pleasant environment in the bus by providing cooled and heated air, reducing humidity, and supplying an adequate amount of draft-free air.

The battery thermal management system is designed to automatically heat or cool the coolant that is supplied to all the high-voltage batteries as required. The coolant will warm the batteries in very cold ambient temperatures and cool the batteries in warm ambient temperatures while charging and during bus operation.

Roof-mounted HVAC refrigerant condenser

HVAC unit with integrated thermal management system

Air conditioning systems use a refrigerant that changes states between a liquid and a gas at different places in the system. The liquid refrigerant absorbs a great amount of heat when it boils and becomes a gas. When this gas is compressed and condensed back to a liquid state, the absorbed heat is given up. With the proper closed system of evaporator, condenser, compressor, expansion valve, and temperature control, the refrigerant becomes a very effective medium for heat transfer. The system utilizes R470C refrigerant. The following are the major components of the air conditioning system.

Evaporator and Heater Core: Several heat exchangers are integrated in the main HVAC unit. The HVAC and battery thermal management system each have their own refrigerant evaporator and coolant heater cores to cool and heat their respective circuits (air for the passengers and coolant for the high-voltage batteries). Heated coolant is provided by the chassis-mounted coolant heater.

One evaporator transfers heat from the bus interior to the refrigerant. Interior air is drawn from the bus through the return air grille in the rear bulkhead, passed through a washable filter, then travels through the evaporator coil and heater core, where it is cooled, heated, and/or dehumidified, according to the selected mode of system operation. Dehumidification occurs when humid air is passed over the cold evaporator, so that moisture in the air condenses on its surface. This water drips off the evaporator and is channeled to drain hoses in the powertrain compartment. Conditioned air is then discharged out to the passenger area through the air ducts on both sides of the bus interior.

The other evaporator transfers heat from the battery coolant to the refrigerant, keeping the high-voltage batteries at their optimal operating temperature even in warm environments and/or high-current situations. The battery TMS has a second heat exchanger that transfers heat from the heated HVAC coolant to the battery coolant to maintain battery temperatures in cold environments. By utilizing heat from the HVAC coolant, a dedicated battery heater is not required. This saves weight, cost, and improves overall vehicle efficiency. The unit is capable of switching between cooling and heating the batteries depending on operating conditions and independently of HVAC demands.

Condenser: Transfers heat from the refrigerant to the outside air by drawing cool ambient air through both sides of the roof-mounted condenser and circulating the air through the condenser coil. The hot air is then exhausted out the top of the condenser unit.

The roof-mounted condenser is sized for full cooling capacity up to 120ºF (49ºC) ambient temperature; that is, the unit can maintain 70ºF (21ºC) interior temperatures and proper battery coolant temperatures simultaneously. The roof-mounted location provides unrestricted airflow through the cores, improving performance.

Compressor: Raises the pressure and temperature of the refrigerant and forces it into the condenser.

The electric scroll compressor supplies both the passenger and high-voltage battery cooling circuits. An integrated electric high-voltage DC/AC inverter allows the compressor output to be automatically adjusted to match the required load, which improves energy efficiency.

Expansion Valve: Reduces the temperature of the refrigerant and meters the flow of refrigerant to each evaporator. One expansion valve regulates the output of the HVAC evaporator, and one regulates the battery TMS evaporator.

A single variable-speed 24 VDC pump provides coolant flow to all of the high-voltage battery packs. Each battery pack can individually modulate the pack coolant flow using the flow control valve in the battery pack.

All electric fans and the blower use brushless 24 VDC motors rated at a minimum of 40,000 hours.

The HVAC system is controlled by the Thermo King IntelligAIRE III, an advanced bus climate-control system that can be programmed for either manual or automatic operation. The IntelligAIRE's modular configuration, connected via CAN to the vehicle's J1939 network, offers the user great flexibility for configuration, reduces the number of electrical connections, and significantly reduces vehicle weight.

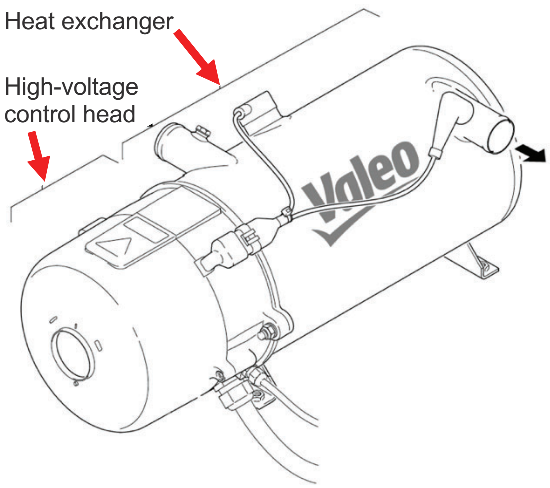
The HVAC system is one of the largest users of energy on an electric vehicle, and agency-specific decisions can greatly impact the energy consumption of the bus. By reducing the heating and cooling load requirements by adjusting the temperature set points closer to the outside temperature, agencies can significantly increase their operational range.

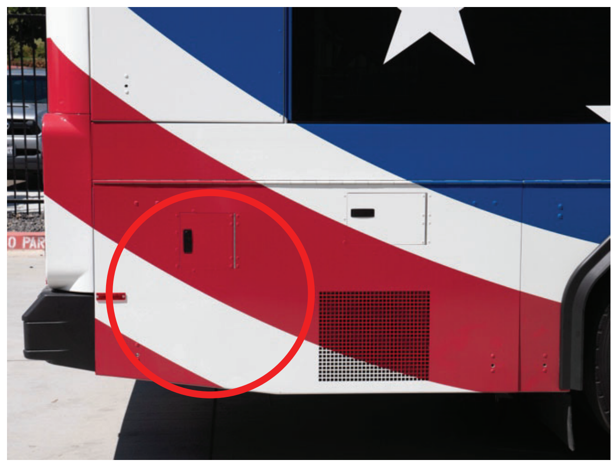
Specifications	
Supplier	Thermo King.
Model	TE18.
Cooling capacity	91,000 Btu/hr total system capacity (71,000 to 96,000 Btu/hr for passengers and up to 25,000 Btu/hr for batteries)
Heat capacity	68,000 to 94,000 Btu/hr (actual output depends on coolant heater selection)
Air flow	2,400 CFM at full speed.
Refrigerant type	R407C.
Warranty	3 years, parts and labor.

ALL-ELECTRIC COOLANT HEATER

Early in the development of GILLIG's Battery Electric Bus, the passenger compartment and high-voltage battery heating strategy was an area of focus. As electric heating can account for a significant portion of the overall energy consumption of an electric vehicle, GILLIG wanted to ensure that the vehicle was able to deliver the level of heating performance necessary to meet transit demand in the most economical manner possible.

The battery thermal management system, the main HVAC unit, the auxiliary driver's heater, and optional floor-mounted and threshold heaters all require heat output. GILLIG weighed the relative benefits of electric, grid-based heaters in each of these applications against a heated coolant-based system with a centralized, independent heat source and determined that from a safety, efficiency, fleet commonization, cost and packaging standpoint, the coolant-based system was optimal. GILLIG selected the Valeo Thermo DC 200 all-electric heater to provide the coolant heat.





The electric head is 100% emission-free, allowing for both quiet operation and heating in enclosed spaces without exhaust fumes. The heater is suitable for heating at very low temperatures down to 0°F (–18°C).

Heating cartridges are responsible for the generation of heat by electric current flowing into the unit and are part of the heat exchanger. They are therefore integrated directly into the coolant circuit and, as a result, the generated heat can pass into the cooling circuit without loss.

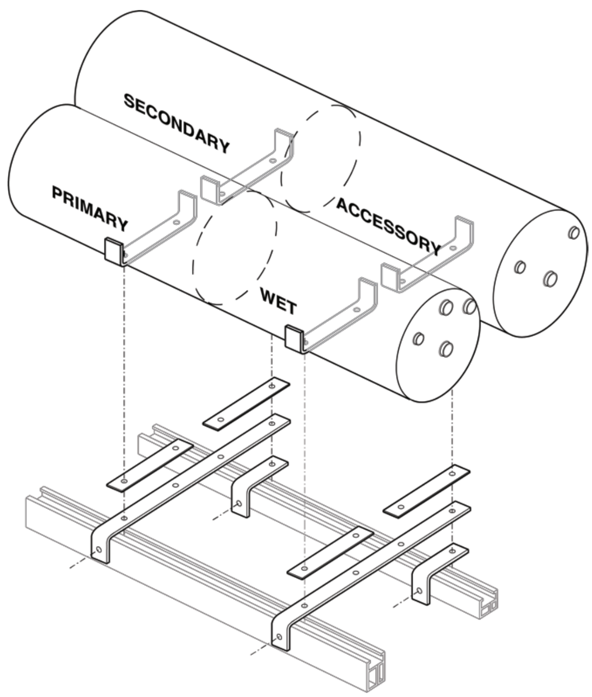
This heater is located on the rear curbside of the bus, chassis-mounted below the powertrain compartment batteries. This location provides for impact protection and access for service and inspections.

Specifications	
All-electric coolant heater	Supplier: Valeo. Model: Thermo DC 200. Heat output: 20 kW (68,280 Btu/hr). Supply voltage (HV): 600–750 VDC. Supply voltage (LV): 24 VDC.
Warranty	2 years.
A dual-mode electric/diesel coolant heater is also available.	

AIR SYSTEM OVERVIEW

The air system provides and maintains compressed air to operate the service brakes, emergency/parking brakes, suspension system, passenger door, and the driver's seat. The system is composed of an air compressor, air governor, air dryer, air reservoir tanks, overpressure (relief) and check valves, and the tubing, hoses, and fittings necessary to connect all the components.

The air compressor provides compressed air to the air dryer. The air governor senses the air pressure in the air reservoirs and operates to maintain pressure in the system. When the air pressure reaches a preset lower limit, the air governor turns on the air compressor until the preset upper limit is reached and the air compressor is shut off. The air dryer removes moisture from the compressed air. Accumulated moisture is regularly expelled from the air dryer onto the ground beneath the bus.



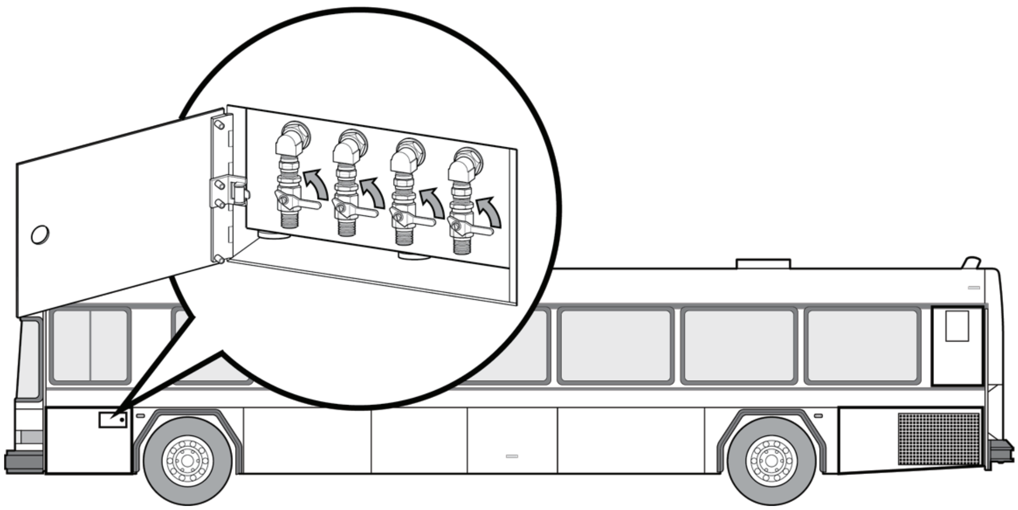
The four air reservoirs are located in a ceiling compartment in the front section of the bus. There are two tanks, each partitioned into two separate reservoirs, providing four separate reservoirs. These reservoirs are, in order of priority, the wet tank, the primary tank, the secondary tank, and the accessory tank. The primary and secondary tanks supply the rear and front brakes, respectively. Air from the accessory supply tank operates the suspension system, the passenger doors, and the driver's seat. The air reservoirs also serve to cool the air and condense water and oil vapors out of the compressed air. Most of this condensation takes place in the air dryer and the wet supply reservoir. The GILLIG air system is FMVSS 121, Air Brake Systems compliant.

Most of the air system uses nylon air brake tubing. This tubing meets SAE J844, Non-metalic Air Brake System Tubing and FMVSS 106, Brake Hoses, requirements and is flexible, durable, and weather resistant. GILLIG utilizes the following hose colors:

- Green indicates primary system, which supplies the rear axle brakes
- Red indicates secondary system, which supplies the front axle brakes
- Brown indicates parking brake system
- Yellow indicates air compressor governor signal
- Black indicates accessories and drain lines

GILLIG utilizes a #16 Teflon hose for the air delivery line from the air compressor to the air dryer. Nylon tubing cannot be used due to the high temperature of the air delivered by the air compressor.

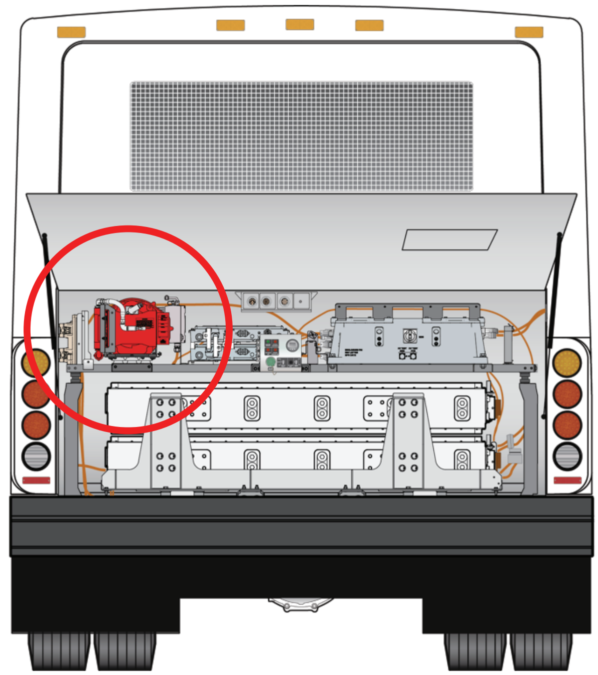
Each reservoir has a check valve at the supply port to maintain pressure in that tank if other reservoirs or air lines were to leak. Each tank is also fitted with a standard manual drain valve. These quarter-turn drain valves are mounted streetside and conveniently located waist high for ease of maintenance, just below the driver's side window with access through a door located in the front streetside skirt panel. The drain lines discharge at street level below the floor of the bus.



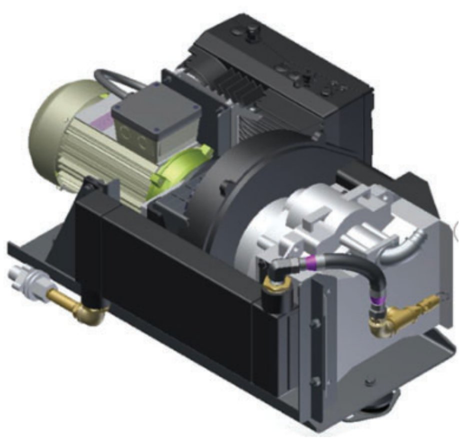
Specifications		
Air Reservoir	**Purpose**	**Volume**
Wet	Cool and dry the air prior to filling other reservoirs	1,450 in.^{3}
Primary	Supplies air to rear service brakes and parking/emergency brake system	1,716 in.^{3}
Secondary	Supplies air to front service brakes and parking/emergency brake system	2,095 in.^{3}
Accessory	Supplies air to the suspension system, the passenger doors and the driver's seat	1,090 in.^{3}

AIR COMPRESSOR

An air compressor is driven by an electric motor and provides compressed air to the air dryer. The Powerex air compressor uses an oil-less scroll compressor. A scroll compressor pushes air through increasing smaller air pockets, increasing the pressure with each successive pocket. Scroll compressors are quieter and smoother than reciprocating compressors because they have only one moving part: an orbital scroll. This also makes the scroll compressor more efficient, reliable, and durable than a reciprocating compressor. By using an oil-less compressor, the air does not become contaminated with oil or oil vapor that would have to be cleaned by the air dryer. This results in less demand on the dryer and therefore lower lifecycle costs and power consumption.



The air compressor is mounted on a vibration-dampened bracket on the powertrain compartment platform in the rear of the bus. The air compressor is supplied with high-voltage DC from the high-voltage DC junction box. A DC/AC inverter is integrated into the compressor assembly to provide 350-V three-phase power to the electric motor.



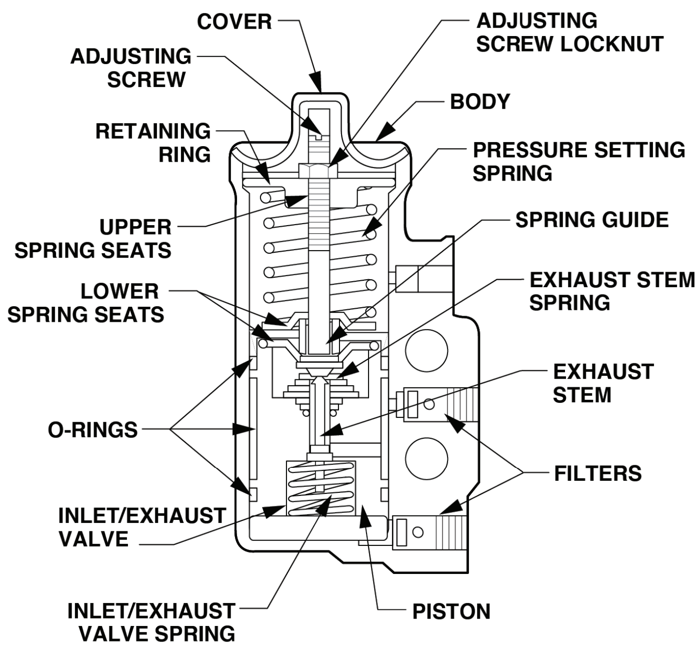
Specifications	
Supplier	Powerex
Compressor type	Oil-less scroll
Input voltage	600–750 VDC
CFM capacity	12 CFM @ 120 PSIG

AIR GOVERNOR

The Bendix D-2 air governor, operating in conjunction with the air compressor unloading mechanism, automatically controls air pressure in the air brake or air supply system between the predetermined maximum (cut-out) and minimum (cut-in) pressures. The air compressor is controlled by the governor, which stops or starts compression when the maximum or minimum reservoir pressures are reached.

Reservoir air pressure enters the Bendix D-2 governor at one of its reservoir ports and acts on the piston and inlet/exhaust valve. As the air pressure builds up, the piston and valve move together against the resistance of the pressure-setting spring. When the reservoir air pressure reaches the cut-out setting of the governor, the exhaust stem seats on the inlet/exhaust valve, closing the exhaust passage, and then opens the inlet passage. Reservoir air pressure then flows around the inlet valve, through the passage in the piston, and then pressurizes the unloader port. A pressure switch connected to the unloader port measures this pressure; when it is pressurized, it turns off the air compressor.

As the system reservoir air pressure drops to the cut-in setting of the governor, the force exerted by the air pressure on the piston is reduced so that the pressure-setting spring moves the piston down. The inlet valve closes, and the exhaust opens. With the exhaust open, the air in the unloader line escapes back through the piston, through the exhaust stem, and out the exhaust port.



AIR DRYER

The Bendix AD-IP (Integral Purge Air Dryer) collects and removes air system contaminants in solid, liquid, and vapor form so that clean, dry air is delivered to the wet tank reservoir and then to the other three air reservoir tanks. Because clean, dry air is used through the system, component life is increased, which reduces maintenance costs.

The AD-IP Air Dryer consists of a desiccant cartridge secured to a die-cast aluminum end cover with a single, central bolt. The end cover contains a check valve assembly, safety valve, heater, and thermostat assembly; three pipe thread air connections; and the purge valve assembly. The removable purge valve assembly incorporates the purge valve mechanism. The dryer is chassis-mounted, curbside, and is accessible from either under the bus or through the hinged skirt panel; all replaceable assemblies can be replaced without removal of the air dryer from its mounting on the vehicle.

The AD-IP air dryer alternates between two operational modes or cycles during operation: the charge cycle and the purge cycle.

When the compressor is loaded (compressing air), compressed air, water, and water vapor flow through the compressor discharge line to the supply port of the air dryer body. As air travels through the end cover assembly, its direction of flow changes several times, reducing the temperature, causing contaminants to condense and drop to the bottom or sump of the air dryer end cover.

After exiting the end cover, the air flows into the desiccant cartridge. Once in the desiccant cartridge, air first flows through an oil separator located between the outer and inner shells of the cartridge. The separator removes water as well solid contaminants.

Air, along with the remaining water vapor, is further cooled as it exits the oil separator and continues to flow upward between the outer and inner shells. Upon reaching the top of the cartridge, the air reverses its direction of flow and enters the desiccant drying bed. Air flowing down through the column of desiccant becomes progressively drier as water vapor adheres to the desiccant material in a process known as adsorption. The desiccant cartridge, using the adsorption process, typically removes most of the water vapor from the pressurized air.

Dry air exits the bottom of the desiccant cartridge and flows through the center of the bolt used to secure the cartridge to the end cover. Air flows down the center of the desiccant cartridge bolt, through a cross-drilled passage, and exits the air dryer delivery port through the delivery check valve.

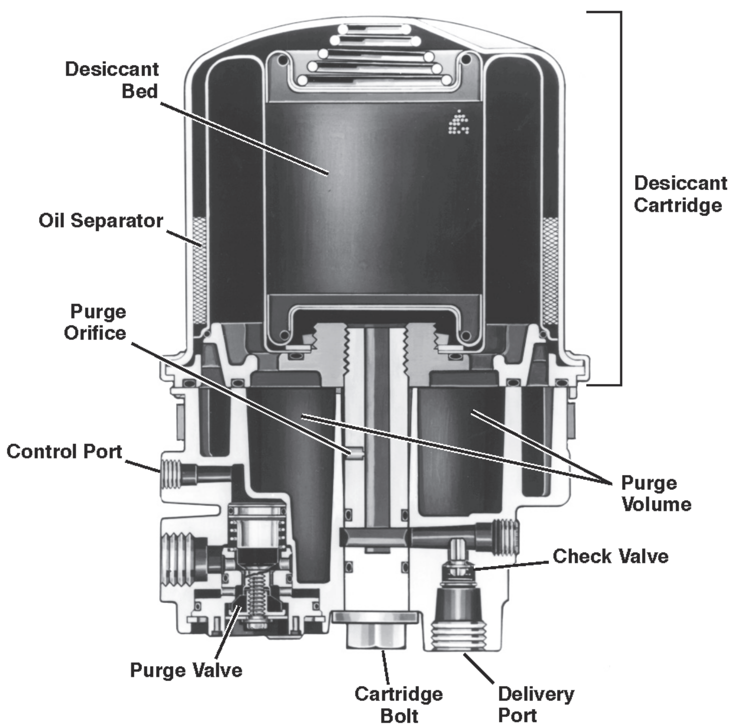
Dry air flowing through the center of the desiccant cartridge bolt also flows out the cross-drilled purge orifice and into the purge volume.

The air dryer remains in the charge cycle until the air system pressure builds to the governor cut-out setting.

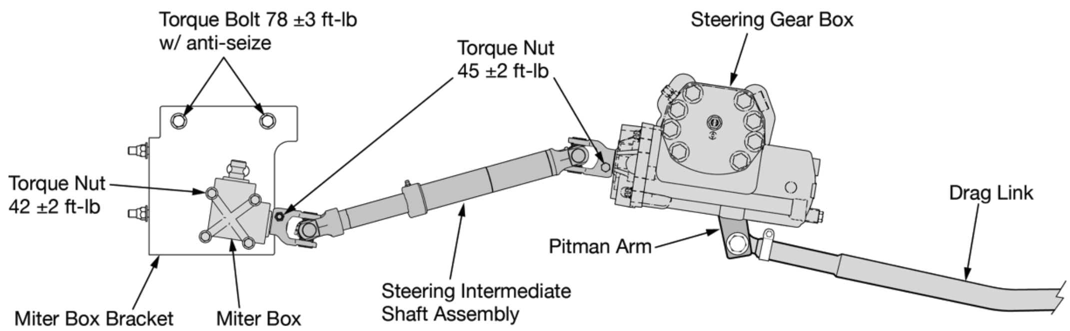
As air system pressure reaches the cut-out setting of the governor, the governor unloads the compressor (air compression is stopped) and the purge cycle of the air dryer begins. When the governor unloads the compressor, it pressurizes the compressor unloader mechanism and the line connecting the governor unloader port to the AD-IP end cover control port. The purge piston moves in response to air pressure, causing the purge valve to open to the atmosphere and the turbo cut-off valve to close off the supply of air from the compressor. Water and contaminants in the end cover sump are expelled immediately when the purge valve opens. Also, air that was flowing through the desiccant cartridge changes direction and begins to flow toward the open purge valve. Solid contaminants collected by the oil separator are removed by air flowing from the purge volume through the desiccant drying bed to the open purge valve.

The initial purge and desiccant cartridge decompression lasts only a few seconds and is evidenced by an audible burst of air at the AD-IP exhaust.

The actual reactivation of the desiccant drying bed begins as dry air flows from the purge volume through the purge orifice in the desiccant cartridge bolt, then through the center of the bolt and into the desiccant bed. Pressurized air from the purge volume expands after passing through the purge orifice; its pressure is lowered, and its volume increased. The flow of dry air through the drying bed reactivates the desiccant material by removing the water vapor adhering to it.

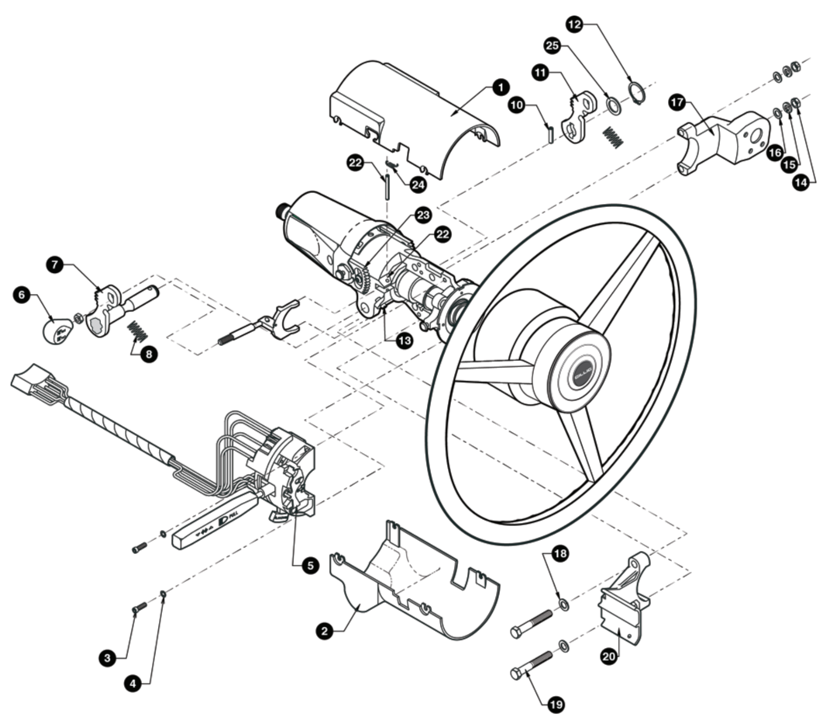


GILLIG Low Floor buses utilize a hydraulically assisted power steering system consisting of the steering wheel, steering column and shaft assembly, steering gear, pitman arm, drag link, and tie rod. An electric hydraulic pump, reservoir, and interconnecting hydraulic lines and hoses are also used in the system.



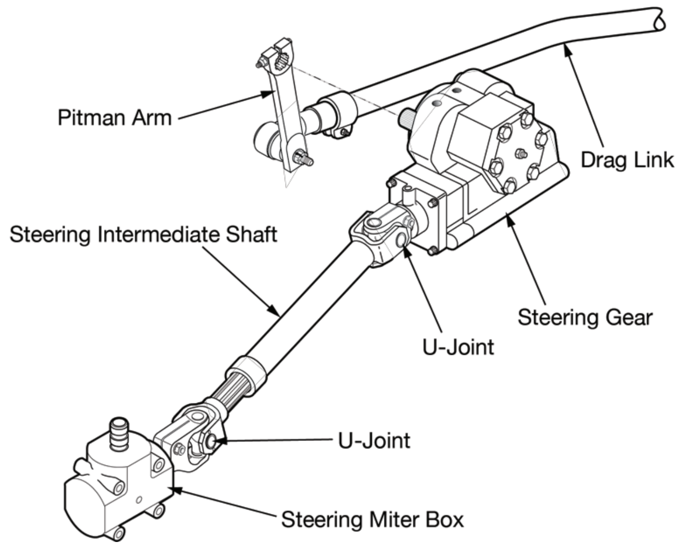
Steering Box Components

The steering wheel is a three-spoke type, constructed of plastic resin over a steel framework. The horn button is mounted in the center of the wheel. The Douglas 900 series steering column is adjustable in two directions—up and down and fore and aft. An intermediate steering shaft connects the miter box to the steering gear.



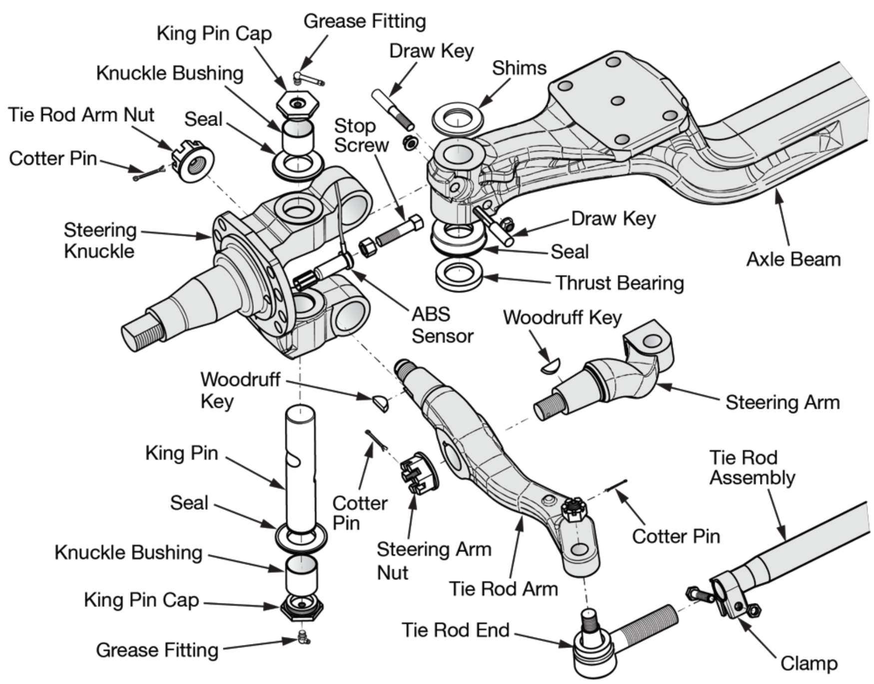
Steering Column and Wheel

The hydraulically assisted steering gear assembly is mounted on a bracket attached between the forward two outriggers on the streetside of the chassis, directly beneath the driver’s platform.



Miterbox/Steering Shaft/Steering Gear Box

The left steering arm and the left and right tie rod arms are secured to the steering knuckles at one end and to a drag link or tie rod at the other. The arms are retained with a key in the steering knuckle in the fixed angular position necessary for proper steering.



Steering Knuckle Assembly

GILLIG utilizes the ZF Model TAS85 steering gear box. The frame-mounted steering gear is a recirculating ball type and contains an integral power cylinder and control valves. A hydraulic supply line connects the steering gear to the electrically driven hydraulic pump, which pulls from the reservoir, and a return line routes fluid from the steering gear back to the reservoir. The hydraulic steering gear system is equipped with two poppet valves, on at each end of the rack piston, to allow pressure relief when the steered wheel approaches the axle stop. When the poppet valves are tripped, pressure is reduced in the steering gear and thus helps to reduce heat generated by the pump and prolongs the service life of the pump.

The hydraulic system consists of a 5.1-quart hydraulic reservoir (to hold the supply of hydraulic fluid) and an electric motor-driven hydraulic pump (to provide the required flow and pressure to the steering gear). The power steering pump is a 24 VDC brushless, permanent magnet motor with variable speed capability and fault diagnosis. The use of the low-voltage system to drive the pump allows it to continue to function in case of a high-voltage power loss.

Specifications	
Steering wheel	Standard: 20-in. (51-cm) diameter, hard plastic. Optional: 20-in. (51-cm) diameter, VIP padded, three-spoke. Optional: 16-in. (41-cm) diameter VIP padded. For use only with ZF EZ Steer column.
Steering column	Standard: Douglas 900 series with adjustable telescoping length and single-tilt steering wheel angle adjustment. Optional: ZF EZ Steer with electric assistance. Requires 16-in. (41-cm) diameter VIP padded steering wheel.
Miter box	Supplier: ZF.
Steering gear	Supplier: ZF. Model: GHP86 Hydraulic fluid: Allison Transynd.
Power steering pump	Supplier: Concentric. Model: IGP

HYDRAULIC SYSTEM

The hydraulic system furnishes hydraulic pressure to the steering gear to steer the front wheels. The system consists of a fluid reservoir, power steering hydraulic pump, steering gear, and associated hoses. These components can be accessed through the streetside battery box compartment.

Hydraulic fluid is stored in the hydraulic reservoir. The hydraulic pump provides constant flow to the steering gear at variable pressure. Fluid leaving the steering gear is returned directly to the reservoir.

The 24 V electric hydraulic power steering pump provides hydraulic pressure to the power steering gear. The hydraulic pump mounts to, and is driven from, the electric motor.

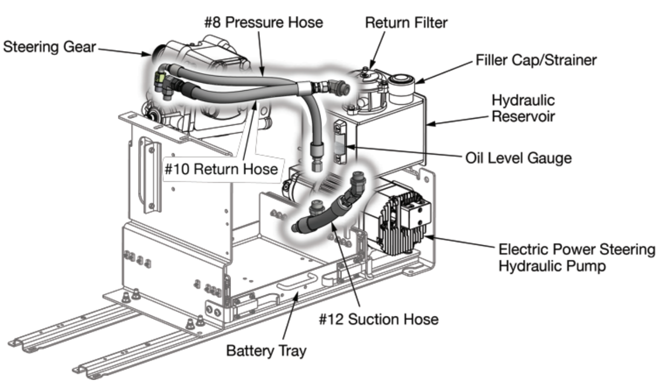
The fluid in the hydraulic system is selected to accomplish all of the various demands placed on it by the system performance parameters. Only OEM-approved fluids can be used.

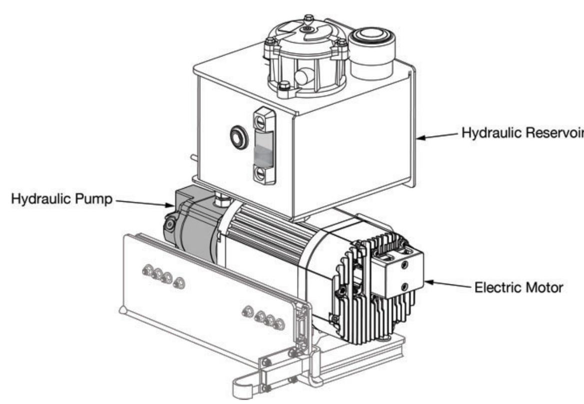
The reservoir is mounted in the streetside front corner of the bus, in the battery compartment. The drop-in filter element keeps foreign matter and dirt from entering the pump and the steering gear. A protective cover is installed above the low voltage batteries to shield the top of the batteries and the exposed electrical terminals on the batteries from hydraulic fluids.

The power steering system depends on sufficient fluid pressure and flow to enable the steering gear to operate as designed. Fluid pressure reacting on a piston creates the force to cause the piston to move and assist the steering effort.

As the piston moves, it is displaced in the cylinder bore by a volume of fluid under pressure. How fast the piston can be displaced depends on adequate fluid flow and volume.

A pressure gauge that can read at least 3,000 psi (20,685 kPa) and a flow meter with a capacity of 10 GPM are needed to check pressures and flow.



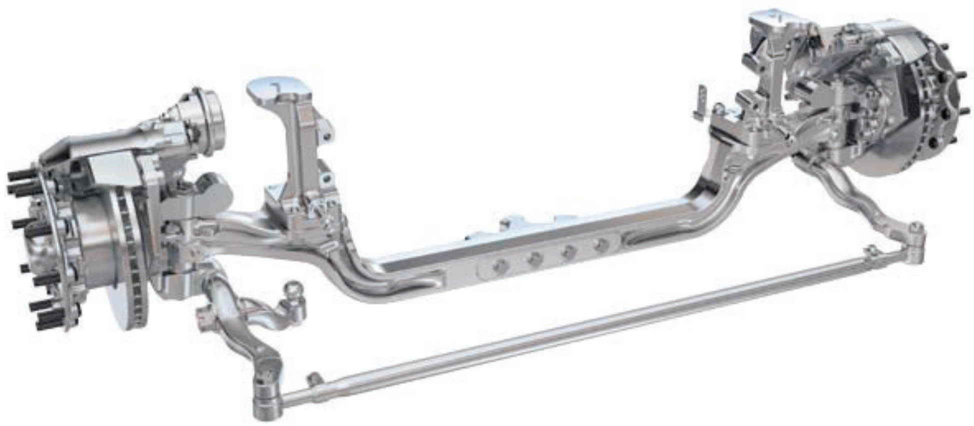


Specifications	
Hydraulic reservoir	Supplier: Helgesen. Model: GILLIG-specific port. Construction: Welded steel construction with black powdercoat finish. Capacity: 5.1 quarts. Filtration: 10-micron replaceable filter element. Level measurement: Sight tube and electric low-level sensor. Drain port: Provided with SAE O ring hex head plug. Tethered fill cap with screen on fill port.
Power steering pump	Supplier: Concentric. Model: EHS. Pump: Gear pump. Pump displacement: 11.3 cc/rev. Electric motor: 24-VDC PM, brushless. With CAN for variable speed capability and fault diagnosis. Pressure relief: 2,175 psi. Flow: 4.19 gpm. Life: 40,000-hour pump and motor. Warranty: 24 months.

FRONT AXLE

The GILLIG Low Floor utilizes the Meritor FH-946 deep-drop front non-drive steer axle as our standard front axle. The front axle transfers the front weight of the bus to the tires, provides the pivoting mechanism to provide steering, holds the front axle brakes to provide braking, and provides the hubs to hold the wheels and allow the wheels to rotate.

The axle includes suspension rod attachment points that are integrated to the I-beam for simplified bracket design and greater bracket flexibility. The FH-946 also includes Easy Steer king pin bushings and tapered roller thrust, which permit easier steering.



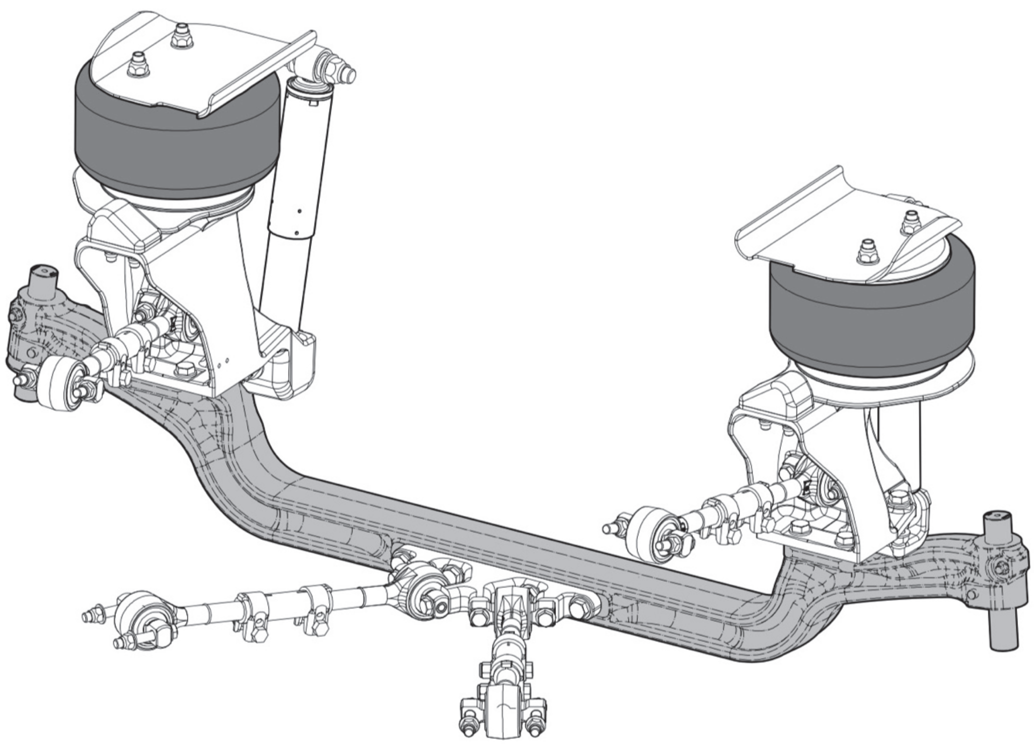
Specifications	
Supplier	Meritor.
Model	FH-946.
Rating	19,200 lb
Wheel-end hardware	Hubs: cast iron. Hub lubrication: Oil lubrication, standard. Grease, optional. Wheel mounting: 10-hole bolt circle. 335-mm (13-in.) bolt circle. 281.2 hub bore. Hub pilot.
Turn angle	51 degrees.
Axle warranty	5 years or 300,000 miles.
Brakes	EX225H3 disc brakes.
Rotor diameter	434 mm (171 in.).
Brake linings	Meritor MA703.
Brake chamber	Type 24.
Brake wear indication	Manual (standard), Electric (optional).
Brake warranty	2 years or 100,000 miles.

FRONT SUSPENSION

The front air suspension is composed of two Firestone air springs with internal bump stops for a smooth ride, shock absorbers to dampen bounce, external roll bumpers to limit suspension roll, and torque rods to maintain axle/frame geometry.

The air system operates automatically to maintain a constant ride height regardless of load or load distribution. The pressure in the air spring bellows is varied automatically by the height control valve in proportion to the bus load. As the bus is loaded, the body settles toward the axles. This movement operates the height control valve, and air is allowed into the air springs. Air pressure in the air springs increases enough to compensate for the additional load. As passengers leave the bus, the height control valves allow air to exhaust from the air springs. The air in the air springs is reduced by the valves in proportion to the weight debarking the bus, which, again, keeps the bus body at normal ride level. The height control valves are designed to operate only when the load in the bus is changed. They do not respond to the rapid relative motion between the axle and body, such as the motion caused by road bumps.

The torque rods hold the axle in a position perpendicular to the axis of the chassis so that the tires track in parallel lines when in operation.



The front suspension kneeling system allows the driver, when the bus is stopped, to override the air suspension height control system and kneel (or lower) the front air suspension. Kneeling the bus reduces the front step height and reduces the wheelchair ramp angle. Reducing the step height or ramp angle makes access into the bus easier for passengers with reduced mobility. The kneeling system allows lowering the front suspension and holding it at the lowered height in any position from normal ride height to fully lowered. Brake and throttle interlock prevent movement when the bus is kneeled. To raise the bus back to normal ride height quickly, the kneeling system includes a fast fill feature. This raises the front suspension back from fully lowered to normal ride height in 3 to 5 seconds. If required to facilitate wheelchair ramp deployment, the kneeling system can also be used to over-raise the front suspension to provide a front suspension height above the normal ride height. An indicator mounted on the instrument panel illuminates during the kneeling operation and remains illuminated until the bus is raised to a height adequate for safe street travel.

Specifications	
Height Control Valve	Barksdale.
Kneeling Valve	Parker, manifold-type valve.
Maximum acceleration: kneel/raise	0.2 g.
Maximum jerk: kneel/raise	0.3 g.
Kneeling time	1.5-2.5 seconds from control activation.
Raise time	2 seconds to permit driving, 5 seconds to return to full ride height.

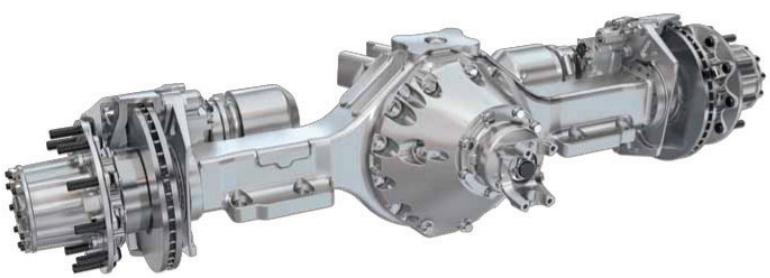
REAR AXLES AND BRAKES

GILLIG uses the Meritor 79000 series single reduction axle. The full floating rear axle has a one-piece housing with welded bowl. Power is transmitted from (and in regenerative braking to) the traction motor through a propeller shaft to the drive pinion gear and differential assembly, to the axle shafts, and then to the rear wheels. The differential assembly, drive pinion gear, and pinion cage assembly are mounted in the differential carrier. By removing the axle shafts, the carrier can be removed for inspection, adjustment, or replacement without having to remove the axle housing from the vehicle.

The differential is a conventional four-pinion type carried in a two-piece case mounted in tapered roller bearings. The drive (ring) gear is bolted to the flanged half of the differential case. Thrust washers are used between the side gears and differential case and also between the differential pinion gears and case. The case halves are secured by cap screws and hardened washers. The differential assembly provides for gear reduction to reduce the revolutions per minute and to multiply the torque from the traction motor while allowing for wheel speed differences.

The differential is supported in tapered roller bearings, which accept both thrust and radial loads. The bearings are mounted within supports in the carrier, while thrust loads are born by the adjusting rings threaded into the carrier supports and bearing caps.

The axle housing has outer end tubes that are threaded to accept wheel bearing adjusting nuts. The axle shafts are the same for left or right sides. The flange at the outer end is attached to the hub by studs, tapered dowels, and nuts. The inner end is splined to the differential side gears.



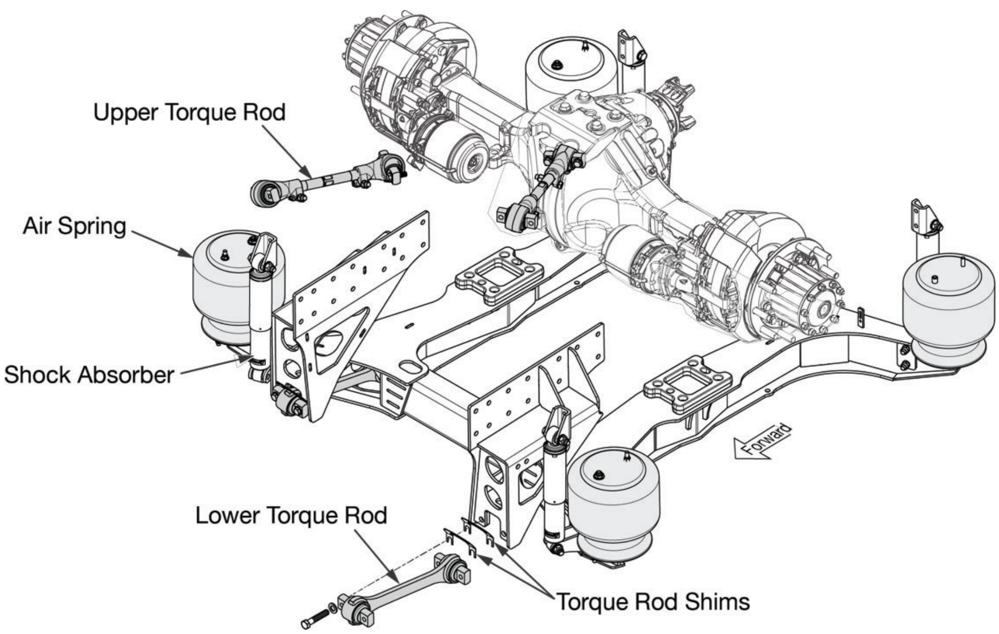
GILLIG buses use air-actuated disc brakes. The force introduced from an air chamber push rod is amplified by the mechanism within the floating caliper housing. This mechanism creates a clamping force that is applied to the inboard brake pad. Once the inboard pad has contacted the brake rotor, a reaction force acts through the floating caliper housing and bridge to pull the outboard pad onto the brake rotor. The brakes are released by reducing the input force from the air chamber, which reduces the clamping force of the brake. A return spring within the caliper housing returns the mechanism back to its starting position, leaving the pads with a defined running clearance to the rotor. The small run-out of the brake rotor and hub then creates a small clearance for the outboard pad after a few revolutions of the rotor. An automatic adjuster adjusts the brake pad clearance to compensate for pad wear. This adjuster is internal to the caliper housing and is manually readjusted back to its starting position when new brake pads are installed.

GILLIG provides an anti-lock braking system (ABS) provided by Wabco. The ABS monitors and controls wheel speed during braking. If a wheel starts to lock up during braking, the ABS reduces air pressure to that wheel's brake to keep all wheels turning at the same speed. When the wheel speed enters the stable region again, the air pressure automatically increases.

Specifications for Rear Axle	
Supplier	Meritor.
Model	79163.
Rating	29,000 lb (13,154 kg).
Rear axle ratio	Standard: 6.14:1.
Wheel-end hardware	Hubs: cast iron. Hub lubrication: Oil lubrication, standard. Grease, optional. Wheel mounting: 10-hole bolt circle. 335-mm (13-in.) bolt circle. 281.2 hub bore. Hub pilot only. Stud pilot not available.
Warranty	5 years or 300,000 miles.

Specifications for Brakes	
Supplier	Meritor.
Model	EX225H3.
Rotor diameter	434 mm (17 in.).
Linings	Meritor MA703.
Brake chamber	Type 24.
Brake wear indication	Manual (standard), Electric (optional).
Warranty	2 years or 100,000 miles.

The Hendrickson 4-bag rear suspension has an H-frame construction, which supports four air springs. The H-frame is a solid piece made up of two pairs of beams perpendicular to each other. The beams are not detachable from one another. The rear axle rests on saddles on two of the suspension beams. The air springs rest on mounting plates at each end of the other two suspension beams. The suspension is connected to the chassis frame by four torque rods. The air springs and shock absorbers form the other connecting points of the suspension and to the chassis frame. Two height control valves automatically maintain correct ride height by controlling air pressure in the air springs. Two upper and two lower torque rods are used to position the axle. The upper torque rods are attached to the axle housing and frame brackets. The lower torque rods are attached to the suspension H-frame and the chassis frame. Each of these rods has rubber bushings with metal inserts to absorb axle deflections. Two pairs of telescoping-type shock absorbers are installed.

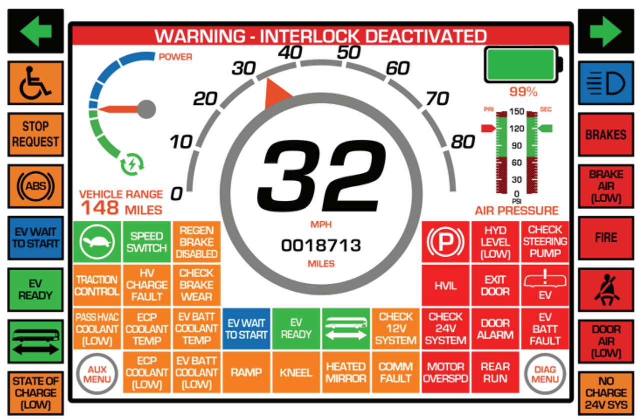


Air springs provide passengers with a smooth and comfortable ride. Each end of the flexible member (the air bag) has a reinforced bead that forms an air-tight seal when the spring is inflated. When in operation, the air bag folds over the piston at the bottom of the suspension so that the characteristic lobe shape is produced. The suspension bump/limit stops are located inside the air spring assemblies to support the bus if there is an air spring failure and to prevent damage to the bus understructure from large suspension deflections.

The air suspension height control valves automatically control the air pressure in the air springs to maintain the proper ride height. As the vehicle is loaded, the air springs compress slightly. The height control valve actuating arm moves up from the neutral position to the fill position. This allows air to flow from the air tanks into the air springs, increasing the pressure in the air springs, and bringing the air spring back to the proper height. When the vehicle is unloaded, the air springs slightly increase in length and the height control valve actuating arm moves from the neutral position to the exhaust position. This exhausts some of the air in the air spring until enough air has been exhausted to bring the air spring back to the proper height.

A touchscreen Multi-Function Display (MFD) initializes when the bus is turned on using the front run switch. This screen is the default display and displays the same operational information provided by standard gauges, such as speed, odometer reading, and voltage. There are also 16 stationary indicators along either side of the MFD. The primary and secondary screens display vehicle warning/information indicators in an easily visible way.

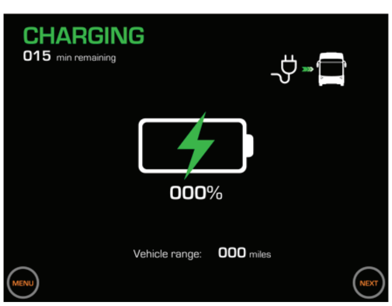
The indicator lamps (30 in the center and 16 on either side of the MFD) are programmed so some are turned on during normal bus function and others call attention to problems with red (for danger) and yellow (for attention/caution) warnings. Some indicators are connected to buzzers or alarms to serve as both alerts for dangerous situations or reminders during normal operations.

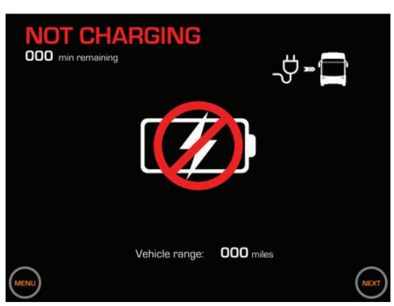


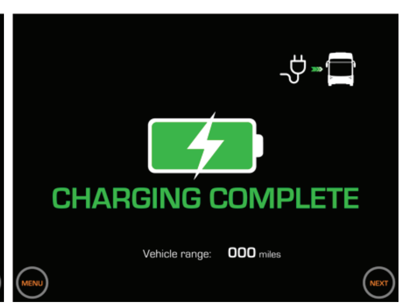
The primary screen is the default display for the driver while in motion. The relevant gauges and indicator lamps are displayed in a central location to allow the operator to quickly review the status while driving.

The MFD also provides a variety of secondary screens to display information during charging, maintenance, or when an alert is required.

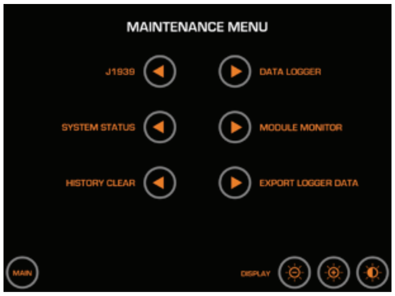
Charging Screens

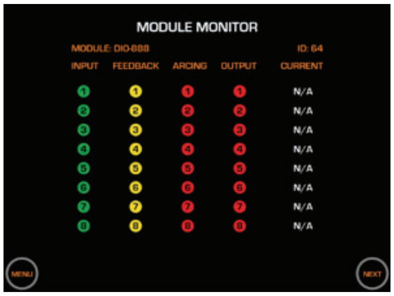


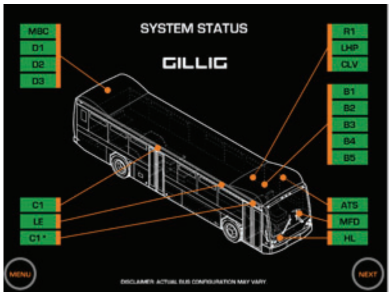




Sample Maintenance Menus







Sample Alert Screens

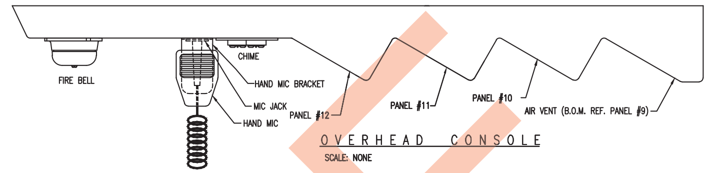
If the secondary screen is selected, it will automatically revert back to the primary screen when the bus is accelerated to at least 3 mph.

If equipped with a compatible camera, the MFD can serve as a back-up monitor. Whenever the bus is operational and is shifted into reverse, the MFD displays full-screen video of the area behind the bus. The MFD switches back to the primary screen when the transmission is no longer in reverse. Additionally, the MFD can display the video feed from a compatible rear door camera when the rear door is opened to allow the driver to verify there are no obstructions before closing the doors.

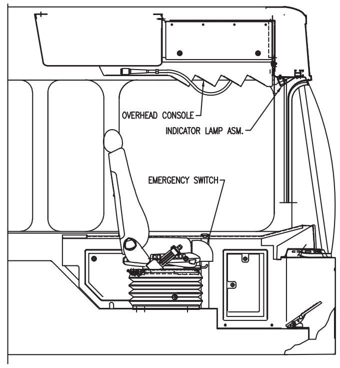
The MFD has two modes for driver convenience: day mode and night mode. In Night Mode, the MFD displays in inverted colors, changing from a white background to a black background, so it is more visible at night and reduces glare and reflection.

REVISIONS

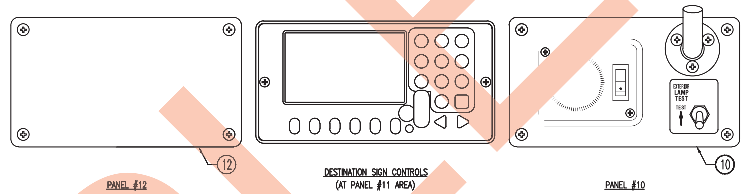
SYM	DWN	ZONE	DESCRIPTION	REL.	DATE
A			CUSTOMER APPROVAL & PRODUCTION RELEASE	REI	
A	KRM		CREATE FORM DRAWING	141023	10/11/19



OVERHEAD CONSOLE
SCALE: NONE



DRIVER'S AREA
SCALE: NONE



OVERHEAD CONSOLE PANELS
SCALE: NONE

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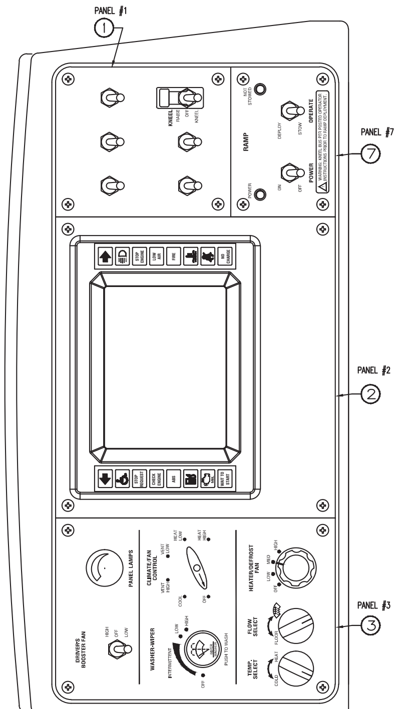
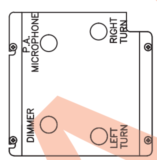
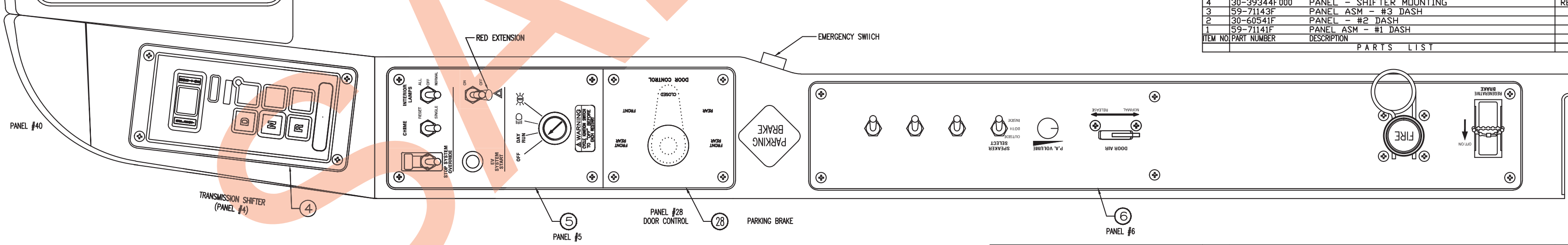
INDICATOR LIGHT BAR NOT REQUIRED WITH MFD







ITEMS 1, 2, 3, 5 & 6 ARE PART OF THE DASH LAYOUT BILL OF MATERIALS (DL-#####-000).
ALL OTHER ITEMS ARE SHOWN FOR REFERENCE ONLY.

ITEM NO.	PART NUMBER	DESCRIPTION	QTY
54			
53			
52			
51			
50			
45			
44			
43			
42			
41			
40			
33			
32			
31			
30			
29			
28	20-53886N000	DOOR CONTROL, VAPOR, ANALOG	REF
27			
26			
25			
24			
23			
22			
21			
15			
14			
13			
12	30-37207F003	PANEL - OVERHEAD CONSOLE	1
11			
10	30-37207F052	PANEL - OVERHEAD CONSOLE	1
7	59-71147F	PANEL ASM - #7 DASH	REF
6	59-71146F	PANEL ASM - #6 DASH	1
5	59-71145F	PANEL ASM - #5 DASH	1
4	30-39344F000	PANEL - SHIFTER MOUNTING	REF
3	59-71143F	PANEL ASM - #3 DASH	1
2	30-60541F	PANEL - #2 DASH	1
1	59-71141F	PANEL ASM - #1 DASH	1

PARTS LIST

NOTES:
1. PANELS #3 AND #5 HAVE INCANDESCENT BACKLIGHTING PER FMVSS 101.
2. SOME FEATURES ARE FOR GRAPHIC PURPOSES ONLY AND DO NOT REFLECT ACTUAL CUSTOMER REQUIREMENTS. REFERENCE BILL OF MATERIAL FOR ORDER CLARIFICATION

SIGNATURE ON THIS DRAWING INDICATES CUSTOMERS APPROVAL OF LAYOUT AND AGREEMENT THAT SAME IS IN COMPLIANCE WITH CUSTOMER'S SPECIFICATIONS. ONCE SIGNED THIS DRAWING BECOMES A PART OF

CONTRACT #____________________

PURCHASE ORDER #:____________________

SIGNED BY:____________________
ACTING ON BEHALF OF AND WITH THE AUTHORITY OF

____

ITEM NO	DESCRIPTION		QTY
3 QAC	GILLIG LLC, LIVERMORE, CA	MARK PART W/PN PER GIL DB #370.002	
		LH SHOWN, RH OPPOSITE	NONE

REMOVE ALL BURRS, BREAK SHARP EDGES

DIMENSIONING AND TOLERANCING ARE PER ANSI Y14.5M-1982 UNLESS OTHERWISE SPECIFIED TOLERANCES ARE IN INCHES:
DECIMALS .X ± .06, .XX± .03, .XXX± .010 — ANGULAR ± .5° — THIRD ANGLE

1ST S.O.:

TITLE: INSTL - DASH/CONSOLE SWITCHES SSLF BATTERY ELECTRIC FORM

DWN: KRM	DATE: 10/11/19	MATER'L SPEC:	
CHKR'S INIT:	DATE:	MFG STD:	
APPR'S INIT:	DATE:	FMVSS COMPL:	FMVSS 101
ORIG REL #: REI 141023	SIZE D	DOCUMENT NO.	DL-81538-000
CAD SCALE: 2 = 1		SHEET 1 OF 1	

GILLIG's Battery Electric Bus telematics is a web-based system which displays live and historical data from the fleet level down to the individual bus.

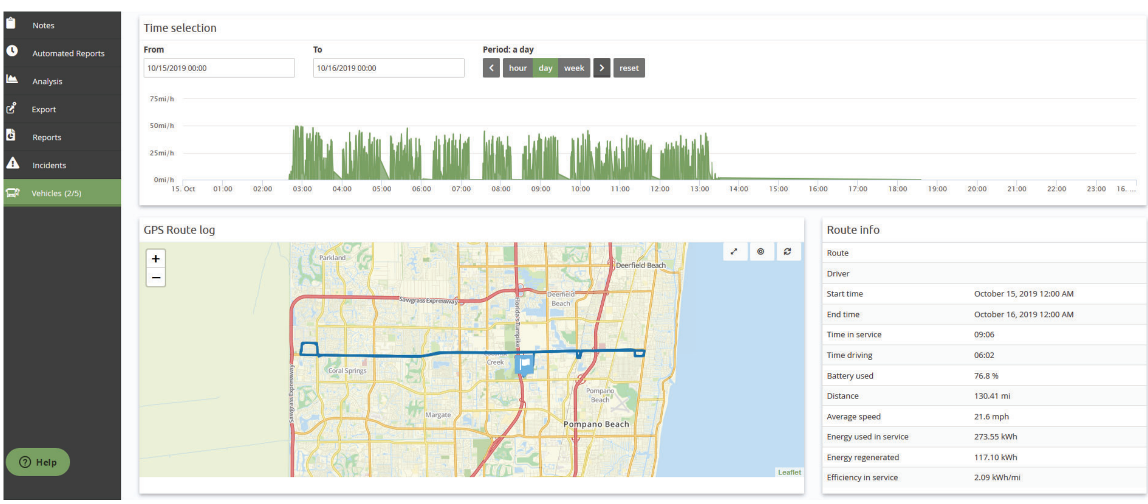
- Organizes data with graph, map, and table views to make goal-based analysis easy.
- Updates with live data every second.
- Resizes to work on both desktop and mobile.
- User-configurable automatic reporting on fleet or individual bus data.
- Report types can be saved for easy online access or emailed automatically.
- User-configurable automatic and immediate alerts such as "Low State of Charge."
- Downloadable raw data in MS Excel format for further processing.

Fleet Dashboard shows live data for all vehicles. There is a map view, a list sorted by battery state of charge, and a list of vehicles that are completely offline.

Vehicle Dashboard shows live data for one vehicle, including State of Charge, location, range remaining, and efficiency per mile that day.

Subsystem tabs show live data, such as HVAC use and temperature, 24 V battery information, door and ramp position, etc.

Route Log shows historical data for one vehicle with a map view. It allows you to see metrics of a route or time period with drag-and-drop selection. This can help with estimating the vehicle range on new routes.



Diagnostic Messages shows recorded and live fault codes, with their descriptions and severity levels.

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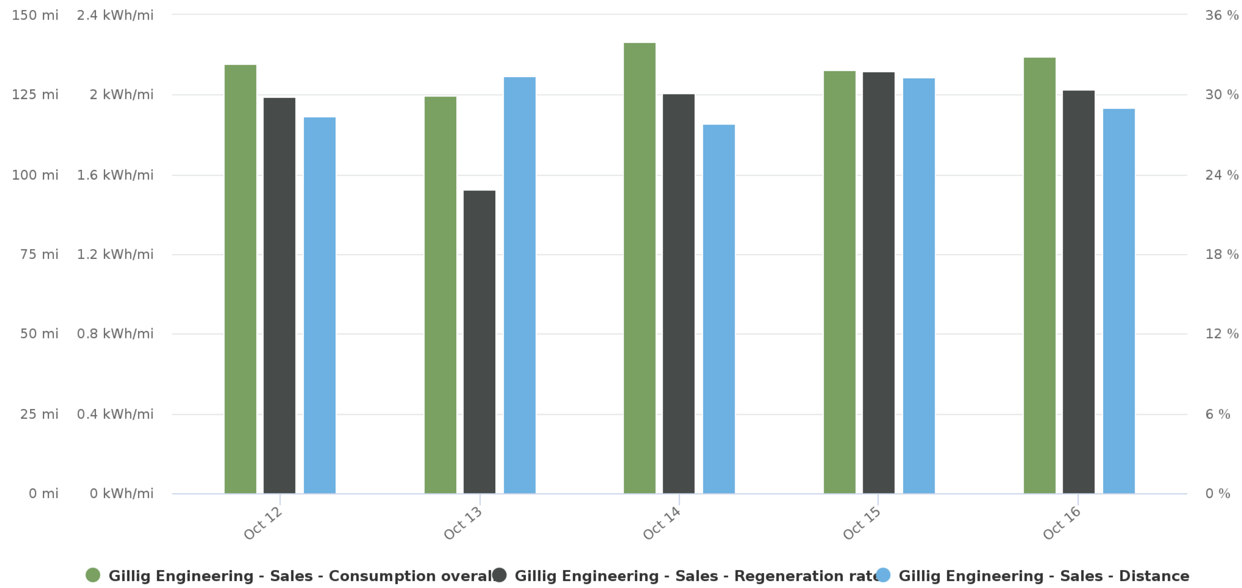
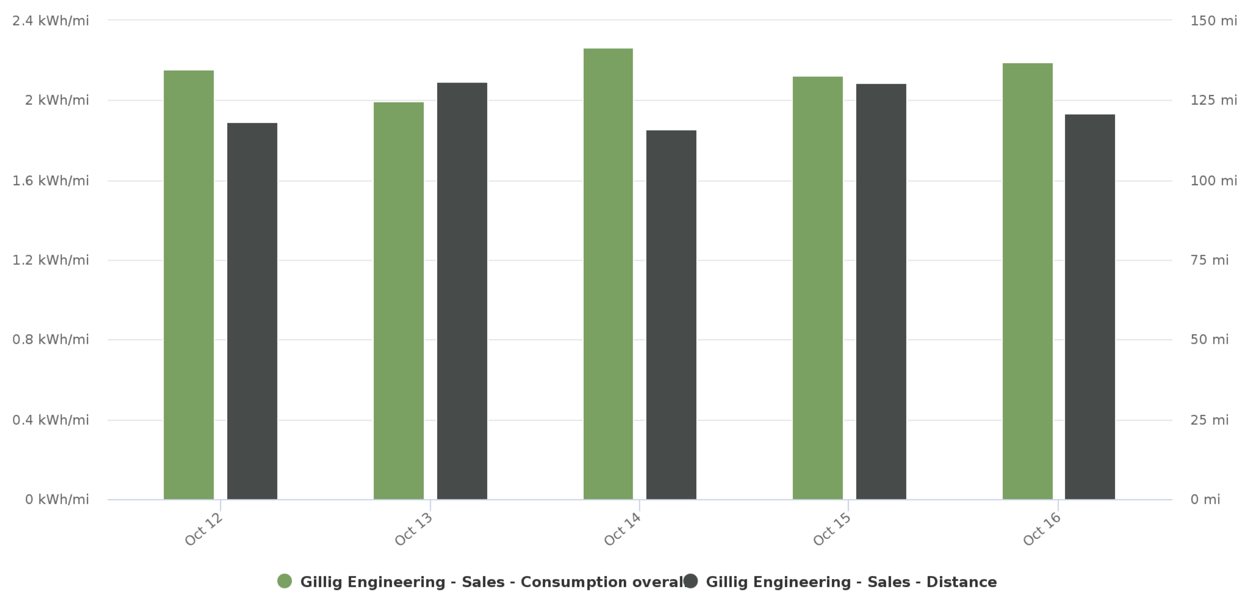
Analysis shows historical data for any number of vehicles with a graph view over time. It allows you to see exactly when certain events happen, such as door status, and can assist with troubleshooting.



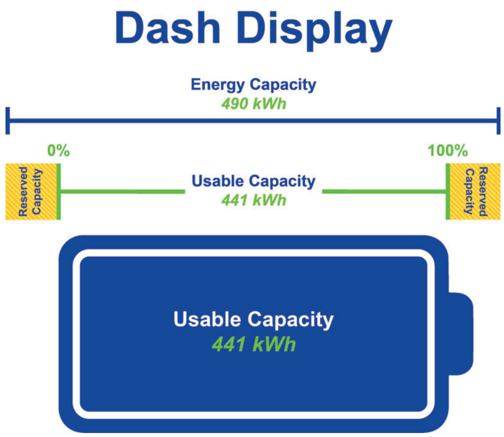
Reports shows historical data for any number of vehicles with a graph view that is averaged by day/week/month/year. It allows you to see trends in average speed, efficiency, distance traveled, etc.

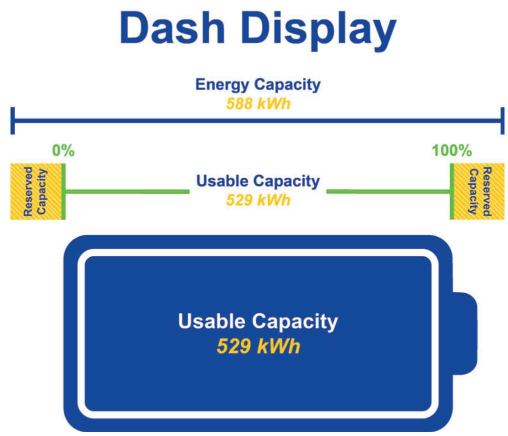


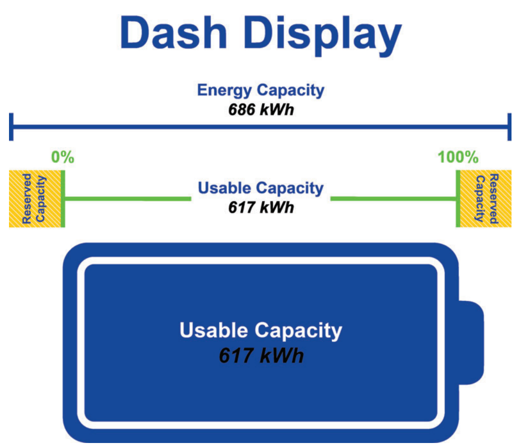
Portal allows administrators to configure access to different users.

Specifications	
Interfaces, J1939 CAN	Baud rate: 500k. Number of channels: 1. Sampling rate: down to 1 ms. Data compression or loss-rate: lossless data compression allowed.
Analog input data collection capability	Voltage input range: 0–10 VDC. Minimum resolution: 0.01 VDC. Minimum sampling rate: selective 10 ms/100 Hz. Number of channels: 6.
Communications	Wireless LAN, 802.11ac. IR5.3.2. GSM (cellular), LTE.
Onboard storage	8 GB minimum.
Power requirements	Full load 5 W. Standby 1 W. Sleep 0.1 W.
Sensors	GPS, gyro, accelerometer (3-axis), and barometric pressure.
Other	Automatic recovery/crash resilient. Remote configuration management. Wake on CAN and I/O.

Many factors determine the real-life range of an electric vehicle, which is derived from the net usable energy (or capacity) and the rate of energy consumption.







Rated Capacity

The rated capacity of a battery is the amount of total energy that can be stored in and discharged from the battery. Battery capacity reduces over the life of the cells as the impact of charging and discharging reduces the ability for the cells to reach full charge. Battery health is monitored by the battery management system and reported via telematics. The State of Health (SOH) is communicated as a percentage of the rated capacity at the start of life.

Reserved Capacity

Battery life is negatively impacted when cells are overcharged or when the depth of discharge is too low. In order to maximize high-voltage battery life, the capacity of the battery is limited to prevent discharge below 10% and charging above 90% of rated capacity. The charge controller prevents the batteries from being charged above the top limit, and derating protocols are in place to prevent the batteries from reaching the bottom limit.

Usable Capacity

The result of reserving some high-voltage battery capacity is that 90% of the rated capacity is available to power the vehicle. This is the usable capacity, and it is used for all calculations. The State of Charge (SOC) reported on the dashboard and via telematics represents the usable capacity remaining until a recharge is necessary.

Energy Consumption

Many factors impact the actual range of electric buses in operation. The duty cycle, route profile, and passenger loading determine how much energy is necessary to drive the traction motor and how much energy is captured through regenerative braking. Drivers can have a significant impact on energy consumption through how effectively they apply throttle and use regenerative braking to slow the bus. The HVAC system is also a significant use of energy on a bus, and settings (temperature set-points, fan speeds, etc.) can be optimized to reduce energy consumption.

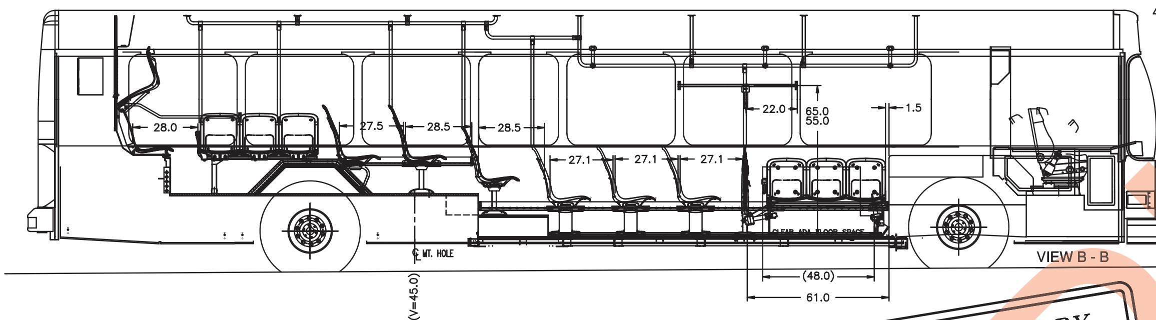
Customer-specified equipment (passenger seats, windows, CAD/AVL, and video equipment, etc.) can have a large impact on total vehicle weight, which can also impact energy consumption. GILLIG has developed a Smart Spec that optimizes the range of the bus through component selection. More details are available for discussion during the pre-production meeting.

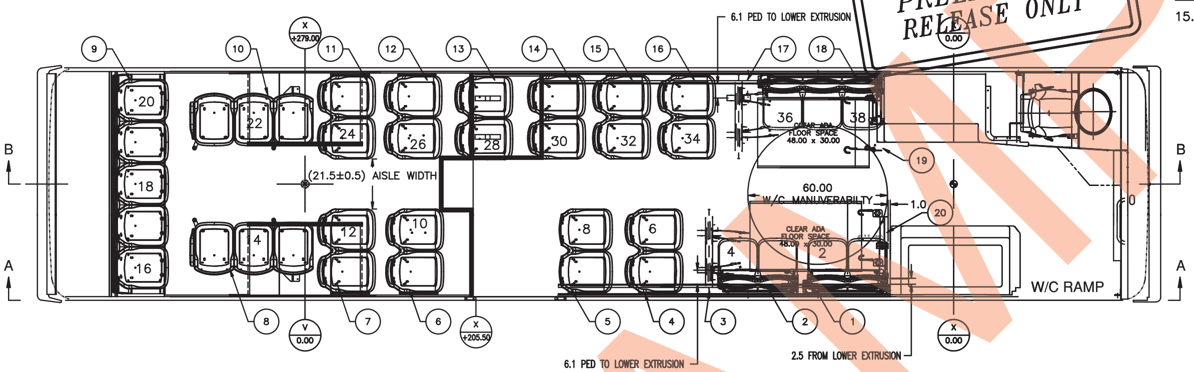
Range Estimates

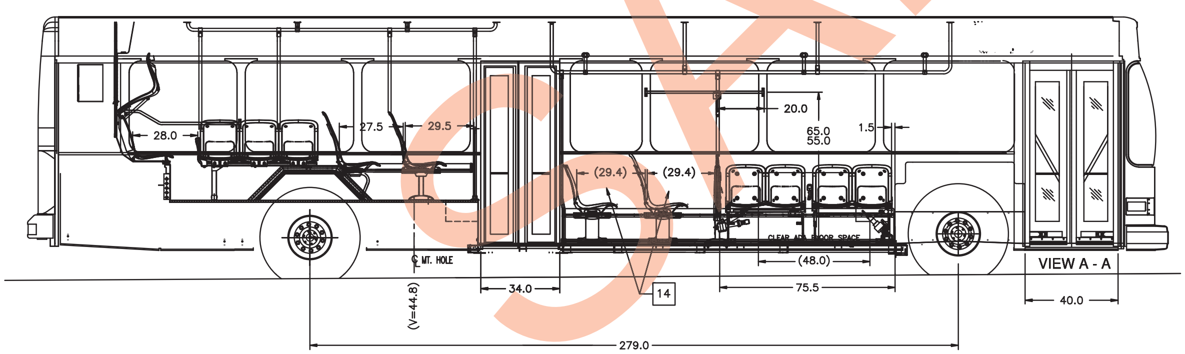
Many factors determine the real-life range of an electric vehicle, consumption is derived from the net usable engery (or capacity) and the rate of energy consumption.

Configuration	High-Voltage Battery Packs, Qty	Total Rated Capacity	Range at 2.3 kWh/mile*
5 battery pack	5, each with 98 kWh	490 kWh	192 miles
6 battery pack	6, each with 98 kWh	588 kWh	230 miles
7 battery pack	7, each with 98 kWh	686 kWh	268 miles
*2.3 kWh is a conservative average energy consumption rate.			

GILLIG PARTS	QTY	GILLIG PARTS	QTY
STANCHION, REAR LONGITUDINAL	4	STANCHION, 1.0 SINGLE OFFSET FWD RD	1
STANCHION, TRVS. @ 3RD STEP	2	STRAPS, O/H GRAB	–
STANCHION, TRVS. @ 2ND STEP	1	BAR, WINDOW, 46.0	2
STANCHION, TRVS. @ 1ST STEP	1	PANEL, MODESTY, 3RD STEP, C. SIDE	1
STANCHION, W/C BARRIER	2		







THIS SAMPLE LAYOUT IS PERTINENT TO DIESEL, BEB, CNG, EGENFLEX HYRBID AND BAE HYBRID BUSES.

SYM	DWN	ZONE	DESCRIPTION	REL.	DATE
A	NSH		RELEASED FOR PRODUCTION	100107	01/17/14
B	NSH		ADD CRASH PROTECTION NOTE	100823	02/25/14
C	NSH		REV #PASS FOR ITEM 17, MOVED ITEM 3 TO CLEAR CHASSIS STRUCTURE	100750	03/13/14
D	NSH		CORRECTED GRAPHICS ON ITEM 18, REV ITEM 8: WAS 28.5	102318	06/12/14
E	NSH		ADDED STANCHIONS TO ITEMS 8 & 10	102146	07/21/14
F	NSH		REV CS MODESTY PANEL GRAPHICS	103650	07/24/14
G	NSH		UPDATED NOTE 1 AND DB REVS	105893	01/26/15
H	NSH		REV ITEM 3 LOC: WAS 76.3, ITEM 1 & 2 TOUCH PAD LOC	119251	01/09/17
J	UKS		REPLACED ITEMS 4, 5, 14–16 WITH UPDATED CANTILEVER MODEL	143439	01/27/20
J	UKS		UPDATED 1ST STEP SPACING OF CANTILVER SEATS & UPDATED NOTES/ DB REV	143439	01/28/20

NOTES:

1. *TO MAXIMIZE OCCUPANT CRASH PROTECTION AND REDUCE THE POTENTIAL FOR SIGNIFICANT INJURY TO PASSENGERS SEATED IN THE FIRST FORWARD FACING SEATS IMMEDIATELY REARWARD OF THE ADA AREA, GILLIG REQUIRES EITHER: 1.1 THE PLACEMENT OF A BARRIER FORWARD OF THESE SEATS. 1.2 USE OF A GRAB/STANCHION POLE FOR THE AISLE SEAT AND WALL MOUNTED GRAB HANDLE FOR THE OUTBOARD SEAT OR 1.3 SEAT BELTS ON BOTH THESE SEATS.*
2. ALL DIMENSIONS ARE IN INCHES.
3. FLOORING LAYOUT: SEE FL–67522R068.
4. THIS DRAWING IS TO BE USED FOR SEAT INSTALLATION. ALL OTHER GRAPHICS ARE SHOWN FOR REFERENCE ONLY. SEE BOM/ PAINT LAYOUT FOR EXTERIOR GRAPHICS AND GLAZING. FOR APPLICABLE O/H RAILS, TRANSMISSION HATCH AND STANCHIONS, RACKS AND HANDLES ON WHEEL WELL SEE BOM/MEETING NOTES.

SEAT AND RESTRAINT NOTES:

10. SEATS & RESTRAINT BELTS MUST MEET FMVSS 209 & 302 STANDARDS.
11. ALL SEATS WITH T–PEDESTALS SHALL HAVE AN OPEN CHANNEL DESIGN. ALL SEATS WITH DIMENSION E=6.12 SHALL HAVE 3.0 LONG MOUNTING SLOTS.
12. W/C BELTS AND RETRACTORS: SEE SPEC SHEET, ALSO AFFECTS REMOTE BELT RELEASE TYPE IF REQUIRED
    A: Q' STRAINT = Q' STRAINT PULL HANDLE LEVER
    B: SURE–LOK = SURE–LOK DUAL AUTO LOK (NOT AVAILABLE FOR OPTION P).
13. FOR EACH W/C LOCATIONS WITH FLOOR ANCHORAGE DISTANCES GREATER THAN 60 INCHES SHALL INCLUDE (2) WEBBING LOOPS. TOTAL QTY SHIPPED LOOSE: 2 (REQUIRED FOR CURBSIDE ADA AREA)
14. HIP TO KNEE DIMENSIONS SHOWN ARE NOMINAL. SEATS WILL BE EQUALLY SPACED.
15. REF: FOR OTHER SEAT DETAILS NOT SHOWN. SEE PURCHASING ORDER SPECIFICATION SHEET.

ITEM NUMBER	VENDOR PART NUMBER	(#) PASSENGER SEAT SIZE	(P) PEDESTAL (C) CANTILEVER	(G) GRAB HANDLE	(F) FLAT BACK PANEL	(QTY) STANCHION CUP	NOTES AND COMMENTS
20		–	–	–	–	–	OPTION H, RH
19		–	–	–	–	–	OPTION H, LH, WHEELWELL MOUNTED
18		3	C	–	–	–	W/C FLIP–UP, AFT ARMREST, STOP REQ.
17		–	P	G	–	1	W/C BARRIER, (2) PED, P1=10.00, P2=16.00, E=8.0, SEE NOTE 12
16		2	C	G	–	–	
15		2	C	G	–	–	
14		2	C	G	–	1	
13		2	P	G	–	1	(2) PED, P1=9.42, P2=16.55, E=6.12
12		2	P	G	–	1	(1) PED, Po = 26.25, E=6.12
11		2	P	G	–	–	MOUNTED TO WHEEL WELL, MIN TRAVEL ±1.5
10		3	P	–	–	2	AFT ARMREST, E=6.12
9		5	–	–	–	–	HINGED SETTEE, 1–3–1, GAS SPRINGS W/ SINGLE LOCKING PIN
8		3	P	–	–	2	AFT ARMREST, E=6.12
7		2	P	G	–	–	MOUNTED TO WHEEL WELL, MIN TRAVEL ±1.5
6		2	P	G	–	1	(1) PED, Po = 26.25, E=6.12
5		2	C	–	–	–	
4		2	C	G	–	–	
3		–	P	G	–	1	W/C BARRIER, (2) PED, P1=10.00, P2=16.00, E=8.0, SEE NOTE 12
2		2	C	–	–	–	W/C FLIP–UP, STOP REQ. @ SEAT POSITION 3
1		2	C	–	–	–	W/C FLIP–UP, AFT ARMREST, STOP REQ. @ SEAT POSITION 2

38 PASSENGERS

PASSENGER SEAT SUPPLIER:
AMERICAN SEATING CO.
PASSENGER SEAT MODELS:
INSIGHT 18.0 WIDE FWD FACING
INSIGHT 17.0 WIDE AISLE FACING

FIRST CHASSIS
XXXXX

SIGNATURE ON THIS DRAWING INDICATES CUSTOMERS APPROVAL OF LAYOUT AND AGREEMENT THAT SAME IS IN COMPLIANCE WITH CUSTOMER'S SPECIFICATIONS. ONCE SIGNED THIS DRAWING BECOMES A PART OF

CONTRACT #______________________

PURCHASE ORDER #:______________________

SIGNED BY:______________________
ACTING ON BEHALF OF AND WITH THE AUTHORITY OF
____

GILLIG DESIGN BULLETIN REQUIREMENTS: UNLESS OTHERWISE SPECIFIED		
DESCRIPTION	DB NUMBER	REV
SETTEE:	DB 157.000	D
UPPER SECTION:	DB 157.001	C
CENTER SECTION:	DB 158.001	C
W/C RESTRAINT OPTION:	DB 152.014	AN
ADA CLEAR FLOOR SPACE:	DB 152.000	A
SEAT DIMENSIONAL SPEC.:	DB 152.001	D

DIMENSIONING AND TOLERANCING ARE PER ANSI Y14.5M-1982, UNLESS OTHERWISE SPECIFIED
HIP-TO-KNEE TOLERANCE: NON PADDED SEATS: ±0.25 PADDED SEATS: ±0.50
LINEAR: .X ±.3 .XX ±.12 .XXX ±.060 ANGULAR ±5°
THIRD ANGLE
CAD SCALE: 1:51
SIZE B

STANDARD REVISION J DATE 01/28/20
DESIGNER N. HOM DATE 07/21/14

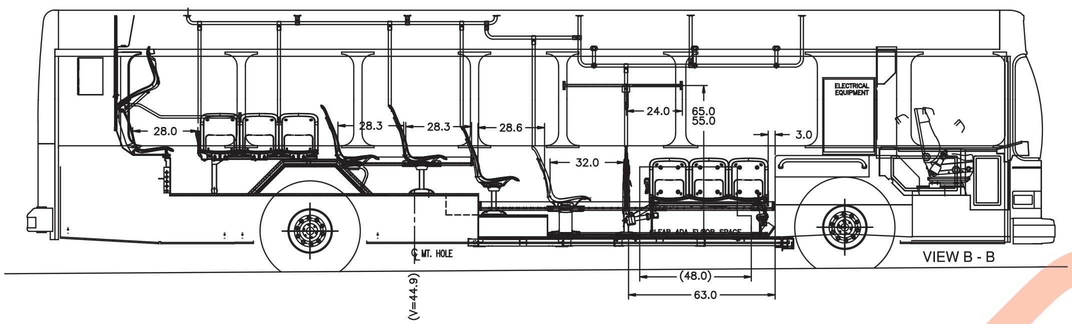
GILLIG LLC
LIVERMORE, CA

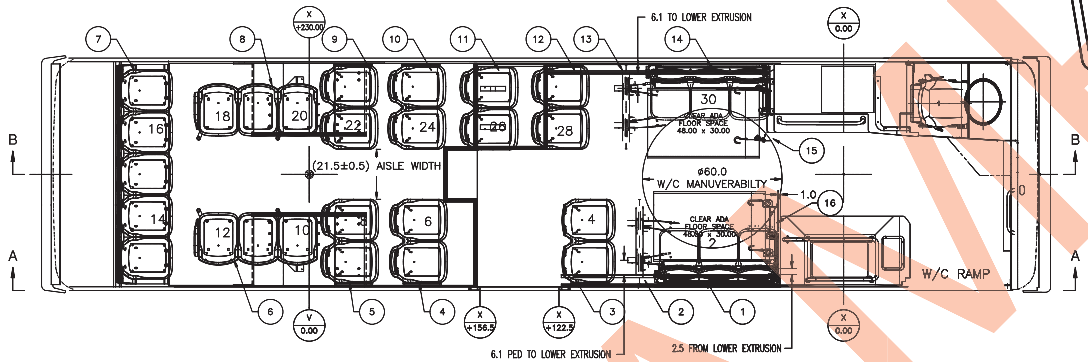
KIT & DIAGRAM, SEAT LF2010 40' X 102"

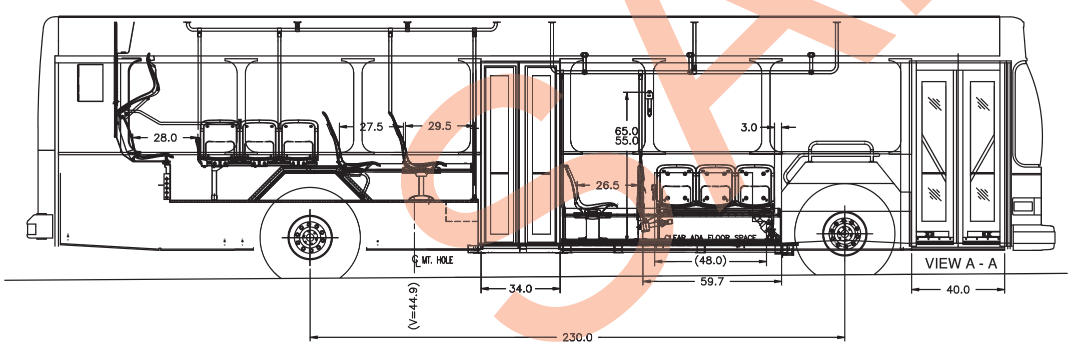
CUSTOMER NAME, STATE

PART NUMBER SL-72715-XXXXX

GILLIG PARTS	QTY	GILLIG PARTS	QTY
STANCHION, REAR LONGITUDINAL	4	STRAPS, O/H GRAB	–
STANCHION, TRVS. @ 3RD STEP	2	BAR, WINDOW, 46.0	1
STANCHION, TRVS. @ 2ND STEP	1	STANCHION, 1.0 SINGLE OFFSET FWD RD	1
STANCHION, TRVS. @ 1ST STEP TO 9.0 O/H DROP	1	PANEL, MODESTY, 3RD STEP, C. SIDE	1
STANCHION, W/C BARRIER	2		







-CONFIDENTIAL-

P	APP	UPDATE CANTILEVER SEAT MODEL AND ITS DIMENSIONS	152312	02/02/21

NOTES:

1. ***TO MAXIMIZE OCCUPANT CRASH PROTECTION AND REDUCE THE POTENTIAL FOR SIGNIFICANT INJURY TO PASSENGERS SEATED IN THE FIRST FORWARD FACING SEATS IMMEDIATELY REARWARD OF THE ADA AREA, GILLIG REQUIRES EITHER: 1.1 THE PLACEMENT OF A BARRIER FORWARD OF THESE SEATS. 1.2 USE OF A GRAB/STANCHION POLE FOR THE AISLE SEAT AND WALL MOUNTED GRAB HANDLE FOR THE OUTBOARD SEAT OR 1.3 SEAT BELTS ON BOTH THESE SEATS.***
2. ALL DIMENSIONS ARE IN INCHES.
3. FLOORING LAYOUT: SEE FL-67525R026 (NEED TO CONFIRM???).
4. THIS DRAWING IS TO BE USED FOR SEAT INSTALLATION. ALL OTHER GRAPHICS ARE SHOWN FOR REFERENCE ONLY AND THE FINAL DESIGN MAY VARY.

SEAT AND RESTRAINT NOTES:

10. SEATS & RESTRAINT BELTS MUST MEET FMVSS 209 & 302 STANDARDS.
11. GRAB HANDLE MATERIAL: ENERGY-ABSORBING OR STAINLESS STEEL????????????????????
12. W/C BELTS AND RETRACTORS: Q-STRAINT???????????????????????????????????????
13. SEAT INSERT: CLOTH COVERED VR50 OR CR50 WITH .50 PADDING
14. CANTILEVERED SEATS SHALL HAVE NO SHROUDS.??????????????????????????????
15. ALL SEATS WITH T-PEDESTALS SHALL HAVE AN OPEN CHANNEL DESIGN. ALL SEATS EXCEPT ADA SEATS SHALL HAVE 3.0 LONG MOUNTING SLOTS.
16. REF: FOR OTHER SEAT DETAILS NOT SHOWN. SEE PURCHASING ORDER SPECIFICATION SHEET.

PRELIMINARY RELEASE ONLY

REVISIONS

SYM	DWN	ZONE	DESCRIPTION	REL.	DATE
A	NSH		RELEASED FOR PRODUCTION	REI 77288	04/08/10
B	NSH		UPDATED DB & ADDED 2010 TO TITLE	REI [illegible]	08/27/10
C	NSH		[illegible] ADDED STANCHION TO SEAT 12	REI [illegible]	01/12/11
D	NSH		REV REAR HIP TO KNEE [illegible]	REI 89713	05/18/12
E	NSH		UPDATE SETTEE [illegible] GAS SPRING [illegible]	REI [illegible]	[illegible]/12
F	NSH		UPDATE SETTEE , CS WW RACK GRAPHICS & DB	REI 96079	07/26/13
G	NSH		ADDED NOTE 1 & C SIDE MODESTY PANEL CALLOUT	101847	04/21/14
H	NSH		REV S.SIDE W/C BARRIER LOC : WAS 63.6	100862	05/27/14
I	NSH		REV O/H RAIL ADDED STANCHION TO ITEM 6 & 8	102350	07/14/14
J	NSH		UPDATED ITEM 6 & 8 TOP VIEW	103248	07/15/14
K	NSH		MOVED ITEM 1 & 14 AFT, UPDATED DB REV	104093	08/28/14
L	NSH		REV ITEM 3 HIP TO KNEE: WAS 27.3	105245	12/15/14
M	NSH		REV NOTE 1	105884	01/12/15
N	NSH		UPDATE GRAPHICS: S SIDE OH GRAB RAIL	111287	10/27/15

ITEM NUMBER	VENDOR PART NUMBER	(#) PASSENGER SEAT SIZE	(P) PEDESTAL (C) CANTILEVER	(G) GRAB HANDLE	(F) FLAT BACK PANEL	(QTY) STANCHION CUP	NOTES AND COMMENTS
16		–	–	–	–	–	OPTION H, RH
15		–	–	–	–	–	OPTION H, LH, WHEELWELL MOUNTED
14		3	C	–	–	–	W/C FLIP-UP, AFT ARMREST, TOUCH PAD
13		–	P	G	–	1	W/C BARRIER, (2) PED, P1=10.00, P2=16.00, E=8.0, REMOTE BELT REL
12		2	C	G	–	1	
11		2	P	G	–	1	(2) PED, P1=9.42, P2=16.55, E=6.12
10		2	P	G	–	1	(1) PED, Po = 26.25, E=6.12
9		2	P	G	–	–	MOUNTED TO WHEEL WELL, MIN TRAVEL ±1.5
8		3	P	–	–	2	AFT ARMREST, E=6.12
7		5	–	–	–	–	HINGED SETTEE, 1-3-1, GAS SPRINGS W/ SINGLE LOCKING PIN
6		3	P	–	–	2	AFT ARMREST, E=6.12
5		2	P	G	–	–	MOUNTED TO WHEEL WELL, MIN TRAVEL ±1.5
4		2	P	G	–	1	(1) PED, Po = 26.25, E=6.12
3		2	C	–	–	–	
2		–	P	G	–	1	W/C BARRIER, (2) PED, P1=10.00, P2=16.00, E=8.0, REMOTE BELT REL
1		3	C	–	–	–	W/C FLIP-UP, AFT ARMREST, TOUCH PAD

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PASSENGERS

PASSENGER SEAT SUPPLIER:
AMERICAN SEATING CO.
PASSENGER SEAT MODELS:
INSIGHT 18.0 WIDE FWD FACING
INSIGHT 17.0 WIDE AISLE FACING

FIRST CHASSIS
000000 – 000000 (00) MM/DD/YY
000000 – 000000 (00) MM/DD/YY

SIGNATURE ON THIS DRAWING INDICATES CUSTOMERS APPROVAL OF LAYOUT AND AGREEMENT THAT SAME IS IN COMPLIANCE WITH CUSTOMER'S SPECIFICATIONS. ONCE SIGNED THIS DRAWING BECOMES A PART OF

CONTRACT #______________________

PURCHASE ORDER #:______________________

SIGNED BY:______________________
ACTING ON BEHALF OF AND WITH THE AUTHORITY OF

____

STANDARD REVISION: P — DATE: 02/02/21
DESIGNER: N. HOM — DATE: 04/08/10

GILLIG
GILLIG LLC
HAYWARD, CA

GILLIG DESIGN BULLETIN REQUIREMENTS: UNLESS OTHERWISE SPECIFIED

DESCRIPTION	DB NUMBER	REV
SETTEE:	DB 157.000	D
UPPER SECTION:	DB 157.001	C
CENTER SECTION:	DB 158.007	B
W/C RESTRAINT OPTION:	DB 152.014	AK
ADA CLEAR FLOOR SPACE:	DB 152.000	A
SEAT DIMENSIONAL SPEC.:	DB 152.001	D

DIMENSIONING AND TOLERANCING ARE PER ANSI Y14.5M-1982, UNLESS OTHERWISE SPECIFIED:
HIP-TO-KNEE TOLERANCE: NON PADDED SEATS: ±0.25, PADDED SEATS: ±0.50
LINEAR: .X ±.3, .XX ±.12, .XXX ±.060 — ANGULAR ±5°
THIRD ANGLE
CAD SCALE: 1:51 — SIZE: B

KIT & DIAGRAM, SEAT LF2010 35' X 102"

CUSTOMER NAME, STATE

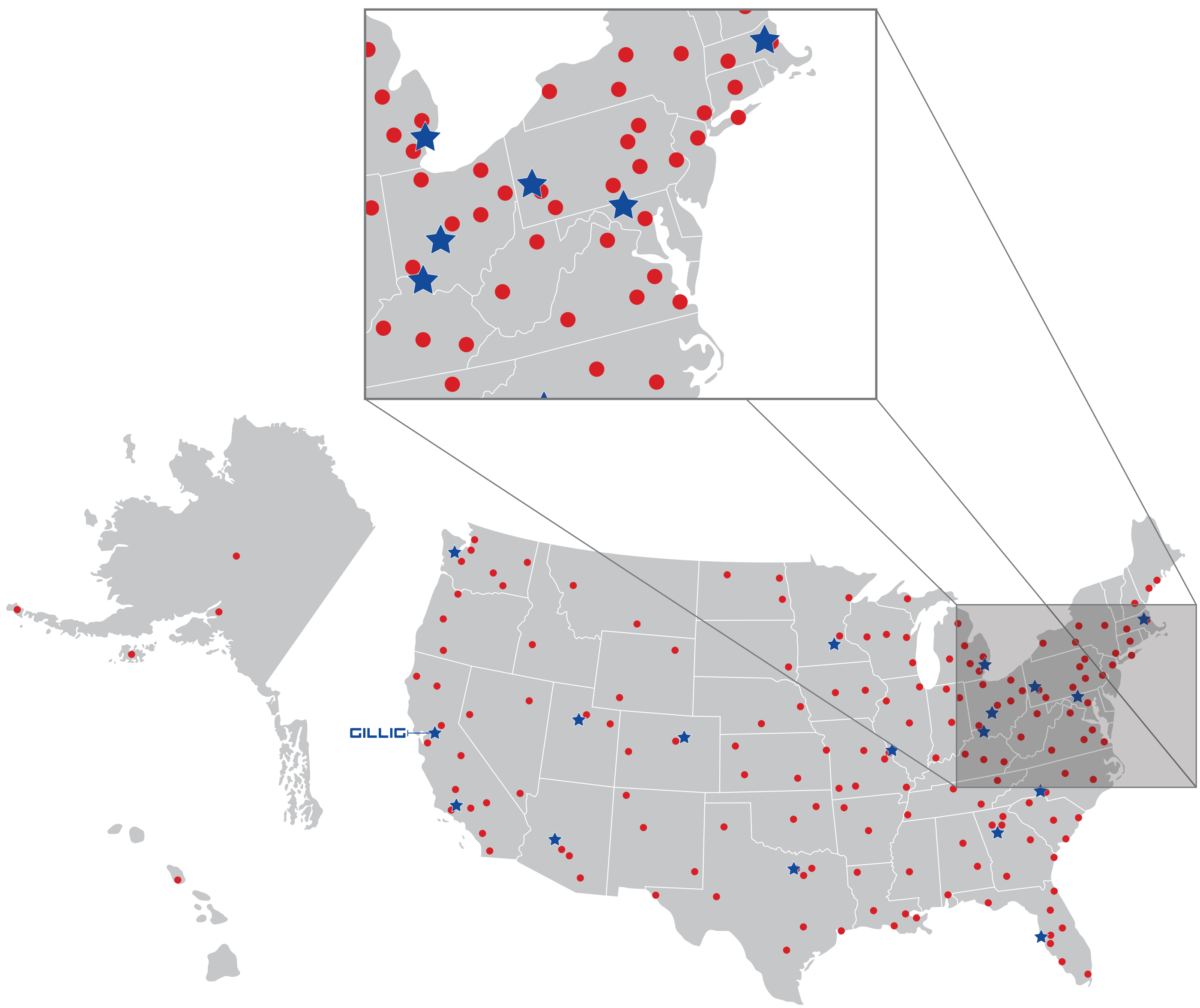
PART NUMBER: SL-66464-XXXXX

Unmatched service and support network across the US

Partners you can trust.

★ GILLIG Field Service Technicians

● Cummins Service Locations



SERVICE DEPARTMENT

GILLIG maintains a fully qualified, trained Service Department to respond to the procuring Agency's request for assistance after delivery of equipment.

The Field Service Trainers and Field Service Representatives have extensive "hands-on" experience on our coaches. The Field Service Trainers are available to provide training to your staff on the proper operation and maintenance of the equipment. The Field Service Representatives are fully qualified to assist the procuring Agency in the maintenance of equipment, including, but not limited to major component replacement and repair, electrical troubleshooting, suspension and frame repair, as well as repair of all ancillary components and systems.

In-house qualified Field Service Representatives are available to troubleshoot questions by phone, Monday through Friday, 5:00 a.m. to 2:00 p.m. (PST).

WARRANTY DEPARTMENT

The Warranty Department is available to assist the procuring Agency processing warranty claims as required. The Warranty Processing Specialist will assist the procuring agency in the proper procedure for obtaining warranty parts, completion of the warranty forms, and the handling of parts for warranty claims processing.

ENGINEERING DEPARTMENT

We also maintain a fully experienced, qualified Engineering Department, directed by the Vice President of Engineering. The Engineering staff are available on request to assist in the resolution of engineering or design problems that may arise within the scope of the specifications during the warranty period.

The GILLIG Engineering Department is located at the manufacturing plant in Livermore, CA, and is continually available to assist the manufacturing process. The integrated staff performs all vehicle engineering, including the research and development of all systems integrated on our vehicles.

All current products were designed and developed by GILLIG Engineering. The entire GILLIG Low Floor transit bus is manufactured in the United States at this one location in Livermore, CA.

GILLIG

CUSTOMER CARE SUPPORT NETWORK

EXECUTIVE DIRECTOR, CUSTOMER CARE
Victor Doran

REGIONAL SERVICE MANAGERS
Eric Ocampo
Mark Bittner
Thomas Seymour

WARRANTY MANAGER
Michelle Tejeras

TECHNICAL SERVICE ADVISOR
Bo Vongamath

TECHNICAL TRAINERS	**BASED**
Russ Ando	Seattle, WA
Lyle Archambeau**	St. Paul, MN
Blaine Fagel	Charlotte, NC
Kevin Hardesty	Columbus, OH

FIELD SERVICE REPRESENTATIVES *	**BASED**
Cody Campeau	St. Paul, MN
Max Camper	Columbus, OH
Jason Fairclough*	Salt Lake City, UT
Jose Garcia	San Francisco, CA
Armando Garibay	Southern California
Matthew Gerbasi	Lowell, MA
Thomas Johnson	Phoenix, AZ
Scott Kovaly	Pittsburgh, PA
Tim Lopez	San Francisco, CA
William Lovelady	Jackson, TN
Sam Nicoara	Atlanta, GA
Paul Oden, Jr.	Cincinnati, OH
Joe Rhea*	Dallas, TX
Ken Riley	Charlotte, NC
Richard Salas*	San Francisco, CA
Steven Sayne*	Seattle, WA
Jason Schwalbert	Phoenix, AZ
Matthew Sharp	San Antonio, TX
Sang Tran*	Los Angeles, CA

CUSTOMER CARE SUPPORT NETWORK

FIELD SERVICE & WARRANTY

Phone - 800-735-1500
Fax- 510-785-1348

Victor Doran	Exec.Director, Customer Care	victor.doran@gillig.com
Eric Ocampo	Regional Service Manager	eocampo@gillig.com (call to schedule training)
Mark Bittner	Regional Service Manager	mark.bittner@gillig.com
Thomas Seymour	Regional Service Manager	Thomas.seymour@gillig.com
Michelle Tejeras	Warranty Manager	michelle.tejeras@gillig.com
Branden Andersen	Supervisor Service Engineering	branden.andersen@gillig.com
Steve Finley	Field Service Engineer	steve.finley@gillig.com
Johnny Phothipanya	Warranty Processing Specialist	johnny.phothipanya@gillig.com
Bo Vongamath	Technical Advisor Warranty	bo.vongamath@gillig.com
Dominic Nava	Parts Specialist	dominic.nava@gillig.com
Field Service	Customer Care Coordinator	FieldService@gillig.com
Warranty Claims	Warranty Admin	WarrantyClaims@gillig.com
Warranty Parts	Parts Specialist	WarrantyParts@gillig.com
Kristina Aldana	Administrative Assistant	kristina.aldana@gillig.com
Jacqueline Hernandez	Customer Care Admin	jacqueline.hernandez@gillig.com

Training instructors employed by GILLIG are fully qualified service personnel with extensive “hands on” experience on our coaches. They have been trained in all phases of coach repair including, but not limited to major component replacement and repair, electrical troubleshooting, suspension and frame repair as well as repair of all ancillary components and systems.

* Performs pre-delivery service at the customer site, as well as ongoing field product support services.
** ASE Certified Mechanic

FIELD SERVICE QUALIFICATIONS

VICTOR DORAN - Executive Director, Customer Care
Executive Director of Customer Care is responsible for supporting customers post delivery service needs including warranty, field service and training. Victor's 30+ years' experience includes Diesel Technician, Service Department Management, Custom Engineering and broad OEM Customer Service Support functions primarily in the Commercial Truck and School Bus market. In addition, Victor earned a Diesel Technician Certification from Ohio Diesel Tech. and a BSMET from Kent State University and joined GILLIG in 2020.

ERIC OCAMPO – Regional Service Manager
Eric has been with GILLIG since January 1987. He came to GILLIG from A.C. Transit where he worked for 2 ½ years involved in special projects. He has 1 year in R.O.C. diesel technology and electrical and 5 years as an automotive technician. He also received training on DDEC, Allison, Lift-U wheelchair lifts and Luminator destination signs for troubleshooting and repair. Eric spent 10 years as a Field Service Representative and was a Field Service Trainer from 1996-2013. In April 2002, he completed training with Cummins I.S.L. troubleshooting and familiarization, and in November 2004, he completed training with Allison Hybrid electric drives. Since 1999, he has received numerous extensive training classes from I.O. Controls Multiplex Systems covering the T-1, T-2, G-3 and the latest G-4 systems.

MARK BITTNER – Regional Service Manager
Mark joined our GILLIG family in 2019. He brings extensive knowledge and experience in transit bus maintenance and troubleshooting. He grew up in Pittsburgh, PA and is a graduate of Steel Center Technical School and Ohio Diesel Technical Institute. He began his career in 1986 with a Pittsburgh based Detroit Diesel Allison distributor. There he served in troubleshooting, repair and overhaul of all Detroit Diesel Allison Propulsion systems. From 1993 through 2018 Mark worked for the Port Authority of Allegheny County in Pittsburgh, PA. There he performed all aspects of transit bus maintenance, troubleshooting and repairs. While there he became a bus maintenance technical trainer and developed many vehicle maintenance, overhaul programs and provided technical support. Since 2005 Mark has been working with GILLIG busses at the Pittsburgh Port Authority of Allegheny County. Mark also enjoyed owning a business in Pittsburgh, PA with his two sons where they design and build racing engines and offer field service repairs for a diesel propulsion systems. Mark and his family now reside in the Florida.

THOMAS SEYMOUR – Regional Service Manager
Tom has been with GILLIG since November of 2018. Prior to joining GILLIG, he worked at the Kansas City Area Transportation Authority. He spent 13 years as a Class A Mechanic, and 1 year as the Maintenance trainer. He has multiple ASE certifications, HVAC Type II certification, and is a Certified CNG fuel Cylinder and Systems inspector. He holds a Class A CDL w/passenger endorsement. He has been trained on Voith transmissions, Allison transmissions, Cummins engines, Agility fuel systems, Lift-U, Thermo King Intelligaire I & II, Dinex T2/G3/&G4, J1939, and Amerex fire suppression. He has competed and won multiple awards at the APTA International Bus Roadeo.

MICHELLE TEJERAS – Warranty Manager
Michelle has been with GILLIG since March 2022. She comes from a Manufacturing and Distribution industry primarily in the Customer Support and Service Operations Arenas. Michelle has many years of experience in Warranty Operations Management. She has also been instrumental in the implementation of many major system installations including a Warranty Operations system, a Contact Management (CRM) System, and a Dealer Management System.

RUSS ANDO - Trainer
Russ resides in Washington State and covers the Pacific Northwest Region. Russ Joined GILLIG in March 2001 and worked in several areas on the production line, including line foreman. In July 2002, Russ joined the Field Service Department. He has done classic auto restoration since 1979 and has completed several body-off, frame-up restorations. Along with his knowledge of mechanics and hands on approach to his job, he earned a BFA with honors in illustration from California College of Arts and Crafts.

LYLE ARCHAMBEAU – Trainer
Lyle lives in St. Paul, MN and covers the Midwest region. He has been employed at GILLIG since 1989. He has three years' experience in Heavy vehicle Maintenance while stationed in the U.S. Army. Also, Lyle has five years' experience in the Automotive Maintenance Industry. He is ASE Certified in Auto Electric, Brakes, Suspension, Engine Performance and Engine Rebuilding. He has attended classes at Auto tech for Air Conditioning, and Engine Electronics Controls and Diagnosing.

BLAINE FAGEL – Trainer
Blaine joined GILLIG as an FSR in 2006 and moved to Trainer in 2010. He began in the trucking industry in 1990. He has been in the transit industry since 1995. He has fueled trucks/buses and performed preventative maintenance. He has also been a technician, union officer, shop supervisor, technical spec writer and QA officer. He worked for Lynx Orlando from 1995-2003 and Charlotte CATS from 2003-2006. He has been ASE Certified for heavy truck steering and suspension, A/C refrigerant recovery and recycle, as well as for bus/truck air brakes. Blaine is also a Type I & II Certified A/C Technician. He has taken many classes for electrical, preventative maintenance, suspension, hydraulics, brakes, A/C, wheelchair lift (Lift-U), Cummins, Detroit Diesel, Allison, Amerex as well as many managerial courses in people skills, time management, computer software for transit specific products, Excel, Word, Outlook, Adobe Professional, and PowerPoint.

KEVIN HARDESTY – Trainer
Kevin has been a technical coach trainer since 1987. He has been a field service trainer for GILLIG since 2005. Prior to being employed as a field service trainer for GILLIG, Kevin operated his own technical training company for 9 years. Kevin started as a technical trainer for the Flxible Corporation in 1987. He also spent 2 years at the Central Ohio Transit Authority as the Training Supervisor. During his time at these positions, he has performed technical writing and created numerous training classes using PowerPoint software. His other duties have included various field service tasks as required.

CODY CAMPEAU – Field Service Representative
Cody lives in New Richmond, WI and covers the Midwest region, he joined the GILLIG family in 2019 after working as a Field Service Technician contractor for GILLIG since 2010. During that time he gained experience performing retrofits to buses, checking in new buses and processing warranty issues.

MAX CAMPER – Field Service Representative
Max joined GILLIG in July 2022. He came from the Central Ohio Transit Authority where he spent nearly 30 years as a Diesel and Hybrid Technician, Supervisor, Warranty Compliance Coordinator and Senior Technical Trainer. Max started his career in the United States Army, receiving training in the United States Army Ordnance Center and School, Track Vehicle Repair. Max has participated in the APTA International Bus Roadeo and holds a Class B CDL with passenger endorsement. He is a certified CNG Fuel System Inspector, obtained his Universal 608 and has received factory training from Cummins, Detroit Diesel, International, Bendix, TK and more. Max is located in Columbus, OH.

JASON FAIRCLOUGH – Senior Field Service Representative
Jason has been employed with GILLIG since March 2001. He has 3 years' experience as a Quality Engineering Technician for Nova Bus Inc. Where he had taken several classes: Kizan, Metrology, Paint and Body. Jason also has a certificate from the National Fire Academy, for Hazardous Materials Incident Analysis, Hydraulics and Fluidics. While at GILLIG, Jason has taken classes in I/O, Air Systems, Allison Electric Drive, and Service Training. In addition, Jason has been building and racing vehicles since 1989.

JOSE GARCIA - Field Service Representative
Jose joined GILLIG in the Production Department in 2015. He started in second shift and became a lead after four months. After one year, he moved to first shift labor pool and worked various departments before joining Field Service. Before GILLIG, Jose worked for 15 years as an auto mechanic. He started as a lube mechanic as a tech 1, then became a tech 4 master mechanic. He attended De Anza College and completed the automotive program. He also completed 3 ASE certified tests.

ARMANDO GARIBAY – Field Service Representative
Armando joined the GILLIG family in September 2022. He brings with him 12 years of experience in the commercial bus manufacturing industry, 7 of those years were leading a production line specializing in transit HVAC systems installation, other 5 years were spent overseeing the acceptance process of large volume fleet deliveries throughout the country as Field Service Repesenative. Certifications include a Universal Type HVAC certification through Mt. San Antonio Community college in Walnut California and CNG fuel cylinder and systems certification though NGVi, the leading provider of CNG technical training.

MATTHEW GERBASI - Field Service Representative
Matt joined GILLIG in 2021 as Field Service Representative for the Northeast. Prior to joining GILLIG he worked at Transport of Rockland in Rockland County, NY. He started as a technician then worked his way up to Maintenance Manager. Matt has multiple ASE certifications and is trained in multiple systems such as Cummins, Allision Hybrid, Detroit Diesel, Amerex, Lift-U, Ricon, Dinex and Thermoking. Matt studied at Lincoln Technical Institute and has 11 years of heavy-duty experience.

THOMAS JOHNSON – Field Service Representative
Thomas obtained his A.S. degree in Automotive Technology from Pima Community College. Before joining GILLIG, he spent 15 years as a Maintenance Mechanic at SunTran Transportation in Tucson, AZ performing repairs and diagnostics on their transit fleet.

SCOTT KOVALY – Field Service Representative
Scott was born and raised in Pittsburgh PA where he currently live with his wife, son and daughter. He graduated from Rosedale Technical College in 1988. After Rosedale he worked for GM, VW and Ford as the transmission and drive-ability specialist until 1994. He began his transit career with the Port Authority of Allegheny County in 1993 where he held various positions to include, hourly technician, materials control specialist, maintenance technical trainer, assistant manager of maintenance, manager of maintenance and bus procurement specialist. Scott holds ASE Master Technician status in Transit, Automotive and Heavy disciplines. He joined the GILLIG family in October of 2019 with the Field Service Department.

TIMOTHY LOPEZ – Field Service Representative
Tim has been employed with GILLIG since January 2007. He worked in Labor Pool for five years and three years in Ready Row. Two of the three years in Ready Row he obtained his Commercial Driving License. While working in Ready Row he took customers on test drives on their new buses and explained the functionality of the bus. He studied Automotive Maintenance and Repair along with Machine Shop in High School Regional Occupation Center (R.O.C.). He received an Associate of Occupational Studies degree from Universal Technical Institute.

WILLIAM LOVELADY – Field Service Representative
Bill joined GILLIG After spending 24 years at the Jacksonville Transportation Authority as a bus operator, technician, and trainer, he has hundreds of transit training hours under his belt. His key responsibilities include the post-delivery inspection, repair, and maintenance of all GILLIG buses deployed to the South Atlantic area. Bill prides himself in delivering exceptional customer service and always puts our customer’s needs first.

SAMUEL MAC NICOARA - Field Service Representative
Sam was born in Romania and immigrated to the US in 1980. In 1994, he graduated Sierra Academy of Aeronautics in Oakland, CA and received an aeronautical degree in Airframe & Powerplant as well as flight engineering. He applied his training in the aviation field and helped expand a superconducting magnet fabricating plant that he managed for over 10 years. In 2014, he joined GILLIG and worked as a troubleshooter in the Electrical Department. In 2016, he joined Field Service as a field service representative, servicing customers nationwide.

PAUL ODEN, JR. – Field Service Representative
Paul has in-depth experience working on GILLIG buses. For 19 years, he has served as a mechanic for the Southwestern Ohio Regional Transit Authority in Cincinnati, maintaining GILLIG buses and Cummins powertrains. He particularly enjoyed working on schematics and using his problem-solving skills. Paul joined GILLIG in October of 2019.

JOE RHEA - Senior Field Service Representative
Joe has been employed with GILLIG since 1988 and has had training in Voith, Transmission troubleshooting, & Lift-U Wheelchair lifts and Luminator Electric Destination Signs. He has also attended training classes by the GILLIG trainer in the Electrical System, Air System and Hydraulic systems on the GILLIG buses. Joe lives in Central Texas and covers the Southern Region.

KENNETH RILEY – Field Service Representative
Ken joined the Marine Corps in the early 1990's where he learned how to purify water and repair equipment. He went to work for Walmart logistics in 2000 where he eventually worked as a trailer and tractor mechanic working on Detroit series 60 and Cummins N14 engines on International Semi-trucks. He learned Cummins Insite and earned Detroit, Cummins and International certifications. In 2005 he earned certifications in Level 1,2,3, Out of Service and hazmat inspections as a Commercial Vehicle Officer for the State of Washington. Ken started working in Transit in 2005 at Island Transit in Whidbey Island Washington as a Journeyman Mechanic. He was promoted to Lead Mechanic in 2010 then Maintenance Supervisor in 2012 and Maintenance and Facilities Manager in 2014. Ken led his team to be recognized at the Washington State Transit Association for the Spirit Award on both Fleet Technicians and Facility Technicians. Ken joined GILLIG in January 2022.

RICHARD SALAS – Senior Field Service Representative
Richard has been employed with GILLIG since 1998. He worked in Labor Pool for one year and worked 4 years as a Working Foreman in in the Trim department. He was also the Working Foreman for the Maintenance Department on 3rd shift. He has attended training courses for the Dinex and Air systems. He is based out of the San Francisco area.

STEVEN SAYNE – Field Service Representative
Steven has been employed with GILLIG since June 2003. He worked with 1st shift Maintenance Department for 3 years. He was also the Working Foreman for the Maintenance Department on 2nd shift for 5 years. He has 10+ years of automotive and machine service and repair experience. He also has 10+ years of electrical and electronics service and repair experience. He has attended training courses for the Dinex and Air systems. He resides in Washington State and covers the Pacific Northwest Region.

JASON SCHWALBERT – Field Service Representative
Jason has been employed with GILLIG since December of 2017. Prior to that, he worked in the Phoenix Transit System for over 17 years as a Project Lead performing duties ranging from Transit Bus Maintenance to Shop Management. Jason has accumulated many Certifications and Licensing over the years including 3 ASE Master Certifications, Both A/C Section 608 Universal, & Section 609 certifications, and a Class B CDL w/Passenger Endorsement. He has earned an Associate Degree in Automotive, Diesel, and Industrial Technologies from Universal Technical Institute. Jason lives just outside Phoenix in Goodyear AZ.

MATTHEW SHARP – Field Service Representative
Matt sharp worked 4 years at KCATA in Kansas City, MO as a class mechanic and was certified in facilities. Prior to being a transit mechanic, Matt had 20 years experience in the heavy equipment industry as a mechanic and operator, working 3 years for Murphy tractor and equipment as a heavy equipment field mechanic. Matt has vast knowledge in heavy repair and electrical diagnostics from working on Caterpillar heavy equipment specializing on 953 track loaders. Working at KCATA he diagnosed and repaired all aspects of GILLIG diesel and CNG buses.

SANG TRAN – Senior Field Service Representative
Sang joined GILLIG in March 1997. He first started out in Dept. 04 for a few months then transferred to the Labor Pool in late 1998. For the following years, he worked throughout most departments, and spent most of his time in Dept. 03 (Electrical), performing work duties such as front dash harnesses/main electrical panel installations, engine power trouble shooting for buses to start before they get into Rack area (Dept.09). In mid-2001, Sang became a Field Service Representative and relocated to Fairfax County in State of Virginia. During his service years, he had attended training courses for Dinex and Air Systems. Before joining GILLIG, Sang worked for Morehouse Foods Co. in Emeryville, CA as a lead machinist and oversaw the high volume of bottling, labeling, capping machines, and performed electrical trouble shooting problems as required. Upon CNG market demand in Southern California, Sang lives in Orange County, CA in and covers the Pacific Southwest region.

BO VONGAMATH – Technical Service Advisor
Bo has been with GILLIG since January of 1999. He worked 2 years in the Labor Pool, 3 years in the Electrical Department and 4 years as a Quality Inspector in the Field Service Department. He also received training on Allison Electric Drive, Certified ASE Refrigerant Recovery and Recycling. Before GILLIG, Bo worked at Chuck E. Cheese as their Electronic Technician for 10 years.

GILLIG

ENGINEERING SUPPORT

GILLIG maintains a fully experienced and qualified Engineering Department directed by the Vice President of Engineering. The Engineering staff is involved in all design requests and is also made available to the customer on request to assist in the resolution of engineering or design problems that may arise within the scope of the specifications during the production and/or warranty period.

The GILLIG Engineering Department is located at the manufacturing plant in Livermore, CA, and is available to assist the manufacturing process. The integrated staff performs all vehicle engineering, including the research and development of all systems integrated on our vehicles.

All current products were designed and developed by GILLIG Engineering. Attached is our staff description and organization.

GILLIG ENGINEERING ORGANIZATION

Name	Function	Education	Background
G. Vismara	Vice President, Engineering	BSME	32 yrs. industry experience at Peterbilt, Loral Space Systems & GILLIG
K. Vorsatz	Sr. Director, Current Product Engineering	BSME	16 yrs. industry experience at BAE Systems & GILLIG
T. Meagher	Sr. Director, New Product Engineering and Advanced Engineering	BSME, BSEE	36 yrs. industry experience at Ford, Caterpillar, Case New Holland & GILLIG
R. Donovan	Director, Validation	ASME, BSEE, MBA-Executive Leadership	28 Yrs. Industry Experience. General Motors & GILLIG
A. Van Haeften	NPE Manager, Mechanical	BSME, PE	15 yrs. industry experience at Westinghouse, Park Hannifin & GILLIG
C. Ababseh	Manager, Mechanical Engr Body & Interior - CPE	BSME	17 yrs. industry experience at GILLIG
F. Andrade	EE Manager, NPE	BSEE	10 yrs. industry experience at E-N-G Mobile Systems & GILLIG
H. Tuft	Manager, Powertrain & Structures - CPE	BSME, MSME	2 yrs. experience at Electroglas Inc & AutoCat USA Inc., 16 yrs. experience at GILLIG
J. Ralleta	Manager, Order Management	College	13 yrs. experience at GILLIG
M. Itanna	Manager, Electrical Engineering - CPE	BSEE, MSc. EE, MBA-Organizational Leadership	12 yrs. industry experience at Parker Hannifin, United States Stee (USS), Emerson/Vertiv & GILLIG
M. Pinto	Continuous Process Improvement Manager	BSME, MSME, MSPM and PMP	18 yrs. industry experience at Ford, Volkswagen & GILLIG
R. Quebbeman	Manager, Order Management	AS Mech. Engr.	51 yrs. industry experience bus and truck design - Mack, International & GILLIG
S. Vanderlip	Manager, Mechanical Engineering Systems	BSETME, PE	37 yrs. industry experience at Peterbilt & GILLIG

B. Bachellor	Supervisor -Passengers Interior	BSME	6 yrs. industry experience at Lennox & GILLIG
D. Garcia	Bill of Material Supervisor	H.S.	7 yrs. industry experience at GILLIG
F. Fotos	Supervisor - CPE	BSEE, MEM	7.5 yrs. industry experience at Northrop Grumman & GILLIG
G. Roderick	Supervisor, Order Processing	AA	36 yrs. industry experience at GILLIG
J. Dalmeida	Supervisor, Driver's Interior	BSME	11 yrs. industry experience at New Flyer & GILLIG
J. Reekie	Supervisor, Powertrain	MSME	12 yrs. industry experience at Caterpillar, BP/Castrol & GILLIG
S. Yusoff	Supervisor, Structures	BSAE, MBA	11 yrs. Industry experience at Electro Motive Diesel, Hendrickson International and GILLIG
A. DeGracia	BOM Specialist	AA Theology	13 yrs. Industry experience
A. Frey	Sr. Mechanical Engineer I	BSME	12 yrs. industry experience at Cummins & GILLIG
A. Heidari	Sr. HIL Architect / Systems Engineer	BSEE	7 yrs. Experience at Sage Analytical, NATC and GILLIG
A. Khalil	Sr. Mechanical Engineer II	BSME	7 yrs. industry experience at power generation, additive MFG, electronic thermal systems & GILLIG
A. Monserret	Mechanical Engineer II	BSME	3 yrs. industry experience at GILLIG
A. Rosales	Associate Mechanical Engineer	BSME	1 yr. industry experience
A. Wan	Sr. Electrical Engineer II	BSEE	21 yrs. industry experience at BAE Systems, KLD Tech, Tropos Tech, & GILLIG
B. Haley	Mechanical Engineer II	BSME	8 yrs. industry experience Product development
B. Nguyen	Design Engineer, Electrical	BSEE	17 yrs. industry experience at HP, Kla-Tencor and GILLIG
B. Wu	Design Engineer	BSEE	27 yrs. industry experience at Bakery Automation, Building HVAC Controls, and GILLIG
C. Clemensen	Mechanical Engineer 1	BSME	3.5 yrs. Industry experience at Schneider Electric & GILLIG
C. Espinosa	Mechanical Engineer II	MSME	11 yrs. industry experience at Lawrence Livermore Lab, SFMTA & GILLIG
C. Gonzalez	BOM Specialist	College	14 yrs. GILLIG experience
C. Nguyen	Production Support Technician		23 yrs. industry experience at GILLIG
C. Silva	BOM Analyst	HS	34 yrs. industry experience at GILLIG

D. Aranovich	CAD Designer	BS Engr Tech	26 yrs. industry experience at Metaldyne, Ford, LightSail Energy & GILLIG
D. Haiduk	CAD Designer	MSME	20 yrs. industry experience in several international electro-mechanical companies & GILLIG
D. Lewis	Electrical Engineer	BSEE	26 yrs. Industry experience at Blue Bird Corp, Heil Environmental, United Streetcar, Freightliner, E-One, RFA/Roadtec, and GILLIG
D. Williams	Mechanical Engineer II	BSME	4 yrs. industry experience at civilian/government proving grounds & GILLIG
E. Hughes	Mechanical Engineer II	BSME	3 yrs. industry experience at GILLIG
E. Martin	Mechanical Engineer 1	BSME	2 yrs. Industry experience at Northrop Grumman and GILLIG
EJ Mariscal	BOM Specialist	HS	21 yrs. industry experience at GILLIG
F. Alarcon	BOM Analyst	College	15 yrs. Industry experience
F. Cruz	Configurator Specialist	BSC-Mgmt.	20 yrs. industry experience at GILLIG
G. Estantino	Mechanical Engineer II	BSME	6 yrs. industry experience at ICON Aircraft & GILLIG
G. Mortazavi	Electrical Engineer I	MSEE	5.5 yrs. industry experience at Chicago Transit Authority & GILLIG
H. Mehrzai	Electrical Engineer	MSEE	4 years industrial experience at Grossi Electric Inc, Viant Medical, and GILLIG
H. Perez	Production Support Tech	H.S.	8 yrs. industry experience at GILLIG
H. Sanchez	Sr. Mechanical Engineer I	BSME	7 yrs. industry experience GCM & GILLIG
J. Abrew	BOM Specialist	H.S.	31 yrs. industry experience at GILLIG
J. Fisher	Sr. Mechanical Designer	HS	24 yrs. industry experience at Burke Porter Machinery, Stewart & Stevenson & GILLIG
J. Ocampo	BOM Analyst	College	31 yrs. industry experience at GILLIG
J. Ruiz	BOM Analyst	High School	7 yrs. Industry experience
J. Seei	Configurator Specialist	HS	23 yrs. experience at GILLIG
J. Solis	Electrical Engineer	BS Mechatronic Engineering	1 yr. industry experience at GILLIG
J. Turner	Sr. Electrical Engineer I	BSEE	8 yrs. industry exp at GILLIG
J. Yang	Electrical Engineer - NPE	MSEE	18 yrs. industry experienceat Auto, Commercial Avionics, Autonomous Vehicle. BAE & GILLIG & LIGHT
K. Fernandez	Configurator Specialist	H.S.	9 yrs. industry experience at GILLIG

K. Kung	Electrical Engineer II	BSEE	14 yrs. industry experience at New Logic Research, Elma Electronics, Novate Solutions, and GILLIG.
K. Lynch	BOM Specialist	High School	25 yrs. GILLIG experience
K. Nguyen	Product Validation Engineer	BSME	5 Yrs. Industry experience, UniTrans & GILLIG
L. Bush	Sr. Electrical Engineer I	BSIT	20 yrs. industry experience at Compass, Autocam, TPI, Dow Jones & GILLIG
L. Nguyen	Sr. Electrical Engineer II	BSEE	17 yrs. industry experience at Panasonic Automotive & GILLIG
L. Perez	Mechanical Engineer I	BSME	
M. Genova	Mngr. Product Safety & Compliance	MSAE	22 yrs. industry experience at AVL, Fiat, Landirenzo-Baytech USA, & GILLIG
M. Janov	Sr. Electrical Engineer I	BSCmpE	6 yrs. industry experience at Fetch Robotics, NASA Langley, SpaceX, & GILLIG
M. Mohammedkair	Sr. Electrical Engineer I	BSEE	10 yrs. industry experience at GILLIG
M. Ortega	Electrical Engineer I	BSEE	4 yrs. industry experience at GILLIG
M. Rands	BOM Specialist	H.S.	10 yrs. industry experience at GILLIG
M. Roberts	Sr. Mechanical Engineer II	MSME	8 yrs. industry experience at BHJ Dynamics & GILLIG
M. Ruth	Sr. Electrical Engineer II	BS EMET	22 yrs. industry experience at Harley Davidson, Voith, & GILLIG.
M. Shaieb	Sr. Mechanical Engineer I	BSME	41 yrs. industry experience at BAE Systems & GILLIG
N. Clopton	Sr. Mechanical Engineer II	BSME	14 yrs. industry experience Parker Hannifin, Racor Division
N. Henderson	Sr. Mechanical Engineer I	BSME	8 yrs. industry experience at Zodiac Aerospace & GILLIG
P. Orr	Mechanical Engineer 1	BSME	6 mo. Industry experience at Haas Automation and GILLIG
P. Titus	Sr. Product Validation Engineer	3yr. College toward BSEE, various Training certificates	35 Yr. industry manufacturing and management experience, Sun Microsystems, Oracle, Fujikura and GILLIG
P. Zimmerman	Production Support Specialist		28 yrs. industry experience at GILLIG
R. Brar	Sr. Mechanical Engineer II	MS Aerospace Engineering	10 yrs. industry experience at Int'l Cars & Motors, Heil Trailer & GILLIG
S. Dunbar	Electrical Engineer	BSEE	6 yrs. industry experience at GILLIG
T. Agawa	Sr. Mechanical Engineer I	BSIT	33 yrs. industry experience at GILLIG & Peerless Lighting
T. Doom	Mechanical Engineer 2	BSME	8 yrs. Experience at Aisin, B & H Labeling & GILLIG

T. Gilbert	Sr. Product validation Engineer	BSEE/MSEE	7Yrs. Industry Experience, Space Systems/Loral, Brava & GILLIG
T. Jones	CAD Specialist	AA Mechanical	18 yrs. industry experience NABI & GILLIG
T. Nguyen	Electrical Engineer	BSEE	2.5 yrs. industry experience at EBMUD, Teledyne RISI, and GILLIG
T. Talavera	BOM Analyst	College	5 yrs. Industry experience
V. Ng	Mechanical Engineer I	BSME	5 yrs. industry experience Kinetic Systems, T&H Manufacturing and GILLIG
V. Vo	Production Support Specialist		16 yrs. industry experience at GILLIG
W. Nairn	Production Support Lead	College	20 yrs. industry experience at GILLIG

GILLIG

WARRANTY SUPPORT

GILLIG stands behind the quality of our products and we have selected supplier partners who share this belief as well. We have provided our GILLIG APPLICATION FOR WARRANTY PROCEDURE which describes the process by which GILLIG handles warranty claims. Normal warranty work (other than that work required to be performed by sub-suppliers as discussed below) will be performed by the Agency's maintenance department and reimbursed by GILLIG at the documented warranty labor rate. In the unlikely event that abnormal warranty is required, GILLIG will work with the Agency to resolve any such warranty projects which Agency believes should be repaired directly by GILLIG.

Due to the nature of some components and the associated warranties, GILLIG believes that warranty work on the following should initially be managed by the sub-suppliers:

- Engine
- Transmission
- Axles
- Air Conditioning Unit
- Batteries
- Destination Signs
- Video Surveillance Systems
- Intelligent Transit Systems
- Agility CNG Fuel System

GILLIG routinely assists customers in resolving warranty matters when local vendors are unable or unwilling to provide necessary support by involving GILLIG's contacts either at the local service facilities or through the component manufacturer's corporate levels.

Feel free to contact our Field Service Department for assistance or if you have questions:

Field Service Coordinator
GILLIG Service Department
451 Discovery Drive
Livermore, CA 94551
(510) 264-5073
FieldService@GILLIG.com

GILLIG

WARRANTY SERVICE STAFF

The Customer Care Department is available to assist the procuring Agency in processing warranty claims as required. GILLIG's Field Service Representatives will assist the procuring agency in the proper procedure for obtaining warranty parts, completion of the warranty forms, and the handling of parts for warranty claims processing. In-house qualified Field Service Representatives are available to troubleshoot questions by phone Monday through Friday, 5:00 a.m. to 2:00 p.m. and have direct access to GILLIG's Engineering Department in order to provide quick turnaround should additional technical assistance be required.

EXECUTIVE DIRECTOR, CUSTOMER CARE
Victor Doran

WARRANTY MANAGER
Michelle Tejeras

REGIONAL SERVICE MANAGERS
Eric Ocampo
Mark Bittner
Thomas Seymour

TECHNICAL ADVISOR WARRANTY
Bo Vongamath

WARRANTY PARTS SPECIALIST
Dominic Nava

WARRANTY PROCESSING SPECIALISTS
Johnny Phothipanya

FIELD SERVICE COORDINATOR

Our Warranty group essentially deals with repair, replacement, or reimbursement for product failures during the warranty period of a particular product. A warranty claim, describing the failure (and other relevant details) must be filed in order to start the process of getting the failure fixed.

The warranty claim is reviewed by the Warranty Processing Specialist and a determination on its status (accept, accept with adjustments, or reject) is made, often after discussions with GILLIG's Q.A., Manufacturing, or Engineering Departments, or with vendor OEMs. The claim response is then sent back to the customer, as well as being relayed to relevant GILLIG departments for corrective action, including as necessary, reimbursement or replacement for the customer, design or manufacturing review at GILLIG, reporting to and recovery from the vendor, as well as additional information collection, testing and/or redesign for GILLIG or the vendor, when needed. We usually ask for failed parts to be returned to help with failure analysis and vendor recovery.
If you disagree with a warranty claim decision, you can resubmit the claim along with additional justification supporting your position, to the Service Manager for reconsideration. Your claim will be reviewed and you will be notified of the review decision within a week or two.

GILLIG INSTRUCTIONS

FOR COMPLETING APPLICATION FOR WARRANTY CLAIM

GILLIG requires only one failure per claim. A single claim can be for multiple buses as long as they're for the same failure, and have identical labor claimed. The VIN and mileage of each bus on the claim should accompany the Application for Warranty.

GILLIG uses the information on the Application for Warranty to detect failure trends and make improvements, failure descriptions such as "B.O.", "Inop" or "Found Bad" will not suffice. The reason for removal and any troubleshooting procedures should be included to help expedite claims. GILLIG prefers the Repair Order be included with the claim.

Warranty repairs exceeding "Standard Repair Times", (SRT), should have prior authorization to prevent large cuts in reimbursement. To obtain prior authorization, please contact your Warranty Processing Specialist by calling GILLILG Field Service or emailing WarrantyClaims@gillig.com.

Claims for normal replacement items, such as light bulbs, and mechanical adjustments, such as doors or alignments, are not normally approved unless their failure was caused by a warrantable defect. In addition, consumables, such as belts, tires and brake linings, are not warrantable, unless their failure was caused by a warrantable defect of another component.

Warranty claims should be submitted to GILLIG within 30 days of the date of failure. Claims can be emailed to WarrantyClaims@gillig.com.

Claims need to have unique claim numbers assigned. Each property should have a unique prefix, and then whatever number best suits your operation, (such as the Repair Order number). If you do not have or do not know your unique prefix, please contact your Warranty Processing Specialist.

GILLIG will pay at the direction of the bus owner, not the hired contractor or repair shop, until and unless the bus owner directs it.

GILLIG cannot pay an invoice not made out to GILLIG, unless it's listed as a sublet bill on an Application for Warranty Claim.

APPLICATION FOR WARRANTY

It is not necessary to use GILLIG pre-printed forms, but any form used will need the following information:

1. Unique Claim Number (must be pre-approved by GILLIG Warranty).
2. Date claim is being filled out
3. Unit Serial # (Last six digits of the VIN)
4. Coach Number
5. Bus Owner, or Bus Property Name
6. Date bus placed in Revenue Service
7. Odometer or Hub mileage at time of failure
8. Date of Failure
9. Where Repaired (if not at the owner's property)
10. If Claim concerns the Engine, the Engine Serial Number
11. If Claim concerns the HVAC, the Air Conditioning Unit Serial Number
12. If Claim concerns the Transmission, the Transmission Serial Number
13. Complete description of failure, (Repair Order preferred)
14. Were any parts used? (Yes or No)
15. Description of parts used with the GILLIG Part Number
16. Original Part Number (If replacement Part Number differs Original Part Number)
17. Price of the part(s) unless provided by GILLIG
18. Number of parts used
19. Provide subtotal for each part
20. Total all the parts used for this claim
21. Provide contractual warranty labor rate
22. Number of hours worked
23. Multiply number of hours by the labor rate for the total labor claimed
24. Work done by outside firm or tow to be entered and copy of invoice attached
25. Total Sublet cost(s)
26. Total amount for the claim
27. If bus is in California and claim is emission-related, Engine Hours (from ECM or hourmeter)
28. Name & Contact Information of warranty person to answer any questions of claim
29. Email or Phone Number for person having knowledge of claim
30. Name & Contact Information of person who submitted claim
31. Email or Phone Number for person who submitted claim
32. Address of where to send reimbursement or parts credit.

See attached copy of claim with corresponding numbers to indicate where to put the above information.

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APPLICATION FOR WARRANTY

Required fields are marked with an asterisk (*)

*CLAIM NUMBER: #1 *DATE: #2

MAIN (510) 785-1500 | FAX (510) 785-1348

*UNIT SERIAL # #3	*OWNER #5
BUS OR COACH # #4	*MILEAGE AT FAILURE #7
*IN SERVICE DATE #6	WHERE REPAIRED #9
*DATE OF FAILURE #8	ENGINE SERIAL # #10
A/C SERIAL # #11	TRANSMISSION SERIAL # #12

*DESCRIBE SPECIFIC (COMPLAINT, CAUSE, CORRECTION) REPAIRS REQUIRED AND ATTACH COPY OF REPAIR ORDER

#13

#14

IF REPLACEMENT PART NUMBER DIFFERS FROM ORIGINAL PART NUMBER, LIST THE ORIGINAL PART NUMBER HERE: ##16
(IF MORE SPACE IS NEEDED, PLEASE USE SEPARATE SHEET AND ATTACH TO BACK OF CLAIM)

REPLACEMENT PART NUMBERS	PRICE			
PARTS USED: YES ☐ NO ☐	PRICE EACH	QTY. USED	SUBTOTAL	
#15	#17	#18	#19	
				PARTS TOTAL $ #20
*LABOR RATE #21 / *HR. #22				*LABOR TOTAL $ #23
SUBLET (ATTACHED INVOICE COPIES)	PARTS	LABOR	TOTAL	SUBLET TOTAL $ #25
1. #24				*GRAND TOTAL $ #26
2.				

NOTE: IF CALIFORNIA BUS, NEED ENGINE HOURS FROM HOURMETER OR ECM #27

*NAME/PHONE OF CONTACT FOR ADDITIONAL INFO #28 //
//

E-MAIL ADDRESS(ES) #29

*SUBMITTED BY / PROPERTY NAME & ADDRESS #30

E-MAIL ADDRESS(ES) #31

*REIMBURSEMENT NAME AND ADDRESS (IF DIFFERENT FROM ABOVE) #32

E-MAIL ADDRESS(ES)

NOTE: Warranty will be denied if the defective material is not received by GILLIG within 30 days of the failure date.

GILLIG | 451 DISCOVERY DRIVE | LIVERMORE, CALIFORNIA 94551 | 800.735.1500

Application_for_Warranty.indd_20170710

WARRANTY PARTS ORDERING PROCEDURE

1. Determine part(s) being ordered by referring to the parts manual for the specific bus in question. If the part can't be found or isn't listed, you can call GILLIG's Warranty Parts Specialist at 510-264-4433 or WarrantyParts@gillig.com.

2. The information needed:
    a. GILLIG part number
    b. Quantity
    c. Description of part (pump, motor, etc.)
    d. VIN, (Last 6 digits of VIN)
    e. Description of Failure
    f. Mileage at failure
    g. Instructions on where to send parts, (if applicable)

3. If bus is within the base bus warranty, GILLIG will ship the warranty part(s) to your location. Parts will be sent prepaid, best way, (normally second day). If the part is needed there the next day, it can be sent overnight and the difference of shipping cost will be charged back.

4. Normally, GILLIG will want the failed part returned. If so, then we will email an RGA. The defective part should be returned to:

GILLIG, LLC
ATTN: RGA # __________
1100 Voyager Street, Dock B
Livermore, CA 94551

PARTS THAT ARE REQUESTED TO BE RETURNED SHOULD BE SENT WITHIN 30 DAYS. IF THE PARTS ARE NOT RETURNED WITHIN THAT TIME, THE COST WILL BE INVOICED BACK.

5. If the bus is outside the base bus warranty, but the failed component still has warranty coverage from the supplier, the part will have to be purchased from GILLIG's Parts Department, which can then be claimed on an Application for Warranty Claim. GILLIG will roll that over to the supplier, and whatever reimbursement the supplier makes will then be forwarded to the end user.

PARTS RETURN PROCEDURE

Defective part should be returned to GILLIG within 30 days of receipt of GILLIG's Return Goods Authorization, (RGA).

All parts should be capped or plugged to prevent leakage, if applicable. Excess dirt or grease should be removed to facilitate handling.

Removed part should be handled/packed as if new.

Parts should never be sent "COD". GILLIG may provide a call tag, or the shipping cost can be included on the Application for Warranty.

Call tags are only utilized when the bus is still covered by the base bus warranty. If a call tag is being requested, we will need to know 1) RGA # & 2) Total weight of package.

Part(s) must be tagged with the following information:

A. Last 6 digits of VIN
B. Date bus went into Service & Mileage at Failure
C. Concise reason for removal
D. Bus owner's name/name of transit agency

CHANGE CONTROL

GILLIG's change control process involves several departments within the organization and working with our component suppliers as their products reach end of life. GILLIG believes in a constant improvement process, this is controlled thru an Engineering Production Change (EPC) process managed by our Materials Department. A meeting is scheduled once a month with Materials, Purchasing, Engineering, Manufacturing, Sales and Parts, to discuss product improvements/new design and supplier end of life notifications.

Once a change has been identified the subject matter is reviewed by Engineering for design, Purchasing for cost, Manufacturing for production impact, Parts for aftermarket support and Materials/Sales for customer implications. Once approved by all departments, Engineering and the Bill of Material group will release the component details (parts, installation drawings, customer, dates) and production implementation plan thru our documented EPC control process.

FIELD SERVICE MODIFICATIONS

GILLIG's focus on designing and building the most reliable and cost-effective bus in the industry necessitates selecting supplier partners who share our philosophies on quality and reliability. As a result of this focus, GILLIG has no major fleet defects (grounded fleet), a minor number of vendor defects and the lowest warranty claim experience in the industry.

Over the past five years, GILLIG has sent out several Field Service Bulletins which communicate suggested maintenance procedures, clarifications of previously released procedures and supplier or GILLIG proposed repairs. Seven of these bulletins were minor field repairs resulting from design improvements intended to prevent future failures.

We have provided a sample for your reference.

FIELD SERVICE BULLETIN

FS-2019-02: Product Alert - *FS 300 Hose Identification*

Date: May 6, 2019

Model: All

Model Years: 1997 – 2019

Because of a supply issue with the blue hose covering, Eaton is temporarily making FC-300 hose using black covering. FC-300 hose assemblies made between October 2018 to May 2019 will be affected by this change.

To avoid being mistaken for FC-350 hose, Eaton has applied the following unique identifiers to the FC-300 hose assemblies:

1. ***Yellow ink markings to the hose identifying it as FC-300.***
   Note: White ink markings are used on FC-350 hose assemblies.
2. ***Blue stripe around the hose identifying it as FC-300.***
   a. ***Hoses 2-ft and shorter will have a blue stripe located in the center of the hose length.***
   b. ***Hoses longer than 2-ft, up to 4-ft in length have a blue stripe located at each end, adjacent to the fitting.***
   c. ***Hoses longer than 4-ft have a blue stripe located at each end, adjacent to the fitting, and an additional stripe located in the center of the hose length.***

In addition, the hose will still have a foil tag with the Gillig part number.

Note: FC-300 and FC-350 have different pressure ratings, so it's important to not mix them.

Approved:

Robert L. Birdwell, Executive Director
Quality Control & Field Service

Product Alert

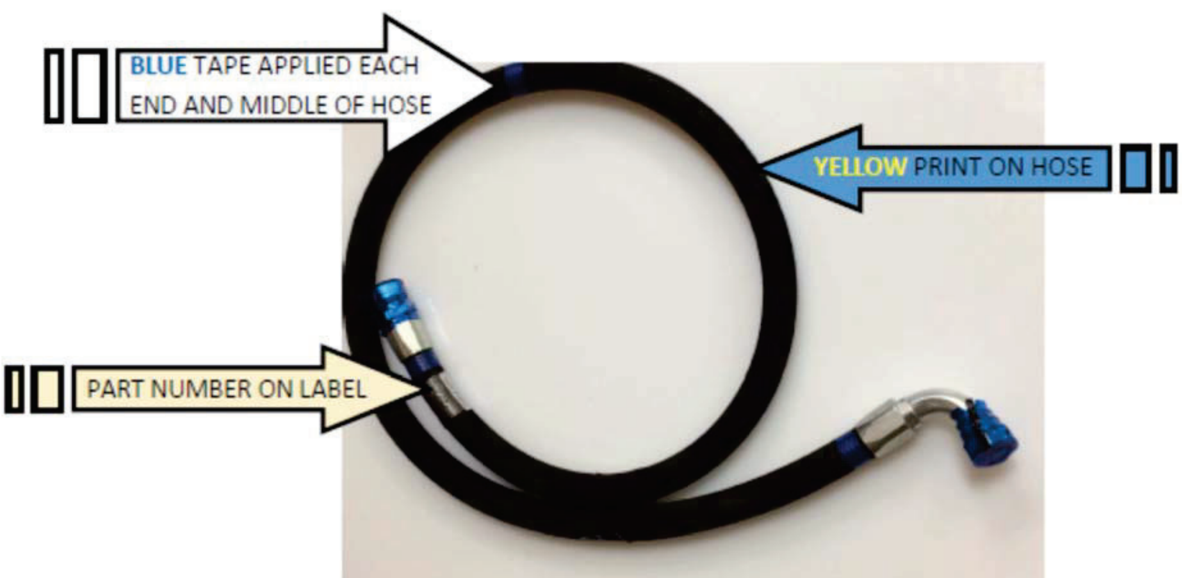
Affected products: Gillig hose assemblies part numbers 46-xx**B**xxxx-xxxx

Gillig hose assemblies made with Eaton FC300 hose, which typically have a blue yarn cover will temporarily have a black cover.

Due to a supply issue with blue yarn Eaton is temporarily making FC300 hose with black colored yarn and applying yellow print instead of white print. The hose is otherwise identical to what has always been supplied and meets all specifications for use.

HOW TO IDENTIFY THIS HOSE AS CORRECT

1. **BLUE TAPE IS BEING APPLIED TO EACH ASSEMBLY AS A QUICK CHECK THAT IT IS FC300 HOSE**
2. **HOSE WILL HAVE YELLOW PRINTING INSTEAD OF WHITE**
3. **PART NUMBER ON LABEL WILL IDENTIFY THE CORRECT HOSE ASSEMBLY**



FS-2019-02
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Original blue FC-300

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STANDARD REPAIR TIMES

TASK DESCRIPTION	SRT
BATTERY ELECTRIC BUS MAIN COMPONENTS	
R&R ESS JUNCTION BOX	2.00
R&R HVAC JUNCTION BOX	2.00
R&R FRONT PLUG-IN CHARGER	4.00
R&R REAR PLUG-IN CHARGER	2.00
R&R HV CABLE	TIME VARIES DEPENDING ON CABLE
R&R BATTERY TMS	4.00
R&R PASSENGER ECOOLANT HEATER	6.00
R&R AIR COMPRESSOR (POWEREX)	2.00
R&R POWER STEERING PUMP	1.50
R&R ELECTRONIC COOLING PACKAGE	5.00
R&R MAIN BATTERY DISCONNECT SWITCH (KISSLING)	2.00
R&R ESS PACKS (ROOF)	1.00
R&R ESS PACK (CHASSIS)	3.00
R&R ESS PACKS (POWERTRAIN COMPARTMENT)	12.00
R&R TRACTION MOTOR INVERTER & TRACTION MOTOR	12.00
R&R DC/AC CONVERTER	4.00
R&R DC/DC CONVERTER	4.00
R&R SYSTEM CONTROL MODULE	1.00
R&R BATTERY MANAGEMENT SYSTEM	1.00
R&R CHARGE CONTROLLER	1.00
R&R PRIMARY HV JUNCTION BOX	6.00
WHEELCHAIR RAMP MECHANICAL	
REMOVE/INSTALL RAMP ASSEMBLY	2.00
CLEAN/REPLACE/ADJUST CHAIN	1.00

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WHEELCHAIR RAMP ELECTRICAL

REPLACE FLASHER FOR RAMP BEEPER	0.50
CLEAN/REPAIR/REPLACE CONTROLLER BOARD	1.00
CLEAN/REPAIR/REPLACE DUETSCH PLUG	0.60
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPAIR/REPLACE WIRING	2.50

FRONT AXLE

REPLACE KING PIN/BOTH SIDES	7.90
REPLACE TIE ROD END/BOTH SIDES	1.70
ALIGN FRONT END	0.90
REPLACE TIE ROD ASSEMBLY	1.70
LUBRICATE KING PINS/DRAGLINK/TIE ROD ENDS	0.70
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.30
R&R ABS SENSOR	0.50
ABS CABLE	1.50

REAR AXLE

REPLACE REAR AXLE	8.00
REPLACE DIFFERENTIAL	6.00
REPLACE GASKET, O-RING OR SEAL	6.00
REMOVE/INSTALL REAR AXLE FOR TOWING PURPOSES	0.70
ADD/CHANGE DIFFERENTIAL GREASE	0.40
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
PINION SEAL	2.00
R&R ABS SENSOR	1.00
ABS CABLE	1.50

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STANDARD REPAIR TIMES

AXLE HUB

REPLACE AXLE HUB	4.20
REPLACE AXLE BEARING	0.60
REPLACE AXLE HUB SEAL	1.70
REPLACE WHEEL STUDS/NUTS	0.30
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50

BRAKES

REPLACE BRAKE SPIDER	1.80
REPLACE SLACK ADJUSTER	0.80
REPAIR/REPLACE SLACK ADJUSTER LINKAGE	0.70
LUBRICATE BRAKE PINS	0.90
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
FRONT BRAKE JOB	1.50
REAR BRAKE JOB	3.00
FULL FRONT BRAKE JOB INCLUDING WHEEL SEAL	4.00
FULL REAR BRAKE JOB INCLUDING WHEEL SEAL	4.50
R&R BRAKE CALIPERS ON DISC BRAKES	2.50

SUSPENSION

REPLACE AIR BAG	1.50
REPLACE LEVELER VALVE/LINK	1.10 EA
ADJUST AIR BAG HEIGHT	0.60
REPLACE UPPER AND LOWER TORQUE ROD	0.80
REPLACE UPPER TORQUE ROD MOUNT/BRK	2.00
REPLACE SHOCK ABSORBER/BUSHINGS	0.90
REPLACE LOWER TORQUE ROD MOUNT/BRK	4.00
REPLACE SHOCK MOUNT	1.10
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
KNEELING VALVE	2.00

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STANDARD REPAIR TIMES

STEERING

REPLACE STEERING GEAR	3.00
REPLACE MITER BOX	1.20
REPLACE PITMAN ARM	1.10
REPLACE DRAGLINK/END	1.00
REPLACE STEERING POPPET KIT	1.50
REPLACE STEERING WHEEL	0.80
REPLACE POWER STEERING PUMP	2.00
REPAIR HORN SYSTEM	1.00
RESEAL STEERING GEAR/ANGLE BOX	2.40
REPAIR/REPLACE STEERING COLUMN	2.00
LUBRICATE STEERING COMPONENT	1.00
REPAIR/REPLACE POWER STEERING RESERVOIR	1.50
ADD OIL OR FLUSH SYSTEM	0.50
REPAIR/REPLACE PIPE/HOSE	1.30
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
R&R TRW EASY STEER COLUMN	2.00

TIRES

REPLACE TIRES	1.50
REPAIR TIRE	1.10
BALANCE TIRES	1.00
ROTATE TIRES	1.70

EXTERIOR BODY

REPAIR/REPLACE BODY FRAMEWORK COMPONENT	2.00
REPAIR/REPLACE BULKHEAD	1.80
REPAIR/REPLACE EXTERIOR BODY PANEL	1.00
REPAIR/REPLACE FENDER RUBBER/TRIM	1.00
REPAIR/REPLACE/INSTALL/TIGHTEN MIRROR	0.60

REPAIR/REPLACE/ADJUST WIPER/WASHER COMPONENT	0.80
REPAIR/REPLACE/TIGHTEN BUMPER	1.00
REPAIR/REPLACE ROOF HATCH	0.80
SAND/PAINT EXTERIOR BODY-LEFT HAND	5.10
SAND/PAINT EXTERIOR BODY-RIGHT HAND	5.10
REPAIR/REPLACE MUD FLAP	0.90
REPAIR/REPLACE RUB RAIL	0.50
SEAL WATER LEAK INTO COACH	2.00
REPAIR/REPLACE BATTERY TRAY	2.80
W/S WIPER MOTOR	1.00
FRONT CAP	20.00

INTERIOR BODY

REPAIR/REPLACE FLOOR	22.00
REPAIR/REPLACE MODESTY PANEL	1.20
REPAIR/REPLACE INTERIOR BODY PANEL	0.90
REPAIR/REPLACE DRIVER'S SEAT/CUSHION	1.10
REPAIR/REPLACE/INSTALL/TIGHTEN MIRROR	0.30
REPAIR/REPLACE/INSTALL FAREBOX	0.80
REPAIR/REPLACE SUN VISOR	0.60
REPAIR/REPLACE WINDOW LATCH	0.80
REPAIR/REPLACE/INSTALL DRIVER'S SEAT BELT	0.60
REPAIR/REPLACE BELLCORD/GUIDE	0.70
REPAIR/REPLACE PASSENGER SEAT/COVER/CUSHION	0.30
REPAIR/REPLACE STEPWELL-FRONT 0252, REAR 0320	0.80
REPLACE COVERING FOR BRAKE/THROTTLE PEDAL	0.80
REPAIR/REPLACE STANCHION/MOUNT	0.50
REPAIR/REPLACE ENGINE HATCH COVER	1.00
REPAIR/REPLACE FLOOR COVERING	16.00

WINDOWS AND GLASS

REPLACE PASSENGER WINDOW GLASS/LOWFLOOR/BRT PER SIDE	2.00
REPLACE WINDSHIELD GLASS	2.00
REPLACE DOOR GLASS	0.80
REPLACE DESTINATION SIGN GLASS	1.00
REPAIR/REPLACE WINDOW FRAME/RUBBER	0.80
SEAL WATER LEAK INTO COACH	1.30
REPAIR/REPLACE EMERGENCY WINDOW RELEASE	0.80
REPLACE WINDSHIELD GLASS BRT 1 PC	3.00
REPLACE BRT OPERA WINDOW	1.00

PASSENGER DOORS

REPAIR/REPLACE PASSENGER DOOR ASSEMBLY	1.90
REPLACE PASSENGER DOOR MOTOR	1.20
REPAIR/REPLACE/ADJUST PASSENGER DOOR LINKAGE	0.90
REPAIR/REPLACE TOUCH-BAR	1.40
REPAIR/REPLACE ENGINE COMPARTMENT DOOR	0.50
REPLACE LIFT-U MAT	0.60
REPAIR/REPLACE DOOR CONTROL VALVE	0.50
REPAIR/REPLACE FRONT DOOR SHUT OFF VALVE	1.00
REPLACE RELAY	0.60
REPLACE/ADJUST PROXIMITY SWITCH	0.50
REPAIR/REPLACE REAR DOOR SOLENOID	0.70
LUBRICATE DOOR LINKAGE/HINGE	0.50
REPAIR/REPLACE PIPE/HOSE	0.30
REPAIR/REPLACE SENSITIVE DOOR EDGE	1.10
REPAIR/REPLACE WIRING	0.50
RECONDITION PASSENGER DOOR ENGINE	1.50

GILLIC

COMPARTMENT DOORS (EXTERIOR)

REPAIR/REPLACE ENGINE DOOR	1.10
REPAIR/REPLACE RADIATOR DOOR	0.50
REPAIR/REPLACE BATTERY DOOR	0.80
REPAIR/REPLACE FUEL DOOR	1.00
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50

SPECIAL EQUIPMENT/ACCESSORIES

REPAIR/REPLACE BIKE RACK	0.50
REPLACE/INSTALL REFLECTIVE TRIANGLES	0.30
REPLACE/INSTALL FIRE EXTINGUISHER	0.30
REPAIR/REPLACE/INSTALL ADVERTISING SIGN FRAME (PER)	0.80
REPAIR/REPLACE/INSTALL PASSENGER COUNTER	0.80
REPAIR/REPLACE/INSTALL DRIVERS BOX	0.90
REPAIR/REPLACE/INSTALL WHEELCHAIR RESTRAINTS (ALL)	1.10
INSTA CHAIN REPAIRS-SOLENOID	1.00

TWO WAY RADIO

REPLACE RADIO/CONTROL HEAD	0.90
REPLACE RADIO CONTROL UNIT	1.30
REPAIR/REPLACE RADIO POWER UNIT	1.00
REPAIR/REPLACE ANTENNA	1.30
INSTALL COMPLETE RADIO ASSEMPLY	1.50
REPLACE HANG UP CRADLE ASSEMBLY	0.50
REPAIR/REPLACE WIRING	0.50

HEATER AND DEFROST SYSTEM

REPLACE HEATER CORE	2.00
REPLACE MARINE PUMP	1.00
REPLACE DEFROSTER/HEATER MOTOR	1.50

REPLACE WATER MODULATOR VALVE	1.00
REPLACE/ADJUST THERMOSTAT/GRADUSTAT	0.30
REPAIR/REPLACE HEAT CONTROL VALVE/CABLE	1.10
CLEAN/REPLACE HEATER FILTER	0.10
REPLACE CIRCUIT BREAKER	0.20
REPLACE SWITCH	0.70
CLEAN/REPAIR/REPLACE AMPHENOL PLUG	1.00
REPLACE HEATER RESISTOR	0.80
REPAIR/REPLACE PIPE/HOSE	1.00
REPAIR LEAK	0.40
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPLACE RELAY, SWITCH, DIOD, ETC.	0.60
REPAIR/REPLACE WIRING	0.80

AIR COMPRESSOR AND SUPPLY SYSTEMS

REPLACE AIR COMPRESSOR GOVERNOR	0.90
REPLACE AIR DRYER	1.50
REPLACE SAFETY VALVE	0.50
SERVICE/REPLACE PURGE VALVE	0.90
REPLACE AIR SWITCH	0.50
REPLACE CHECK VALVE	0.50
REPLACE GASKET/O-RING/SEAL	1.40
REPAIR/REPLACE PIPE/HOSE	1.40
REPAIR LEAK	0.90
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50

AIR BRAKE SYSTEMS

REPLACE BRAKE TREADLE VALVE	1.50
REPLACE BRAKE RELAY VALVE	2.00
REPLACE QUICK RELEASE VALVE	0.50
REPLACE REAR BRAKE CHAMBER	1.00
REPLACE FRONT BRAKE CHAMBER	0.60
REPLACE AIR SWITCH	0.60
REPAIR/REPLACE PIPE/HOSE	0.80
REPAIR LEAK	0.80
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPLACE RELAY, SWITCH, DIODE, ETC.	0.50

BRAKE INTERLOCK SYSTEMS

REPLACE/ADJUST AIR REGULATOR VALVE	0.70
SERVICE/REPLACE SOLENOID/SKINNER VALVE	1.10
REPLACE CIRCUIT BREAKER	0.30
REPLACE RELAY	0.50
REPLACE/ADJUST MICRO SWITCH/BRACKET	0.50
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPLACE SWITCH	0.60
REPAIR/REPLACE WIRING	0.80

ELECTRICAL ACCESSORIES

REPAIR/REPLACE PASSENGER CHIME	0.50
REPAIR/REPLACE BACK UP BEEPER	0.50
REPLACE/INSTALL AM/FM RADIO/ANTENNA	0.90
REPAIR/REPLACE NEXT STOP COMPONENT	0.90
REPAIR/REPLACE HORN COMPONENT	0.80
REPAIR/REPLACE DRIVER'S FAN	0.70
REPAIR/REPLACE P.A. SYSTEM COMPONENT	1.00

REPAIR/REPLACE MIRROR SWITCH/MOTOR/WIRING	1.00
DINEX MODULES/MULTIPLEXING	0.50
W/S WIPER MOTOR	1.00
R&R AMEREX CONTROL MODULE	0.50
R&R AMEREX HEAT SENSOR(THERMISTOR)	0.50
R&R GILLIG FIRE DETECTION WIRE	1.00

CHARGING SYSTEMS

REPLACE/ADJUST REGULATOR	0.70
REPLACE VANNER EQUALIZER	1.00
REPLACE CIRCUIT BREAKER	0.30
REPLACE RELAY	0.30
REPLACE DIODE	1.10
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPLACE RELAY, SWITCH, DIODE, ETC.	0.50
REPAIR/REPLACE WIRING	0.80
CHECK/TROUBLESHOOT CHARGING SYSTEM	1.50

BATTERY

REPLACE BATTERIES	0.70
SERVICE AND CLEAN OFF BATTERIES	0.50
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.40
DISCONNECT ALL POWER BEFORE WELDING	1.50

INTERIOR LIGHTING SYSTEMS

REPLACE FLOURESCENT TUBE/BULB/LED	0.50
REPAIR/REPLACE LENS	0.30
REPAIR/REPLACE BULB SOCKET/PIGTAIL	0.50
REPLACE LIGHT BALLAST	0.60
REPLACE CIRCUIT BREAKER	0.30

REPLACE SWITCH	0.50
REPLACE/ADJUST MICRO SWITCH/BRACKET	0.50
REPLACE RELAY	0.20
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPLACE RELAY, SWITCH, DIODE, ETC.	0.50
REPAIR/REPLACE WIRING	0.90

EXTERIOR LIGHTING SYSTEMS

REPLACE BULB/SEAL BEAM	0.30
REPAIR/REPLACE LENS	0.40
REPAIR/REPLACE BULB SOCKET/PIGTAIL	0.60
REPLACE CIRCUIT BREAKER	0.30
REPLACE SWITCH	0.50
REPLACE RELAY	0.30
REPLACE DIODE	0.30
CLEAN/REPAIR/REPLACE AMPHENOL PLUG	1.00
REPLACE COMPLETE LIGHT ASSEMBLY	0.90
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPLACE REPLAY, SWITCH, DIODE, ETC.	0.50
REPAIR/REPLACE WIRING	0.70
REMOVE AND REPLACE FRONT TURN SIGNAL ASM	0.50
REMOVE AND REPLACE LED HEADLIGHT	0.50

WARNING LIGHTS, BUZZERS, GAUGES

REPLACE GAUGE	0.90
REPLACE LIGHT BULB OR SOCKET	0.50
REPLACE SENDING UNIT	0.90
REPAIR/REPLACE INSTRUMENT PANEL	1.00
REPAIR/REPLACE SPEEDO HEAD/TRANSDUCER/SENSOR	0.50

REPAIR/REPLACE BLUB SOCKET/PIGTAIL	0.50
REPLACE CIRCUIT BREAKER	0.30
REPLACE SWITCH OR SENSOR	0.50
REPLACE RELAY	0.40
REPLACE WARNING BUZZER	0.40
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPLACE REPLAY, SWITCH, DIODE, ETC.	0.60
REPAIR/REPLACE WIRING	0.80

DESTINATION SIGN

REPLACE MESSAGE MONITOR/CONTROL CONSOLE	0.50
REPLACE ENCODER	0.90
REPLACE DISPLAY BOARD	0.80
REPLACE DRIVER BOARD	0.70
REPLACE EPROM CHIP/REPROGRAM CONTROL CONSOLE	0.50
CLEAN DESTINATION SIGN/WINDOW	0.80
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPLACE REPLAY, SWITCH, DIODE, ETC.	0.40
REPAIR/REPLACE WIRING	1.00

SHIFT LINKAGE AND CONTROLS

REPLACE SHIFTER BULB OR LENS (VOITH)	0.70
REPLACE SWITCH	1.30
REPAIR/REPLACE WIRING	1.20

DRIVELINES

REPLACE DRIVELINE	1.20
REPLACE U-JOINT	1.00
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50

TRANSMISSION CONTROL SYSTEMS

REPAIR/REPLACE PUSH BUTTON SHIFT UNIT	0.50
REPLACE BRAKE VALVE PRESSURE SWITCH	0.50
REPAIR/REPLACE WIRING	0.90

CHASSIS

LH FRAME REPAIR	12.00
RH FRAME REPAIR	12.00

One of the design goals of all GILLIG Low Floor buses was to maximize maintenance accessibility. A direct measure of this goal is the number of man-hours required to maintain the vehicle. The GILLIG Low Floor bus was designed with this in mind.

First and foremost, the bus uses the T-drive power train configuration. Leveraging the operating economies experienced with our standard floor bus, the Low Floor has been designed to capture the same benefits.

The large rear engine compartment door, large A/C exterior grill with hinges, street side radiator door, and curbside engine compartment door have been designed to reduce maintenance hours by increasing maintenance access. Large access doors are also mounted for the rear wheel wells to improve access to the suspension componentry. A large battery compartment skirt panel encloses the stainless steel slide out battery tray.

The interior destination sign door allows for quick access to the sign and window cleaning. The multiplex electrical system is also accessed from inside the bus overhead of the driver's area and at the rear bulkhead.

The bus is based on a simple design philosophy but with robust design concepts. Our goal was to duplicate the reliability, durability, and cost effectiveness already achieved with our standard floor Phantom bus. This has been achieved.

Proven transit technology was utilized to keep the bus maintenance friendly, and our simple innovative ideas solved those inherent compromises typically found in other low floor bus designs.

Maintenance Schedule

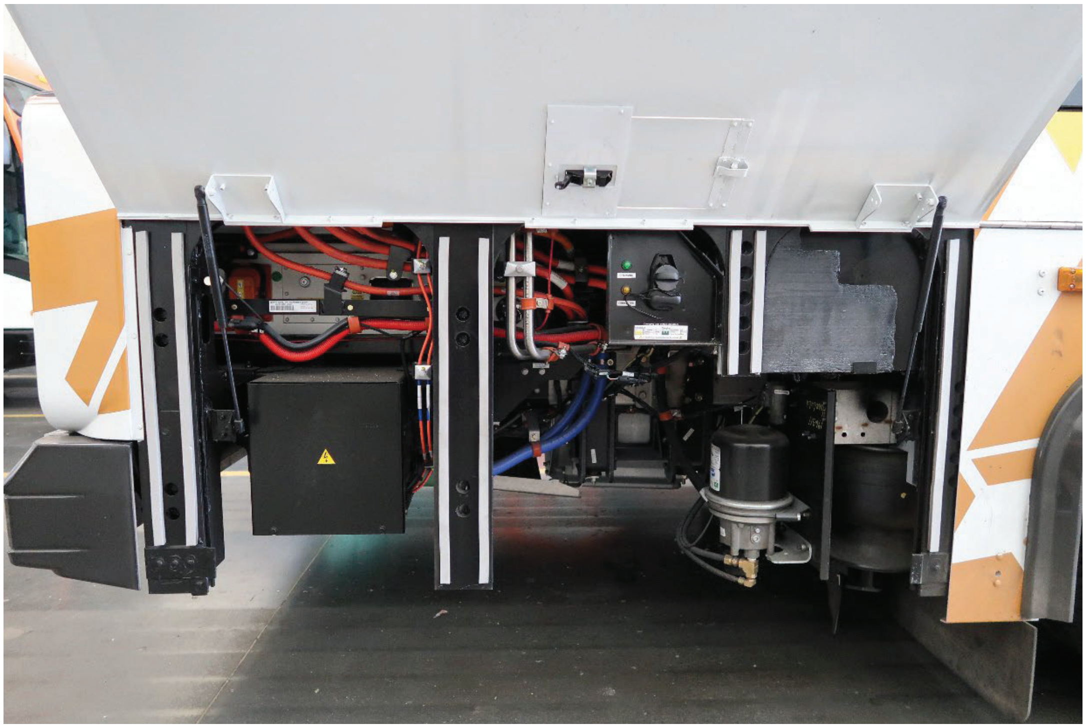
GILLIG's Preventative Maintenance (PM) schedule is based on intervals of 6,000 miles (except for specific major component requirements) beginning at 6,000 miles. Many properties elect to use intervals of 3,000 miles. GILLIG also recommends a daily inspection to be performed by the assigned driver. The daily inspection checklist is often times drawn from a portion of the PM program.

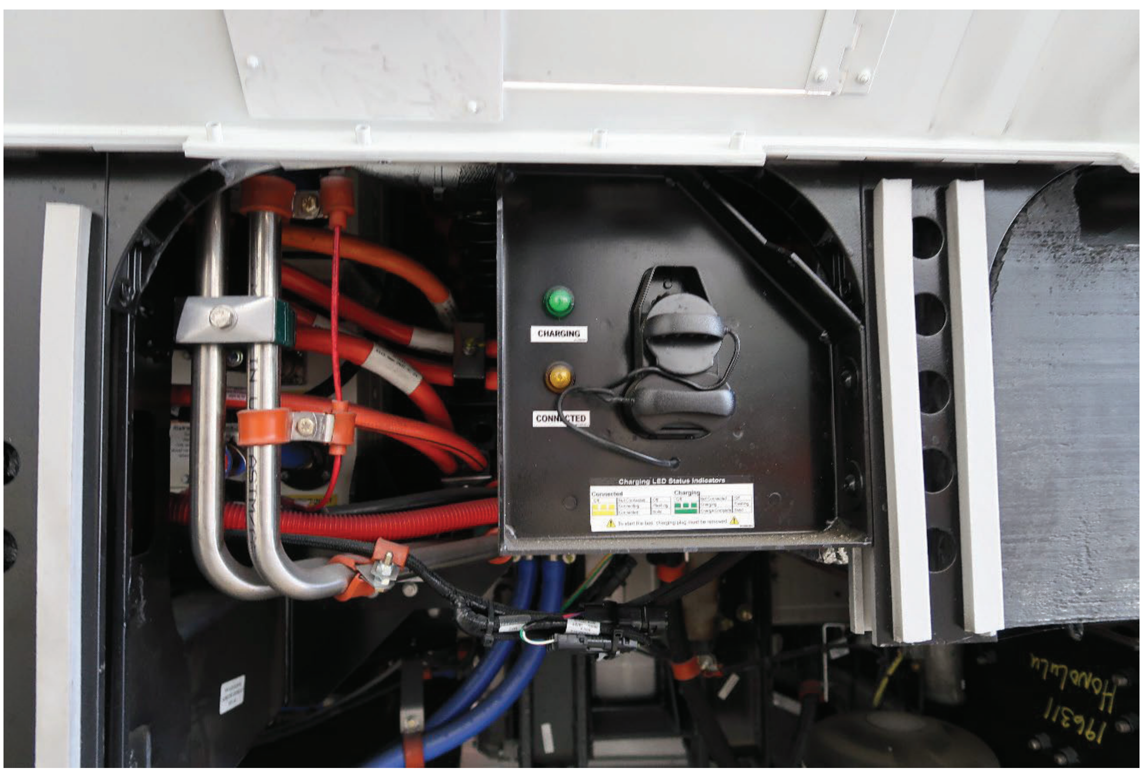
According to PM information gathered from GILLIG customers, the following are estimates that would apply to the following activities:

- If utilized, the 3,000-mile inspection is estimated to take 5.5 man-hours
- The 6,000-mile inspection is estimated to take 7.5 man-hours
- The 12,000-mile inspection is estimated to take 10 man-hours
- The 18,000-mile inspection is estimated to take 7 man-hours
- The 36,000-mile inspection is estimated to take 22 man-hours

Curbside Access Doors

Curbside Battery Thermal Management System (BTMS)

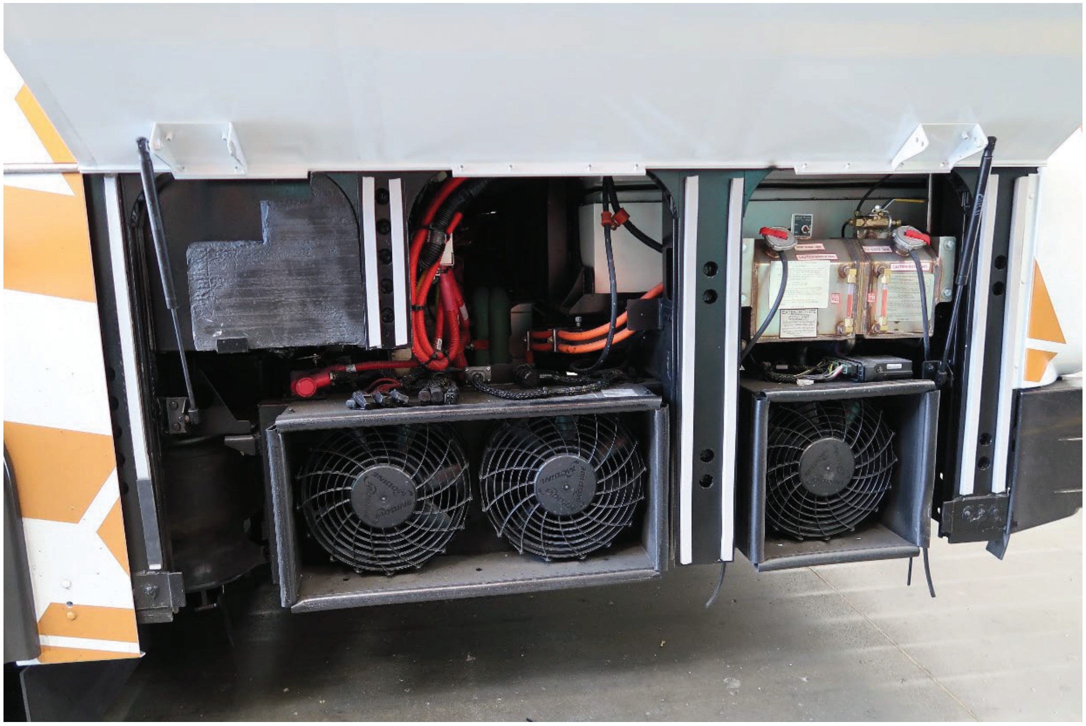


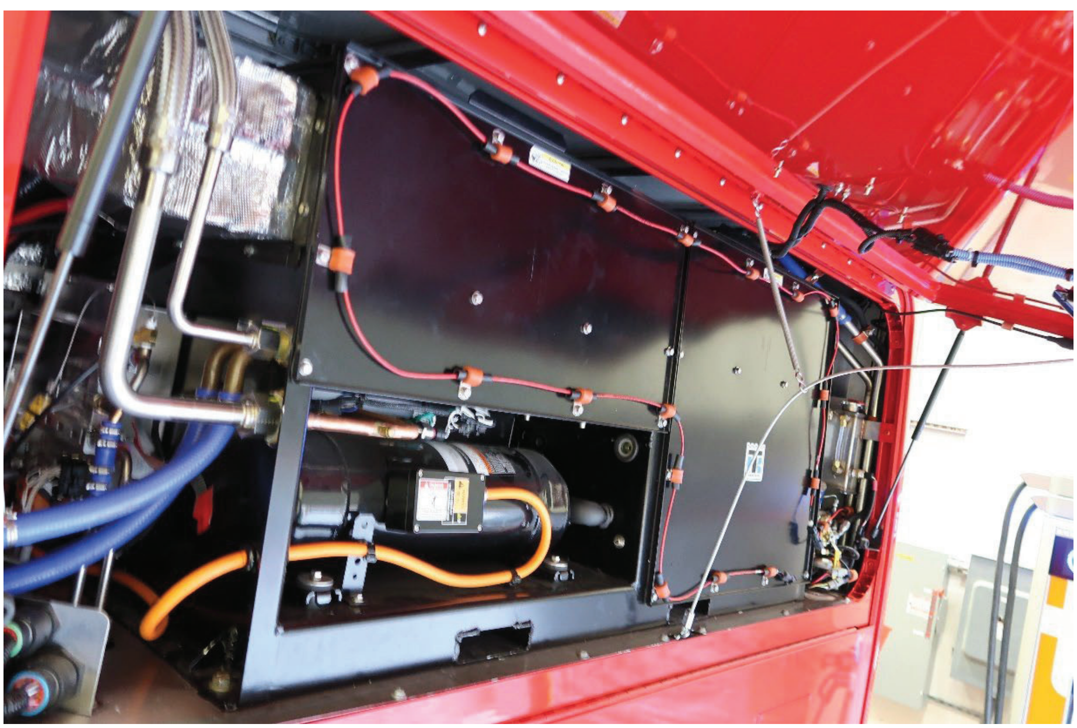


Curbside – Plug-In Charge Port

Streetside Access Doors

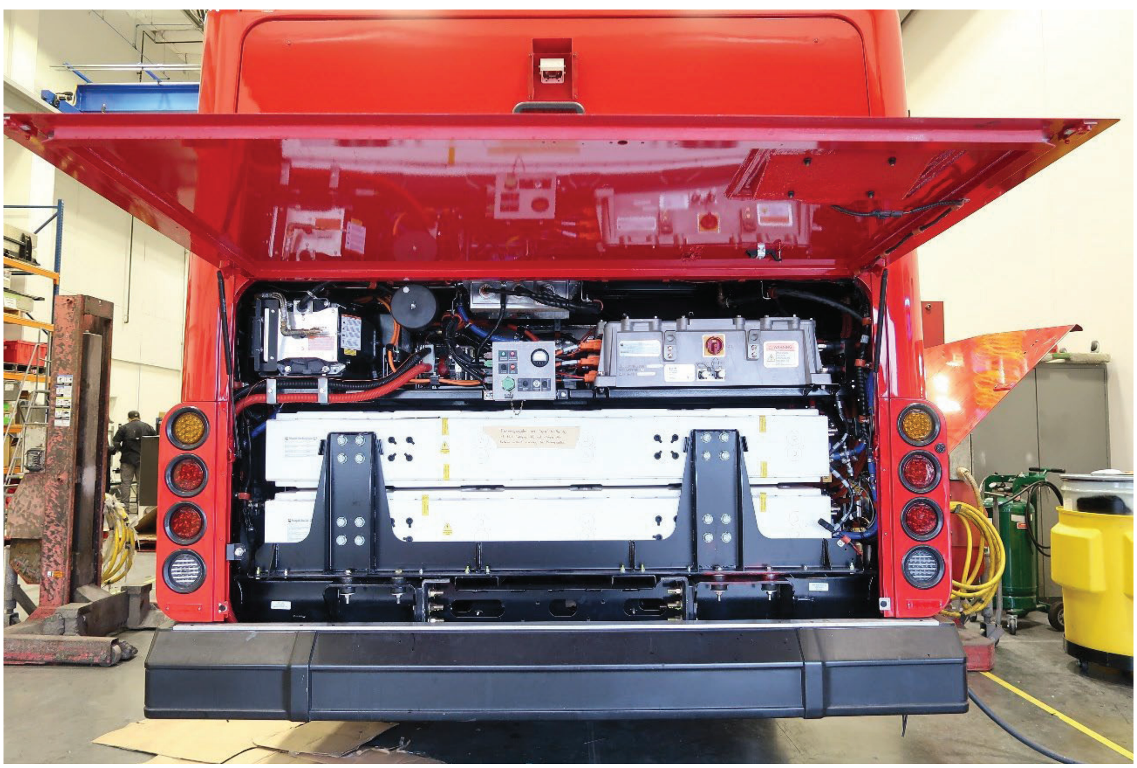
Streetside Access Door – Cooling System Battery Packs





HVAC Access Door

Rear HVAC and Powertrain Compartment Access Doors



Rear Compartment Access Doors – Battery System

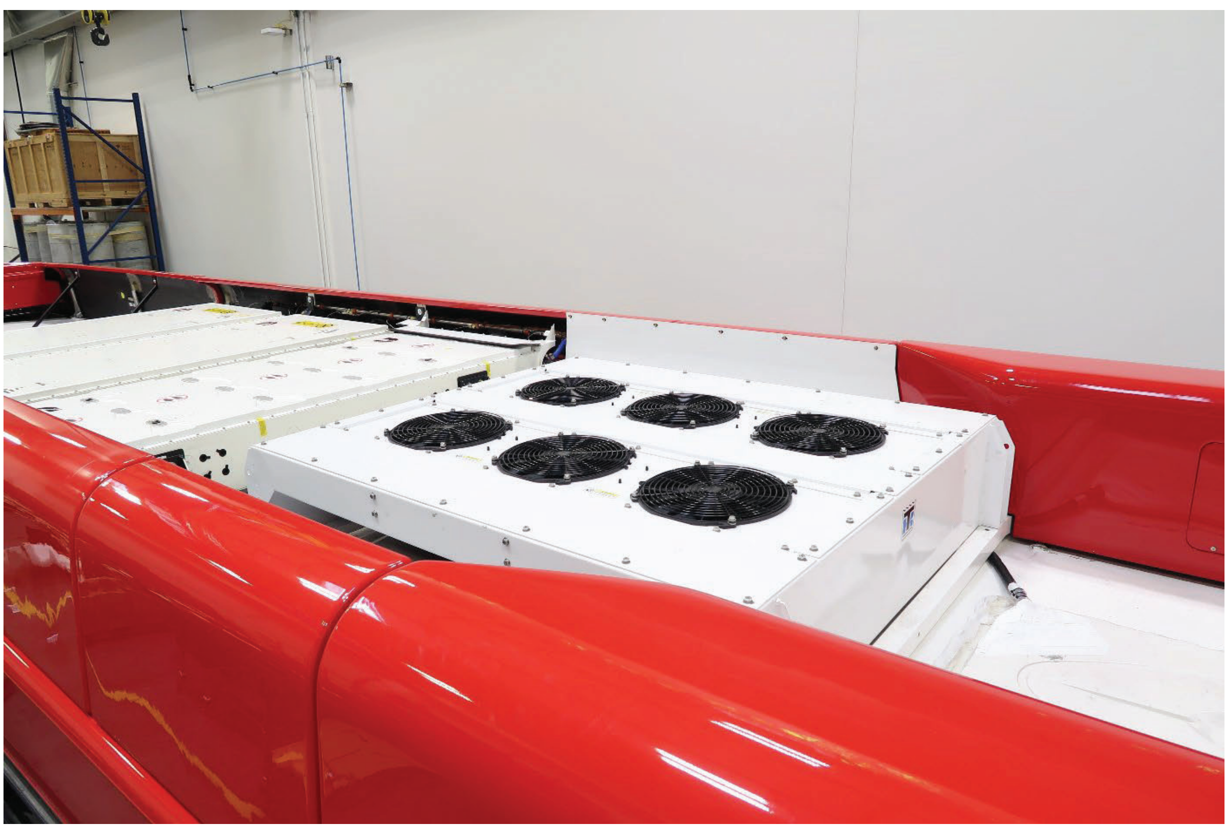
Rear Wheel Skirt Panel Access

Streetside Battery Access Door

Battery Low Voltage Disconnect Switch

Streetside - Air Tank Drain Valves and Optional Plug-In Charger Location

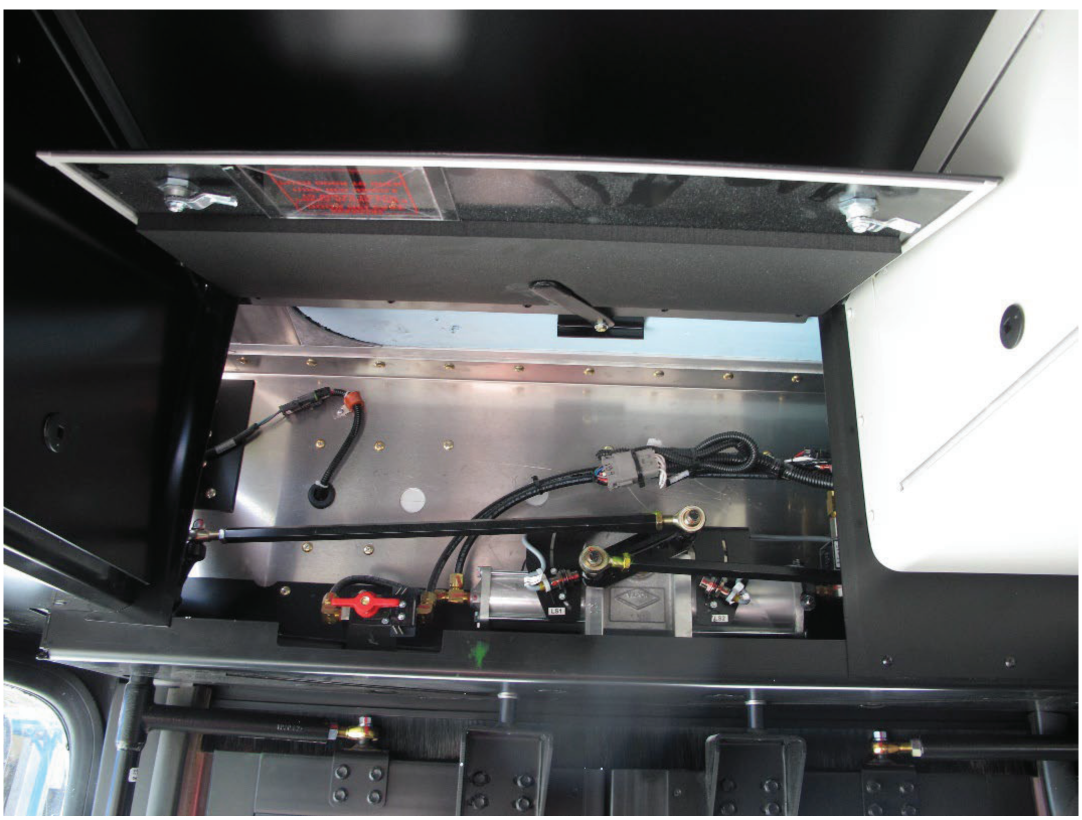
Roof Battery Installation



Rear Bulkhead Mounted I/O Panel

Front Air Tank Compartment Mounted I/O Panel

Front Door Header Access Door



Interior Destination Sign Compartment & Access Door

Interior Driver Storage Box

Interior Electrical Equipment Box

Attachment J
IFB6447

BUS TESTING CERTIFICATION

The undersigned bidder [Contractor/Manufacturer] certifies that the vehicle model or vehicle models offered in this bid submission complies with 49 CFR Part 665.

A copy of the test report (for each bid ITEM) prepared by the Federal Transit Administration's (FTA) Altoona, Pennsylvania Bus Testing Center is attached to this certification and is a true and correct copy of the test report as prepared by the facility.

The undersigned understands that misrepresenting the testing status of a vehicle acquired with Federal financial assistance may subject the undersigned to civil penalties as outlined in the U.S. Department of Transportation's regulation on Program Fraud Civil Remedies, 49 CFR Part 31. In addition, the undersigned understands that FTA may suspend or debar a manufacturer under the procedures in 49 CFR Part 29.

Name of Bidder/Company Name: GILLIG LLC

Type or print name: DEREK MAUNUS, PRESIDENT & CEO

Signature of authorized representative: ____________

Signature of notary and SEAL: See attached.

Date of Signature: 10 / 06 / 2022

REFERENCE OUR ATTACHED CERTIFICATION.

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of ALAMEDA

Subscribed and sworn to (or affirmed) before me on this 6TH day of OCTOBER, 20 22, by DEREK MAUNUS
______________________________,
proved to me on the basis of satisfactory evidence to be the person(s) who appeared before me.

MIRUBENAT TAPIA
COMM. NO. 2319245
NOTARY PUBLIC - CALIFORNIA
ALAMEDA COUNTY
MY COMM. EXPIRES JAN. 19, 2024

(Seal) Signature

MIRUBENAT TAPIA
NOTARY PUBLIC

My commission number: 2319245
My commission expires: JANUARY 19, 2024

DESCRIPTION OF ATTACHED DOCUMENT

Type or Title of Document: BUS TESTING CERTIFICATION

Signer's Name: DEREK MAUNUS

Document Date: OCTOBER 6, 2022

GILLIG

ALTOONA TEST CERTIFICATION

This is to certify that the bus model proposed for your procurement complies with the bus testing regulations required by the Surface Transportation and Uniform Relocation Assistance Act of 1987 as defined in the Interim Final Rulemaking (IFR) by the FTA in the Federal Register 49 CFR Part 665, dated July 28, 1992 and the Final Rule in the Federal Register 49 CFR part 665, dated August 1, 2016.

This statement means that the proposed vehicle complies with one or more of the clauses below, as required by the above IFR:

- was in mass transportation service prior to September 30, 1988, or
- is the same vehicle model that has been previously tested in PTI (Altoona), and that
- any new component(s) has (have) been tested at PTI (Altoona), or
- the installation of any new component(s) did not result in significant structural modification to the vehicle; or
- the installation of the component(s) did not result in a significant change in the data obtained from previous testing of the vehicle model.
- is a new bus model or a bus produced with a major change in components or configuration and shall provide a copy of the final test report to the recipient prior to the recipient's final acceptance of the first vehicle.

GILLIG LLC

By:

DEREK MAUNUS

Title: PRESIDENT & CEO

Date: OCTOBER 6, 2022

ALTOONA TESTING

GILLIG LLC hereby certifies that the bus model proposed for your procurement complies with the bus testing regulations required by the Surface Transportation and Uniform Relocation Assistance Act of 1987 as defined in the Interim Final Rulemaking (IFR) by the FTA in the Federal Register 49 CFR Part 665, dated July 28, 1992 and the Final Rule in the Federal Register 49 CFR part 665, dated August 1, 2016.

GILLIG is pleased to have completed full Altoona testing on all our Low Floor platform buses (diesel, Hybrid, CNG, Battery Electric).

1. PTI-BT-R9922-06-00: 29' Low Floor Diesel (June 2000)
2. PTI-BT-R0410: 35'/40' Low Floor Diesel (December 2004)
3. PTI-BT-R0405: 35'/40' Low Floor Hybrid (October 2004)
4. PTI-BT-R1109: 29' Low Floor CNG (January 2012)
5. PTI-BT-R1203-P: 35'/40' Low Floor BAE Hybrid (July 2012)
6. LTI-BT-R1911: 35'/40' Low Floor CNG (March 2020)
7. LTI-BT-R2020-05: 35'/40' Low Floor BEB (June 2021)
8. LTI-BT-R2022-06-P 35'/40' Low Floor eGenFlex (August 2022)

A copy of the final test report(s) can be provided upon request.

GILLIC

TESTING & DESIGN OPERATING PROFILE VALIDATION

Structural Analysis Validation - Completed

- Design Load Calculations
- Stress Calculations
- Finite Element Analysis
- Computer Simulations

Code and Regulation Compliance Validation

- Design Codes (interior lighting, driver's visibility, etc.)
- Design FMVSS Requirements

Component Application Analysis - Completed

- Component Selections
- Component Application Approvals
- Computer Simulations

Physical Validation Testing – Most Current Completion Date

- Optimization of Ride and Handling – 2011
- Vibration Tests – 2010
- Turning Radius Tests – 2011
- Turning Radius Test - 2020
- Engine Manufacturer Approvals
  - Cummins IQA Approvals 2007
  - Cummins IQA Approvals 2010
  - Cummins IQA Approvals 2013
  - Cummins IQA Approvals 2015 EMP Radiator only
  - Cummins IQA Approvals 2017 ISB BAE Hybrid
  - Cummins IQA Approval 2021 L9 Diesel
  - Cummins IQA Approval 2021 B67 Hybrid
  - Cummins IQA Approval 2021 40' Electric Bus
  - Cummins IQA includes engine/emission system installation approval, cooling system validation and compliance with electrical, AEB's.
- Strain Gauge Validation – 2005
- Loaded Road Dynamic Stress Test – 2006
- TRW Steering Geometry Test – 1998
- TRW Steering Geometry Test -2018
- TRW Steering Geometry Test - 2020
- Crashworthiness Test – 1998
- Crashworthiness Test -2018
- Crashworthiness Test - 2020
- Thermo King Performance Test T14 Unit– 2010
- Thermo King Performance Test T14 High Cooling Capacity -2015
- Thermo King Performance Test E Bus HVAC-2019
- Thermo King Performance Test E Bus HVAC -2020
- Accelerated Durability Test Road simulation/shaker test 40' CNG 2012.

TESTING & DESIGN OPERATING PROFILE VALIDATION

- Accelerated Durability Test Road simulation/shaker test 40’ Electric Bus 2019
- Hot Weather on Road Testing (Death Valley) 40’ Electric Gen 2.0 2019
- Hot Weather on Road Testing (Death Valley) 40’ Electric Gen 2.5 2021
- Cold Weather Chamber and Cold Test Track Testing 40’ Electric Bus 2020
- Cold Temperature Chamber testing 40’ Electric bus 2021
- Vehicle Stability Testing 40’ Electric Bus 2019
- Vehicle Stability Testing 40’ Electric Bus 2020
- Vehicle ESC Testing 40’ Electric 2019
- Vehicle Gradeability On Road Salt Lake City 40’ Gen 2.0 Electric Bus 2019
- Vehicle Gradeability On Road Salt Lake City 40’ Gen 2.5 Electric Bus 2021
- Altoona Style Durability Test Navistar Proving Grounds 40’ Electric 2019
- Altoona Test 40’ Diesel Bus Complete (ISM/Voith) – December 2004
- Altoona Test 40’ Hybrid Bus Complete (ISB/EV40) – October 2004
- Altoona Test 29’ Diesel Bus Complete (S40/B300) – June 2000
- Altoona Test 40’ Hybrid Bus Complete (ISL/Voith Hybrid) – 2010
- Altoona Test 40’ CNG Bus Complete (ISLG/B400R) – May 2011
- Altoona Test 29’ CNG Bus Complete (ISLG/B400R) – January 2012
- Altoona Test 40’ BAE Hybrid – July 2012
- Altoona Test 29’ ISL – June 2010
- Altoona Test 40’ CNG/Disc Brake – June 2013
- Altoona Test 40’ Hybrid Bus (330 ISL/Allison Hybrid) - Feb 2019
- Altoona Test 40’ Hybrid Bus (330L9/BAE Hybrid) – April 2018
- Altoona Test 29’ Electric Bus – May 2018
- Altoona Test 40’ Gen 2.0 Electric Bus - June 2021
- Altoona Test 40’ CNG with Hendrickson Rear Suspension 2019
- Altoona Test 29’ CNG with Hendrickson Rear Suspension 2021
- Altoona Test 40’ Gen 2.5 Electric Bus - In Process

- FMVSS 121 Testing – Brakes
  - 2002 - 29 Ft. Low Floor Drum Brakes
  - 1999 - 29 Ft. Low Floor Drum Brake
  - 1998 - 40 Ft. Low Floor Drum Brake
  - 1997 - 40 Ft. Low Floor Drum Brake
  - 2011 - 40 Ft. Low Floor Drum Brake 27,000 Rear GAWR
  - 2013 - 40 Ft. Low Floor Meritor Disc Brakes
  - 2015 - 29’ Low Floor Meritor Disc Brakes
  - 2016 - 29’ Low Floor Drum Brake
  - 2019 - 40’ Low Floor Meritor Disc Brakes Electric Bus @ 45,000 Lbs. GVWR
  - 2020 - 40’ Low Floor Meritor Disc Brakes Electric Bus @ 47,180 Lbs. GVWR
  - 2022 - 40’ Low Floor Meritor Disc Brakes Electric Bus @ 48,200 Lbs. - Planned 2022

- Transmission Installation Approval & Cooling Tests
  - Allison 2007, 2010, 2013
  - Voith 2007, 2010, 2013, 2020
  - ZF 2007, 2010, 2013,2018
  - ZF 2021 Ecolife/L9
- Hybrid Drive
  - ISL 330 hp Allision - 2018
  - L9 330 hp BAE - 2018
- Amerex Fire Suppression Installation Approval 2013
- Amerex Fire Suppression Installation Approval 40' Electric Bus 2020
- Kidde Fire Suppression Installation Approval 2013
- Fogmaker Fire Suppression Installation Approval 2013
- Fire Trace Fire Suppression Installation Approval 2013
- Fire suppression installation approvals ongoing with new configurations

Best-in-Class Bus Endures Thorough Testing

GILLIG buses go through rigorous testing to ensure the highest quality product for our customers.

Since March 2019, we've been testing our five 40-foot Zero-Emission Battery Electric Buses in areas such as maintainability, reliability, safety, performance, structural integrity and durability, fuel/energy consumption, noise, and emissions. Information from these tests enables us to implement constructive changes before the full production of our Zero-Emission Buses in May 2020. So far, we've driven our buses over 40,000 miles and run them through numerous vehicle level tests.

This past year, we have performed five extensive tests on our five Zero-Emission Battery Electric Buses:

HOT ENVIRONMENT TESTING

Death Valley, CA; Laughlin, NV; and Las Vegas, NV

PURPOSE: To test the Battery Thermal Management System (BTMS); Electronics Cooling Package (ECP); and Heating Ventilation and Air Conditioning (HVAC) Systems at ambient temperatures up to 118 degrees Fahrenheit over nine days in August.

- Hill Climb Testing in Death Valley and Laughlin, often climbing 4,000 feet over 13 miles at a constant 6% grade
- Stop/Start Testing in Las Vegas, to simulate a city bus route in 109 degrees Fahrenheit

GRADEABILITY TESTING

Salt Lake City, UT

PURPOSE: To test our bus's ability to navigate steep grades and long hill climbs by driving up to 3,000-4,000 feet on grades as steep as 17% on multiple routes.

DURABILITY TRACK TESTING

Navistar Proving Grounds
New Carlisle, IN

PURPOSE: To test the durability of the bus by driving on an accelerated durability course with multiple road surfaces (chatter bumps, chuckholes, railroad crossings, and frame twists) for the equivalent distance of 125,000 road miles over seven months.

COLD ENVIRONMENT TESTING

Automotive Enviro Testing (AET) Facility
Baudette, MN

PURPOSE: To test the impact of snow, ice, and frigid temperatures on the performance of our electric bus by driving over 500 miles at a winter proving ground in northern Minnesota. Temperatures were well below zero Fahrenheit, and snow accumulation around the high voltage batteries confirmed that our electric bus platform is robust for operation in extreme climates.

SHAKER (VIBRATION)/ACCELERATED DURABILITY TESTING

Element
Troy, MI

PURPOSE: To test the structural durability of our bus by simulating an entire 500,000 miles of road testing—or four full Altoona durability tests—with a four-post hydraulic shaker system. This shaker durability test was preceded by extensive data collection from over 200 channels of critical structural data.


Test Track in Altoona, PA

FULL ALTOONA TEST CERTIFICATION

Bus Research and Testing Center
Altoona, PA

PURPOSE: Currently, our bus has completed the Federal Transit Administration (FTA) Bus Testing Program for Full Altoona Test Certification. FTA test categories include structural integrity, safety, maintainability, reliability, fuel consumption, emissions, noise, and performance. U.S. transit agencies can use FTA funding to support their purchase of our electric buses.

FEATURED ARTICLES

FEDERAL TRANSIT BUS TEST

Performed for the Federal Transit Administration U.S. DOT
In accordance with 49 CFR, Part 665

Manufacturer: Gillig
Model: 40-Foot Low Floor Battery Electric Bus

Tested in Service-Life Category
12 Year / 500,000 Miles

June 2021

Report Number: LTI-BT-R2020-05

The Thomas D. Larson
Pennsylvania Transportation Institute
201 Transportation Research Building
The Pennsylvania State University
University Park, PA 16802
(814) 865-1891

Bus Testing and Research Center
2237 Plank Road
Duncansville, PA 16635
(814) 695-3404

PennState
College of Engineering

LTI BUS RESEARCH
AND TESTING CENTER

FEDERAL TRANSIT BUS TEST

Performed for the Federal Transit Administration, U.S. DOT
1200 New Jersey Avenue, SE
Washington, DC 20590

In accordance with 49 CFR Part, 665

Manufacturer: Gillig
Manufacturer's address: 451 Discover Drive
Livermore, CA 94551

Model: 40-Foot Low Floor Battery Electric Bus

Tested in Service-Life Category
12 Year / 500,000 Miles

Report Number: LTI-BT-R2020-05

ACCREDITED
Mechanical Testing Certificate 3172.01

David Klinikowski	Director, Bus Research and Testing Center	July 2, 2021
Quality Authorization	*Title*	*Date*

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EXECUTIVE SUMMARY

TEST HIGHLIGHTS

The information in this report pertains only to this specific bus, as received from the manufacturer for testing.

The Check-In section of the report provides a description of the bus and specifies its major components. The following table gives the salient specifications.

Manufacturer	Gillig
Model	40 Foot Low Floor Battery Electric Bus
Chassis Make/Model	Gillig / Low Floor
Chassis Modified	No
Length	40 feet, 10 ½ inches
Fuel	Battery - Electric
Service Life	12 Year / 500,000 miles
Number of Seats (including driver)	38 or 32 & 2 wheelchairs
Manufacturer-Designated Standing Passenger Capacity	36 (34 with wheelchairs in place)
Gross Vehicle Weight used for testing	43,630 lb.
Manufacturer Specified Gross Vehicle Weight Rating	45,000 lb.
Mileage at Delivery	9,856 miles
Test Start Date	July 29, 2020
Test Completion Date	April 26, 2021

The measured curb weight was 10,770 lb. for the front axle and 21,720 lb. for the rear axle. These combined weights provided a total measured curb weight of 32,490 lb. There are 38 seats including the driver and free floor space for 36 standing passengers bringing the potential total passenger capacity to 74. Six seats fold away to accommodate two wheelchairs. When the wheelchairs are in place, there is free floor space for only 34 standing passengers. Utilizing the wheelchair positions in place of the seated passengers is the heaviest seated load weight configuration. Gross load weight would be the same with either the wheelchairs in place or the seats in place, due to the extra room for standing passengers. Therefore, the gross load represents 32 seated passengers, two wheelchairs and 34 standees, or 38 seated passenger and 36 standees. Gross load is calculated as (150 lb. x 66) + (2 x 600) = 11,100. At full declared capacity, the measured gross vehicle weight was 43,630 lb.

BUS TESTING BACKGROUND

On August 1, 2016, FTA announced a final rule for bus testing for improving the process of ensuring the safety and reliability of new transit buses. The rule satisfies requirements in MAP-21 to establish minimum performance standards, a standardized scoring system, and a pass-fail threshold based on the score.

FTA's Bus Testing Program (often referred to as "Altoona Testing" due to the location of the main testing center) tests new transit bus models for:

- Maintainability
- Reliability
- Safety
- Performance (including Braking Performance)
- Structural Integrity (including Structural Durability)
- Fuel Economy (Energy Efficiency and Range, for electric buses)
- Noise
- Emissions

Bus models that fail to meet one or more minimum performance standards will "fail" their test and thus be ineligible for purchase with FTA funds until the failures are resolved and validated through further testing. FTA will use this authority to make sure defects are corrected before a bus model can be acquired with FTA funding.

In each application to FTA for the purchase or lease of any new bus model, or any bus model with a major change in configuration or components to be acquired or leased with funds obligated by the FTA, the recipient shall certify that it has received the appropriate full Bus Testing Report and any applicable partial testing report(s) before final acceptance of the first vehicle. In dealing with a bus manufacturer or dealer, the recipient shall be responsible for determining whether a vehicle to be acquired requires full testing or partial testing or has already satisfied the requirements of this part. A bus manufacturer or recipient may request guidance from FTA in making these determinations.

The purpose of the testing is intended set a "Pass/Fail" standard and grade the performance of the buses in order to provide performance information to the transit authorities that can be used in their purchase or lease decisions. The intent of this report is to provide the grantee a relative measure of the performance of a particular model of transit bus against a standard of performance. The passing of this test should ensure a vehicle has a high probability of meeting its service life in the category it was tested.

The data included in this test report and other applicable reports should be reviewed to choose the most suitable bus for a grantee's operation. A higher scoring bus is not necessarily the best bus for a given application. For example, a bus with a powerful engine may score well because of its performance and gradeability, but another bus with a smaller and more fuel-efficient engine could be a better choice for applications in mostly flat areas. It is the responsibility of the grantee to ensure the proper test report or applicable partial report is in their possession and has been thoroughly reviewed.

The score sheet for the subject vehicle of this test report is provided below. **This bus passed the Altoona test, with an aggregate score of 86.6.**

Bus 2020-05 Gillig Electric

Test category		Standard	Base Pts.	Bonus Pts.	Range	Range	Test Data	Score	FAIL
1. Maintainability	Unscheduled maint.	< 125 hours	2	14	0	125	36.15	11.95	
2. Reliability	# Class 2 failures	< 2 Uncorrected	2	6	0	2	0	8.00	
	Hazards	No uncorrected Class 1	10	0	P	F	P	10.00	
	Stability	Lane change, 45 mph?	2.5	0	P	F	P	2.50	
3. Safety		< 158 feet at 45mph	0.5	2	80	158	121.8	1.43	
	Braking	Holds Lane, Split coeffient	2.5	0	P	F	P	2.50	
		Parking brake, 20% grade	2.5	0	P	F	P	2.50	
	Acceleration 0-30 mph	less than 30 sec	1.5	0	P	F	P	1.50	
4. Performance	Gradeability 2.5%	more than 40 mph	1.5	0	P	F	P	1.50	
	Gradeability 10%	more than 10 mph	2	0	P	F	P	2.00	
	Distortion	Exits are operational	1	0	P	F	P	1.00	
	Static Towing	No significant deformation	1	0	P	F	P	1.00	
5. Structural Integrity	Dynamic Towing	Towable with std. wrecker	1	0	P	F	P	1.00	
	Jacking	Liftable with std. jack	1	0	P	F	P	1.00	
	Hoisting	Stable on jacks	1	0	P	F	P	1.00	
	Durability-Structural	No uncorrected failures	13	0	P	F	P	13.00	
	Durability-Powertrain	No uncorrected failures	12	0	P	F	P	12.00	
	Liquid fuels	1-13mpg			1	13	NA	0.00	
6. Fuel Economy	CNG	10-50 scf/mi	1	6	10	50	NA	0.00	
	Hydrogen	15-98 cf/mi			15	98	NA	0.00	
	Electric	1-3 kWh/mi			1	3	2.467	2.60	
7. Noise	Int. Noise (0-35 mph)	less than 80 db	0.5	3	30	80	75.8	0.75	
	Ext. Noise (0-35 mph)	less than 83 db	0.5	3	50	83	62.5	2.36	
	CO_2	0-4000 g/mi		4	0	4000	0	5.00	
	CO	0-20 g/mi		0.4	0	20	0	0.40	
8. Emissions	Total hydrocarbon	0-3 g/mi	1	0.4	0	3	0	0.40	
	NMHC	0-3 g/mi		0.4	0	3	0	0.40	
	Nitrogen oxides	0-3 g/mi		0.4	0	2	0	0.40	
	Particulates	0-0.1 g/m		0.4	0	0.1	0	0.40	
Total			60	40				86.6	

Note: The use of the scoring system is not mandatory for procurement. It is only necessary that the bus being procured has received a passing score.

ABBREVIATIONS AND ACRONYMS

ABS - anti-skid braking system
ABTC - Altoona Bus Test Center
A/C - air conditioner, or air conditioning
AC - alternating current
ADA - American Disability Act
CDCTS - chassis dynamometer test control system
CVS - constant volume sampling
CW - curb weight (bus weight including maximum fuel, oil, and coolant; but without passengers or driver)
dB(A) - decibels with reference to 0.0002 microbar as measured on the "A" scale
DC - direct current
DIR - test director
DR - bus driver
EPA - Environmental Protection Agency
GAWR – gross axle weight rating
GVL - gross vehicle load (150 lb. for every designed passenger seating position, for the driver, and for each 1.5 sq ft of free floor space)
GVW - gross vehicle weight (curb weight plus gross vehicle load)
GVWR - gross vehicle weight rating
HD-UDDS – Heavy Duty-Urban Dynamometer Driving Schedule
LTI - Larson Transportation Institute
mpg - miles per gallon
mph - miles per hour
PM - Preventive maintenance
PSTT - Penn State Test Track
rpm - revolutions per minute
SAE - Society of Automotive Engineers
SCF - Standard cubic foot
SCH - test scheduler
SA - staff assistant
SLW - seated load weight (curb weight plus 150 lb. for every designed passenger seating position and for the driver)
TD - test driver
TECH - test technician
TM - track manager
TP - test personnel
Wh - Watt hour

TEST BUS CHECK-IN

I. OBJECTIVE

The objective of this task is to log in the test bus, assign a bus number, complete the vehicle data form, and perform a safety check.

II. TEST DESCRIPTION

The test consisted of assigning a bus test number to the bus, cleaning the bus, completing the vehicle data form, obtaining any special information and tools from the manufacturer, determining a testing schedule, performing an initial safety check, and performing the manufacturer's recommended preventive maintenance. The bus manufacturer certified that the bus meets all Federal regulations.

III. DISCUSSION

The check-in procedure is used to identify in detail the major components and configuration of the bus.

The test bus consisted of a Gillig Company, 40-Foot Low Floor Battery Electric Bus. The bus has a passenger door forward of the front axle and a passenger door between the front and rear axles. The front passenger door is equipped with a Ricon / RISSR-OH6782EY00 fold-out ramp. Power is provided by a Cummins electric traction motor.

The measured curb weight was 10,770 lb. for the front axle and 21,720 lb. for the rear axle. These combined weights provided a total measured curb weight of 32,490 lb. There are 38 seats including the driver and free floor space for 36 standing passengers bringing the *potential* total passenger capacity to 74. Six seats fold away to accommodate two wheelchairs. When the wheelchairs are in place, there is free floor space for only 34 standing passengers. Utilizing the wheelchair positions in place of the seated passengers is the heaviest seated load weight configuration. Gross load weight would be the same with either the wheelchairs in place or the seats in place, due to the extra room for standing passengers. Therefore, the gross load represents 32 seated passengers, two wheelchairs and 34 standees, or 38 seated passenger and 36 standees. Gross load is calculated as (150 lb. x 66) + (2 x 600) = 11,100. At full declared capacity, the measured gross vehicle weight was 43,630 lb.

VEHICLE DATA FORM

Bus Number: 2020-05	Date of Check-In: 07/29/2020
Bus Manufacturer: Gillig	Vehicle Identification Number (VIN): 15GGD2810L3189322
Model Number: 40 Foot Low Floor Battery Electric Bus	Chassis Mfr./Mod. #: Gillig / Low Floor
Personnel: E.D. & E.L.	Starting Odometer Reading: 9,856

WEIGHT:

Individual Wheel Reactions:

Weights (lb.)	Front Axle		Middle Axle		Rear Axle	
	Curb	Street	Curb	Street	Curb	Street
CW	5,400	5,370	N/A	N/A	10,490	11,230
SLW	6,410	6,410	N/A	N/A	12,110	13,590
GVW	7,830	7,760	N/A	N/A	13,430	14,610

Total Weight Details:

Weight (lb.)	CW	SLW	GVW	GAWR
Front Axle	10,770	12,820	15,590	16,000
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	21,720	25,700	28,040	29,000
Total	32,490	38,520	43,630	GVWR: 45,000 (Declared by Manufacturer)

Dimensions:

Length (ft/in)	40 / 10½
Width (in)	101 ¼
Height (in)	132 ½
Front Overhang (in)	91 ¼
Rear Overhang (in)	109 ¼
Wheelbase (in)	290
Wheel Track (in)	Front: 85.6
	Middle: N/A
	Rear: 77.7

VEHICLE DATA FORM

Bus Number: 2020-05	Date: 07/29/2020

CLEARANCES:

Lowest Point Outside Front Axle	Location: Wheelchair ramp frame	Clearance(in): 8.0
Lowest Point Outside Rear Axle	Location: Drive motor	Clearance(in): 9.6
Lowest Point between Axles	Location: Battery Pack	Clearance(in): 10.7
Ground Clearance at the center (in)	11.2	
Front Approach Angle (deg)*	7.5	
Rear Approach Angle (deg)*	8.8	
Ramp Clearance Angle (deg)	4.2	
Aisle Width (in)	Front: 22.3	Rear: 22
Inside Standing Height at Center Aisle (in)	Front: 94.6	Rear: 75.9

*Measurements used to calculate approach and departure angles are taken from the centerline of the axles.

BODY DETAILS:

Body Structural Type	Monocoque		
Frame Material	Steel		
Body Material	Aluminum		
Floor Material	Plywood		
Roof Material	Composite		
Windows Type	■ Fixed	☐ Movable	
Window Mfg./Model No.	Arow / Five Star AR DOT 927 M300 AS5		
Number of Doors	1 Front	1 Rear	
Mfr. / Model No.	Front: Vapor Door International / 50940245-01 (L), 5094025401 (R) Rear: Vapor Door International / 51650770-03 (L), 51650770-02 (R)		
Dimension of Each Door (in)	Front: 75.4 x 32.4	Rear: 77.4 x 45.9	
Passenger Seat Type	■ Cantilever (Front)	■ Pedestal (Rear)	☐ Other (explain)
Driver Seat Type	■ Air	☐ Spring	☐ Other (explain)
Mfr. / Model No.	Recaro / Ergo Metro AM80		
Number of Seats (including Driver)	38 or 32 & 2 wheelchairs		

VEHICLE DATA FORM

Bus Number: 2020-05	Date: 07/29/2020

BODY DETAILS (Contd.)

Free Floor Space (ft^2)	55.9
Height of Each Step at Normal Position (in)	Front 1. 13.9 2. N/A 3. N/A 4. N/A
	Middle 1. 14.0 2. N/A 3. N/A 4. N/A
	Rear 1. N/A 2. N/A 3. N/A 4. N/A
Step Elevation Change - Kneeling (in)	Front: 3.3 Middle: 1.1

POWERTRAIN

Type	☐ C.I.	☐ Alternate Fuel	
	☐ S.I.	■ Other (Battery Electric)	
Air Compressor Mfr. / Model No.	Powerex / SDCS05001PM-GG		
Maximum Capacity (ft^3 / min)	16.1		
Starter Type – N/A	☐ Electrical	☐ Pneumatic	☐ Other (explain)
Starter Mfr. / Model No.	N/A		

BATTERY SYSTEM

Maximum Rated Capacity (kWh)	444 kWh (6 battery packs combined)
Usable Capacity (kWh)	355.2
Nominal Voltage (Vdc)	750

PROPULSION CONTROL SYSTEM (Rear Axle)

Propulsion Control System Mfr. / Model No.	Cummins / 5572390
Traction Motor - Mfr. / Model No.	Cummins / TM4
Traction Motor Power rating (kW)	262.5-562.5

OTHERS

DCDC Converter Mfr. / Model No.	Cummins / 5575274
HV Distribution Box Mfr. / Model No.	Cummins / 5575655

Bus Number: 2020-05	Date: 07/29/2020

SUSPENSION

Number of Axles	2		
Front Axle Type	☐ Independent	■ Beam Axle	
Mfr. / Model No.	Meritor / FH946KX46		
Axle Ratio (if driven)	N/A		
Suspension Type	■ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Koni / EVO 4:319		
Middle Axle Type	☐ Independent	☐ Beam Axle	
Mfr. / Model No.	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type	☐ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	☐ Independent	■ Beam Axle	
Mfr. / Model No.	Meritor / 79163KX6-614		
Axle Ratio (if driven)	6.14		
Suspension Type	■ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	4		
Mfr. / Model No.	Koni / EVO 3819		

VEHICLE DATA FORM

Bus Number: 2020-05	Date: 07/29/2020

WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Alcoa LVL ONE / 22.5 x 8.25
	Tire Mfr./ Model No.	Michelin X Incity / 305/70R 22.5
Rear	Wheel Mfr./ Model No.	Alcoa LVL ONE / 22.5 x 8.25
	Tire Mfr./ Model No.	Michelin X Incity / 305/70R 22.5

BRAKES

Front Axle Brakes Type	☐ Cam	■ Disc	☐ Other (explain)
Mfr. / Model No.	Meritor / EX225H3		
Middle Axle Brakes Type	☐ Cam	☐ Disc	☐ Other
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	☐ Cam	■Disc	☐ Other (explain)
Mfr. / Model No.	Meritor / EX225H3		

HVAC

Heating System Type	☐ Air	■ Water	☐ Other
Capacity (Btu/hr)	102,000		
Mfr. / Model No.	ThermoKing / TE18		
Air Conditioner	■ Yes	☐ No	
Location	Rear		
Capacity (Btu/hr)	92,500		
A/C Compressor Mfr. / Model No.	Copeland Scroll Emerson Climate Technology / ZRHV81KTE-TX7-502		

STEERING

Steering Gear Box Type	Hydraulic Gear		
Mfr. / Model No.	TRW / TAS85		
Steering Wheel Diameter	20”		
Number of turns (lock to lock)	5 ½		
Control Type	☐ Electric	■ Hydraulic	☐ Other (explain)

Bus Number: 2020-05	Date: 07/29/2020

OTHERS

Wheelchair Ramps	Location: Front	Type: Foldout Ramp
Wheelchair Lifts	Location: N/A	Type: N/A
Mfr. / Model No.	Ricon / RISSR – OH6782EY00	
Emergency Exit	Location: Window Door Roof Hatch	Number: 6 2 1

CAPACITIES

Fuel Tank Capacity (gallons)	N/A	
Engine Crankcase Capacity (gallons)	N/A	
Drive Motor Capacity (gallons)	3.5	
Differential Capacity (gallons)	5.5	
Cooling System Capacity (gallons)	Battery: 10 gallons	HVAC System: 6 gallons
Power Steering Fluid Capacity (quarts)	5.3	

VEHICLE DATA FORM

Bus Number: 2020-05	Date: 07/29/2020

List all spare parts, tools and manuals delivered with the bus.

Part Number	Description	Qty.
IR13-253	Airbag (Goodyear)	2
AS910C-14P 1380	Airbag (Continental)	4
08-70736-000	Bump stop	2
305/70R 22.5 Michelin X Incity	Tire	1
Alcoa LVL ONE 22.5x8.25	Wheel	1

COMPONENT/SUBSYSTEM INSPECTION FORM

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Bus Number: 2020-05	Date: 07/29/2020

Subsystem	Checked	Initials	Comments
Air Conditioning Heating and Ventilation	✓	E.D.	None noted.
Body and Sheet Metal	✓	E.D.	Scratch & crack on rear door & door glass
Frame	✓	E.D.	None noted.
Steering	✓	E.D.	None noted.
Suspension	✓	E.D.	None noted.
Interior/Seating	✓	E.D.	None noted.
Axles	✓	E.D.	None noted.
Brakes	✓	E.D.	None noted.
Tires/Wheels	✓	E.D.	None noted.
Exhaust	N/A	E.D.	None noted.
Fuel System	✓	E.D.	Battery Electric
Power Plant	✓	E.D.	Battery
Accessories	✓	E.D.	None noted.
ADA Accessible Lift System	N/A	E.D.	None noted.
ADA Accessible Ramp System	✓	E.D.	None noted.
Interior Fasteners	✓	E.D.	None noted.
Batteries	✓	E.D.	None noted.

CHECK - IN

GILLIG
40 FOOT LOW FLOOR BATTERY ELECTRIC BUS

CHECK - IN CONT.

GILLIG
40 FOOT LOW FLOOR BATTERY ELECTRIC BUS

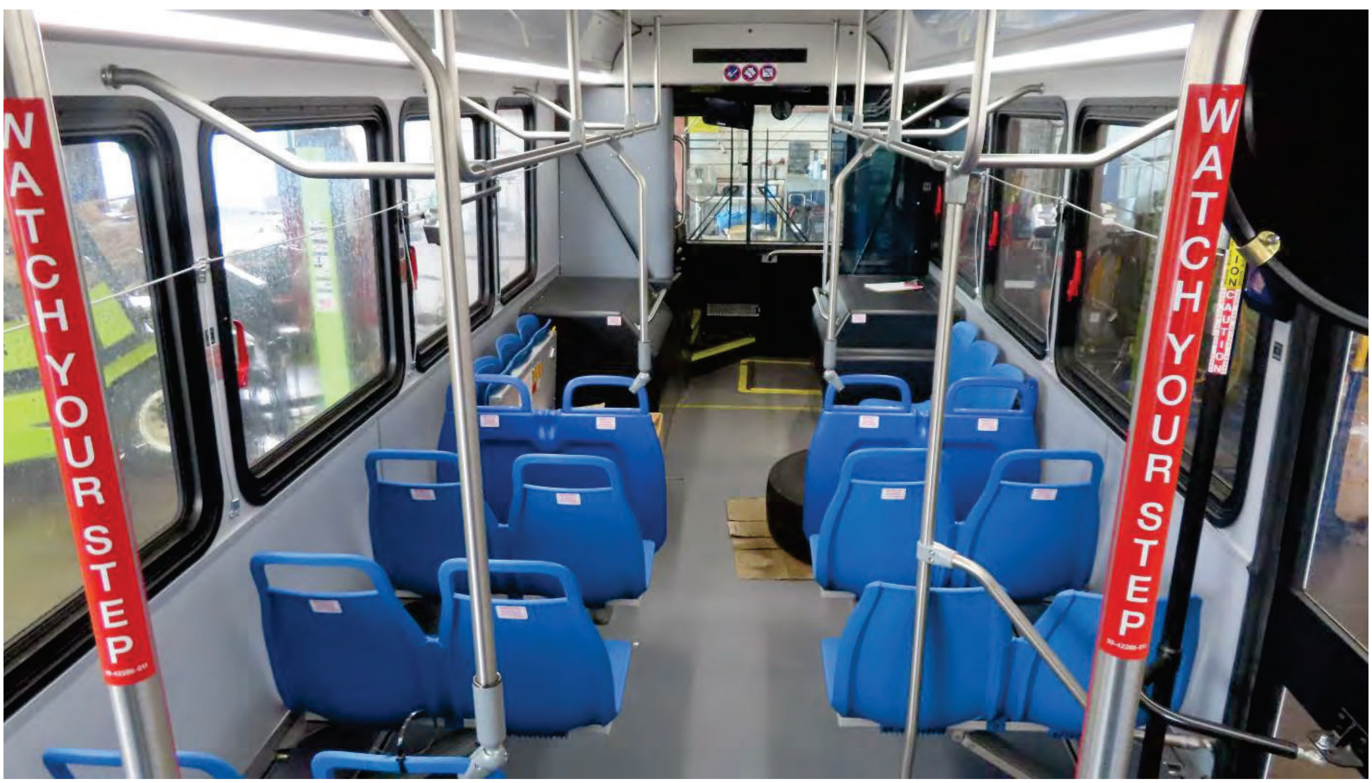
CHECK - IN CONT.

RICON / RISSR – OH6782EY00 FOLD OUT RAMP

OPERATOR'S AREA

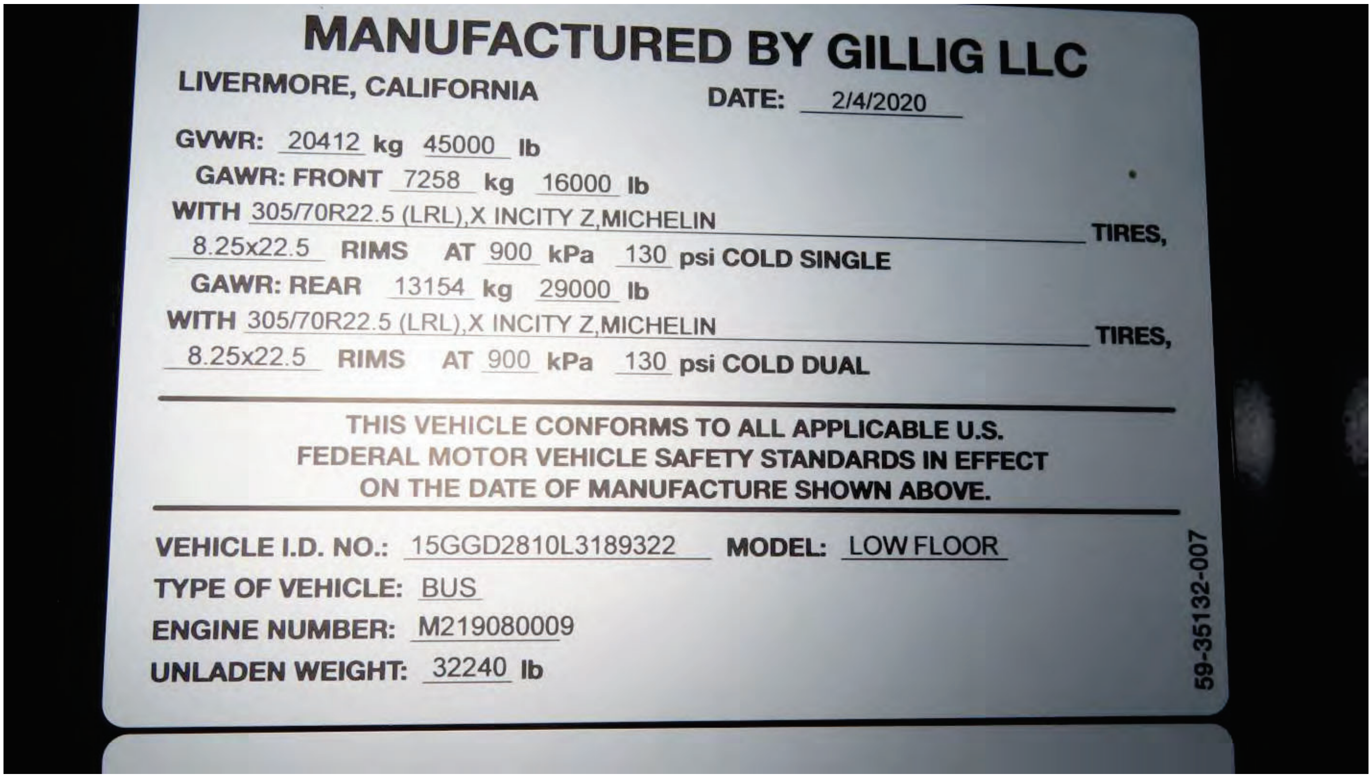
CHECK - IN CONT.

INTERIOR FROM FRONT



INTERIOR FROM REAR

CHECK - IN CONT.



VIN TAG

PLACARD SHOWING MAXIMUM PASSENGERS

CHECK - IN CONT.

REAR COMPARTMENT

1. MAINTAINABILITY

1.1 ACCESSIBILITY OF COMPONENTS AND SUBSYSTEMS

1.1-I. TEST OBJECTIVE

The objective of this test is to check the accessibility of components and subsystems.

1.1-II. TEST DESCRIPTION

Accessibility of components and subsystems was checked, and where accessibility was restricted the subsystem was noted along with the reason for the restriction.

1.1-III. DISCUSSION

Accessibility, in general, was adequate. Components covered in Section 1.3 (repair and/or replacement of selected subsystems), along with all other components encountered during testing, were found to be readily accessible and no restrictions were noted.

ACCESSIBILITY DATA FORM

Bus Number: 2020-05	Date: 04/01/2021

Component	Checked	Comments
ENGINE:		
Oil Dipstick	✓	N/A
Oil Filler Hole	✓	N/A
Oil Drain Plug	✓	N/A
Oil Filter	✓	N/A
Fuel Filter	✓	N/A
Air Filter	✓	N/A
Belts	✓	N/A
Coolant Level	✓	None noted.
Coolant Filler Hole	✓	None noted.
Coolant Drain	✓	None noted.
Spark / Glow Plugs	✓	N/A
Alternator	✓	N/A
Diagnostic Interface Connector	✓	None noted.
TRANSMISSION:		
Fluid Dipstick	✓	N/A
Filler Hole	✓	N/A
Drain Plug	✓	N/A
SUSPENSION:		
Bushings	✓	None noted.
Shock Absorbers	✓	None noted.
Air Springs	✓	None noted.
Leveling Valves	✓	None noted.
Grease Fittings	✓	None noted.

ACCESSIBILITY DATA FORM

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Bus Number: 2020-05	Date: 04/01/2021

Component	Checked	Comments
HVAC:		
A/C Compressor	✓	None noted.
Filters	✓	None noted.
Fans	✓	None noted.
ELECTRICAL SYSTEM:		
Fuses	✓	None noted.
Batteries	✓	None noted.
Voltage regulator	✓	None noted.
Voltage Converters	✓	None noted.
Lighting	✓	None noted.
MISCELLANEOUS:		
Brakes	✓	None noted.
ADA Accessible Lifts/Ramps	✓	None noted.
Instruments	✓	None noted.
Axles	✓	None noted.
Exhaust	✓	N/A
Fuel System	✓	Electric
OTHERS:		

1.2 SERVICING, PREVENTIVE MAINTENANCE, AND REPAIR AND MAINTENANCE DURING TESTING

1.2-I. TEST OBJECTIVE

The objective of this test is to collect maintenance data about the servicing, preventive maintenance, and repair.

1.2.-II. TEST DESCRIPTION

The test was conducted by operating the bus and collecting the following data on work order forms and a driver log.

1. Scheduled Maintenance
    a. Bus number
    b. Date
    c. Mileage
    d. Results of scheduled inspections
    e. Description of malfunction (if any)
    f. Repair action and parts used (if any)
    g. Man-hours required

2. Unscheduled Maintenance
    a. Bus number
    b. Date
    c. Mileage
    d. Description of malfunction
    e. Place and time of malfunction (e.g., in service or undergoing inspection)
    f. Repair action and parts used
    g. Man-hours required

The bus was operated in accelerated durability service. While typical items are given below, the specific service schedule was that specified by the manufacturer.

A. Service
    1. Fueling
    2. Consumable checks
    3. Interior cleaning

B. Preventive Maintenance
    1. Brake adjustments
    2. Lubrication
    3. 3,000 mi (or manufacturer recommended) inspection

4. Oil and filter change inspection
5. Major inspection
6. Tune-up

C. Periodic Repairs
1. Brake reline*
2. Transmission change
3. Engine change*
4. Windshield wiper motor change
5. Stoplight bulb change*
6. Towing operations
7. Hoisting operations

*These items are attended to if found necessary, while the others in the list are removed/replaced/tested for all buses undergoing a full test.

1.2-III. DISCUSSION

Servicing and preventive maintenance were performed at manufacturer-specified intervals. The following Scheduled Maintenance Form lists the mileage, items serviced, the service interval, and amount of time required to perform the maintenance.

The Unscheduled Maintenance List along with related photographs is included in Section 5.7, Structural Durability. This list supplies information related to failures that occurred during the durability portion of testing. The Unscheduled Maintenance List includes the date and mileage at which the malfunction was detected, a description of the malfunction and repair, and the time required to perform the repair.

SCHEDULED MAINTENANCE
Gillig Bus# 2020-05
(Page 1 of 2)

DATE	TEST MILES	SERVICE	ACTIVITY/OBSERVATIONS	DOWN TIME	LABOR HOURS
08/26/20	1,034	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all checked and lubed; all fluids checked. Inspected frame, body and suspension. Front street-side hub is leaking. (This bus has a fluid filled front axle with a visible sight glass which can leak.) Front curb-side and street-side bump stops are showing wear.	4.00	4.00
09/25/20	2,238	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all checked and lubed; all fluids checked. Inspected frame, body and suspension.	4.00	4.00
10/12/20	3,614	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all checked and lubed; all fluids checked. Inspected frame, body and suspension.	4.00	4.00
10/26/20	4,760	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all checked and lubed; all fluids checked. Inspected frame, body and suspension. Both front windshields are leaking.	4.00	4.00
11/04/20	6,262	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all checked and lubed; all fluids checked. Inspected frame, body and suspension.	4.00	4.00
11/20/20	7,363	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all checked and lubed; all fluids checked. Inspected frame, body and suspension.	4.00	4.00

SCHEDULED MAINTENANCE

Gillig Bus# 2020-05
(Page 2 of 2)

DATE	TEST MILES	SERVICE	ACTIVITY/FINDINGS	DOWN TIME	LABOR HOURS
12/15/20	9,236	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all checked and lubed; all fluids checked. Inspected frame, body and suspension.	4.00	4.00
01/06/21	10,206	P.M./Inspection Energy Economy Prep	Steering linkage, tie rods, universals/u-joints all checked and lubed; all fluids checked. Inspected frame, body and suspension.	8.00	8.00
01/19/21	11,224	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all checked and lubed; all fluids checked. Inspected frame, body and suspension. Right front leveling valve was found to have a slight leak causing the bus to lean over when shut down. Rear lower radius arm bushings were found to be showing wear. Damaged curb-side and street-side bump stops were noted.	4.00	4.00
01/28/21	12,348	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all checked and lubed; all fluids checked. Inspected frame, body and suspension.	4.00	4.00
03/05/21	13,714	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all checked and lubed; all fluids checked. Inspected frame, body and suspension. It was noted that the stud which secured rooftop side panel on street-side has broken.	4.00	4.00
03/16/21	14,987	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all lubed; all fluids checked. Inspected frame, body and suspension.	4.00	4.00

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS

1.3-I. TEST OBJECTIVE

The objective of this test is to establish the time required to replace and/or repair selected subsystems.

1.3-II. TEST DESCRIPTION

The test involved components that may be expected to fail or require replacement during the service life of the bus. In addition, any component that failed during testing of the bus was added to this list. Components to be included are:

1. Drive Motor
2. DC to DC Converter
3. Low Voltage Batteries
4. High Voltage Batteries
5. Windshield wiper motor

1.3-III. DISCUSSION

At the end of the test, the items on the list were removed and replaced. The drive motor assembly took 4.50 labor-hours (1 person @ 4.50 hrs.) to remove and replace. The time required for repair/replacement of the other four components is given on the following Repair and/or Replacement Form.

REPLACEMENT AND/OR REPAIR FORM

Subsystem	Replacement Time
Drive Motor	4.50 labor hours
Wiper Motor x 2	0.50 labor hours
DC to DC Converter	3.00 labor hours
Low Voltage Batteries	0.50 labor hours
High Voltage Batteries	10.00 labor hours

It is noted that the battery pack replacement times may vary with the other battery packs due to the location.

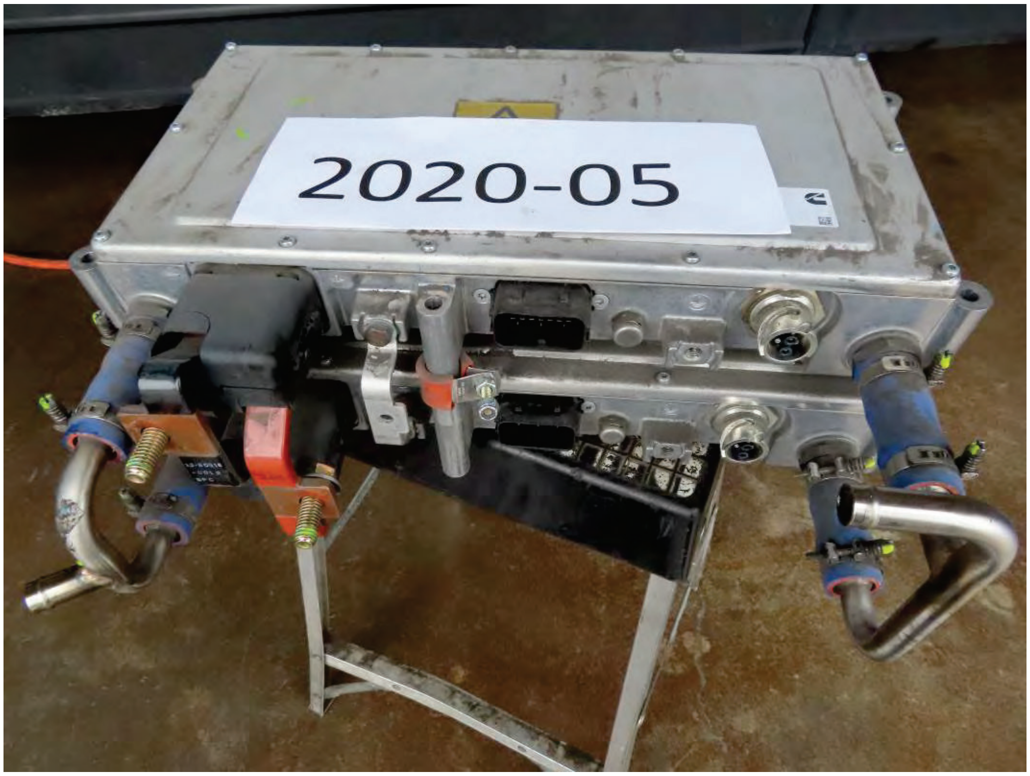
During the test, additional components were removed for repair or replacement and the details are available in Section 5.7 in Unscheduled Maintenance.

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS

DRIVE MOTOR REMOVAL AND REPLACEMENT
(3.50 LABOR HOURS)

WIPER MOTOR REMOVAL AND REPLACEMENT
(0.50 LABOR HOURS)

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS CONT.



DC TO DC CONVERTER REMOVAL AND REPLACEMENT
(3.00 LABOR HOURS)

HIGH VOLTAGE BATTERY REMOVAL AND REPLACEMENT
(10.00 LABOR HOURS)

2. RELIABILITY - DOCUMENTATION OF BREAKDOWN AND REPAIR TIMES DURING TESTING

2-I. TEST OBJECTIVE

The objective of this test is to document unscheduled breakdowns, repairs, down time, and repair time that occur during testing.

2-II. TEST DESCRIPTION

Using the driver log and unscheduled work order forms, all significant breakdowns, repairs, labor-hours to repair, and hours out of service were recorded on the Reliability Data Form.

CLASS OF FAILURES

Classes of failures are described below:

(a) Class 1: Physical Safety. A failure that could lead directly to Injury, a crash and/or significant physical damage.

(b) Class 2: Road Call. A failure resulting in an en-route interruption of revenue service. Service is discontinued until the bus is replaced or repaired at the point of failure.

(c) Class 3: Bus Change. A failure that requires removal of the bus from service during its assignments. The bus is operable to a rendezvous point with a replacement bus.

(d) Class 4: Bad Order. A failure that does not require removal of the bus from service during its assignments but does degrade coach operation. The failure shall be reported by driver, inspector, or hostler.

2-III. DISCUSSION

A listing of breakdowns and unscheduled repairs was accumulated during the Structural Durability Test. The following Reliability Data Form lists all unscheduled repairs under classes as defined above.

The classification of repairs according to subsystem is intended to emphasize those systems which had persistent minor or more serious problems. There were 16 reported failures during testing which occurred throughout several subsystems. Of these failures, there was one Class 4 failures, 12 Class 3 failures and three Class 2 failures. There were no Class 1 failures. These failures are available for review in the Unscheduled Maintenance List, located in Section 5.7 Structural Durability.

This bus passed the Structural and Powertrain Durability sections of the test.

RELIABILITY DATA FORMS

Bus Number: 2020-05	Date: 05/26/21
Personnel: B.L.	

	Failure Type					
	Class 4 Bad Order	Class 3 Bus Change	Class 2 Road Call	Class 1 Physical Safety		
Subsystems	Mileage	Mileage	Mileage	Mileage	Labor Hours	Down Time
Hardware		1,034			0.20	0.20
Electrical		1,416			1.00	1.00
		3,390			0.20	0.20
			12,522		1.00	1.00
		12,866			10.00	10.00
Body		2,238			1.00	1.00
		7,748			0.10	0.10
Suspension		7,363			1.00	1.00
	10,206				1.00	1.00
			11,690		8.50	8.50
		12,354			2.00	2.00
Compressed Air		7,363			2.00	2.00
		7,471			2.65	2.65
Compressed Air/Suspension		12,443			1.00	1.00
			12,481		4.00	4.00
HVAC		14,161			0.50	0.50

3.1 SAFETY - A DOUBLE-LANE CHANGE (OBSTACLE AVOIDANCE)

3.1-I. TEST OBJECTIVE

The objective of this test is to determine handling and stability of the bus by measuring speed through a double lane change test.

3.1-II. TEST DESCRIPTION

The Safety Test consisted of an obstacle avoidance maneuver to evaluate the handling and stability of the bus. The test was conducted at the LTI test track on the vehicle dynamics pad. The bus was driven through a double-lane change course at increasing speeds until the test was determined to be unsafe or a speed of 45 mph is reached. The test is determined unsafe if vehicle handling becomes unstable or if any of the tires lose contact with the pavement.

The layout of the test course was defined by placing pylons along painted guidelines that delineated the course. The guidelines marked off two 12-foot center-to-center lanes. Each lane had two 100 foot long gates with a spacing distance of 100 feet between them. The bus entered the test course in one lane, crossed over to the other lane within the 100 foot gate, traveled for 100 feet, and then returned back into the original lane within the next 100 foot gate. This maneuver was repeated from 20 mph with speed increasing in increments of 5 mph. The test was performed starting from both the right and left lanes.

A test run is considered valid if the bus is able to perform the maneuver at a constant speed without deviating from the test course or striking pylons. If the bus is not able to successfully complete the maneuver due to vehicle instability, the test will be terminated. The highest speed at which the maneuver can be successfully performed up to a maximum speed of 45 mph is recorded on the Safety Data Form.

3.1-III. DISCUSSION

The double-lane change was performed in both right-hand and left-hand directions. The bus was able to safely negotiate the test course in both the right-hand and left-hand directions up to the maximum test speed of 45 mph, and therefore, passed this portion of the test.

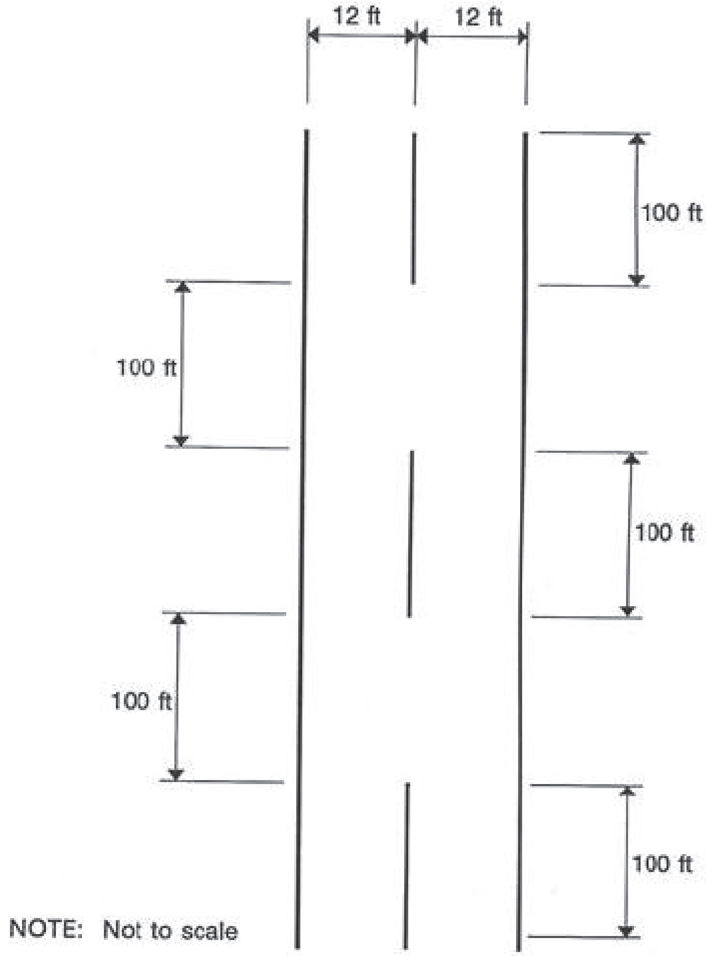


Figure 3.1. Double lane change test course

SAFETY DATA FORM

Page 1 of 1

Bus Number: 2020-05	Date: 11/10/2020
Personnel: S.R., E.D. & M.H.	

Temperature (°F): 72	Humidity (%): 53
Wind Direction: S	Wind Speed (mph): 8
Barometric Pressure (inHg): 30.05	

SAFETY TEST: DOUBLE LANE CHANGE	
Maximum safe speed tested for double-lane change to left	45 mph
Maximum safe speed tested for double-lane change to right	45 mph
Comments of the position of the bus during the lane change:	
The bus maintained a safe profile throughout all portions of testing.	
Comments of the tire/ground contact patch:	
The bus maintained the tire/ground patch throughout all portions of testing.	

3.1 SAFETY

RIGHT - HAND APPROACH

LEFT - HAND APPROACH

3.2 Safety - Braking

3.2 I. TEST OBJECTIVE

The objective of this test is to provide, for comparison purposes, braking performance data on transit buses produced by different manufacturers.

3.2 II. TEST DESCRIPTION

The testing was conducted at the LTI Test Track skid pad area. Brake tests were conducted after completion of the GVW portion of the vehicle durability test. At this point in testing the brakes have been subjected to a large number of braking snubs and will be considered well burnished. For buses that have not completed Durability Testing, the brakes will be burnished according to the test procedure. Testing was performed when the bus was fully loaded at its GVW. All tires on each bus were representative of the tires on the production model vehicle and inflated to the bus manufacturer's specified pressures.

The brake testing procedure is comprised of three phases:

1. Stopping distance tests

   i. Dry surface (high-friction, Skid Number within the range of 70-76)
   ii. Wet surface (low-friction, Skid Number within the range of 30-36)

2. Stability tests
3. Parking brake test

3.2-III. DISCUSSION

The results of the Stopping Distance phase of the Brake Test are available in table 3.2-2. There was no deviation from the test lane during the performance of the Stopping Distance phase.

During the Stability phase of Brake Testing the test bus experienced no deviation from the test lane during both approaches to the Split Friction Road surface.

The Parking Brake phase was completed with the test bus maintaining the parked position for the full five-minute period with no slip or roll observed in both the uphill and downhill positions.

This bus passed all three phases of the Safety –Braking Test.

Table 3.2-1. Braking Test Data Forms

Page 1 of 3

Bus Number: 2020-05	Date: 11/09/2020
Personnel: S.R., E.D. & P.D.	
Amb. Temperature (°F): 70	Wind Speed (mph): 3
Wind Direction: SW	Pavement Temp (°F) Start: 60 End: 69

TIRE INFLATION PRESSURE (psi):

Tire Type: Front: Michelin X Incity 305 70R 22.5
Rear: Michelin X Incity 305 70R 22.5

	Left Tire(s)		Right Tire(s)	
Front	130		130	
	Inner	Outer	Inner	Outer
Middle	N/A	N/A	N/A	N/A
Rear	130	130	130	130

AXLE LOADS (lb.)

	Left	Right
Front	7,760	7,830
Middle	N/A	N/A
Rear	14,610	13,430

Table 3.2-2. Stopping Distance Test Results Form
(longest stopping distance in each test condition in bold)

Stopping Distance (ft)					
Vehicle Direction	CW	CW	CCW	CCW	
Speed (mph)	Stop 1	Stop 2	Stop 3	Stop 4	**Average**
20 (dry)	**33.52**	27.02	24.63	26.56	27.93
30 (dry)	**55.00**	54.34	49.95	53.62	53.23
40 (dry)	**95.44**	90.43	89.47	89.83	91.29
45 (dry)	116.95	121.88	**126.47**	121.91	121.80
20 (wet)	34.99	**36.70**	34.14	33.16	34.75

Table 3.2-3. Stability Test Results Form

Stability Test Results (Split Friction Road surface)			
Vehicle Direction	Attempt	Did test bus stay in 12' lane? (Yes/No)	Comments
Driver side on high friction	1	Yes	None noted.
	2	Yes	None noted.
Driver side on low friction	1	Yes	None noted.
	2	Yes	None noted.

Table 3.2-4. Parking Brake Test Form

PARKING BRAKE (Fully Loaded) – GRADE HOLDING						
Vehicle Direction	Attempt	Hold Time (min)	Slide (in)	Roll (in)	Did Hold	No Hold
Front up	1	5:00	0	0	✓	
	2	N/A	N/A	N/A	N/A	N/A
	3	N/A	N/A	N/A	N/A	N/A
Front down	1	5:00	0	0	✓	
	2	N/A	N/A	N/A	N/A	N/A
	3	N/A	N/A	N/A	N/A	N/A

Table 3.2-5. Record of All Braking System Faults/Repairs.

Date	Fault/Repair	Description
11/09/20	None noted.	None noted.

3.2 Safety - Bus Braking

PARKING BRAKE TEST
PARKING BRAKE HELD FOR 5 MINUTES IN
BOTH 20% UP AND 20% DOWN POSITIONS

4. PERFORMANCE - AN ACCELERATION, GRADEABILITY, AND TOP SPEED TEST

4-I. TEST OBJECTIVE

The objective of this test is to determine the acceleration, gradeability, and top speed capabilities of the bus.

4-II. TEST DESCRIPTION

In this test, the bus was operated at SLW on a chassis dynamometer. The procedure dictates that the test bus be accelerated to a maximum "power-limited"/"governed" or maximum "safe" speed not exceeding 80 mph. The maximum power-limited/governed speed, if applicable, is the top speed as limited by the engine control system. The maximum safe speed is defined as the maximum speed that the dynamometer, the tires or other bus components are limited to. The test vehicle speed was measured using a speed encoder built in the chassis dynamometer. The time intervals between 10 mph increments were recorded using a Data Acquisitions System. Time-speed data and the top speed attained were recorded on the Performance Data Form. The recorded data was used to generate a percent grade versus speed table and a speed versus time curve. All the above are available in the following pages.

4-III. DISCUSSION

This test consisted of three runs from standstill to full throttle on the chassis dynamometer. Speed versus time data was obtained for each run and results are averaged to minimize test variability. The test was performed up to a maximum governed speed of 65.1 mph. The calculated gradeability results are attached. The average time to reach 30 mph was 6.4 seconds. The maximum gradeablity at 10 mph was 52.6% and at 40 mph was 10.5%. This bus passed this section of the test.

PERFORMANCE DATA FORM

Page 1 of 1

Bus Number: 2020-05	Date: 01/13/2021	
Personnel: J.S. & S.I.		
Temperature (°F): 71	Humidity (%): 21	
Barometric Pressure (inHg): 28.8		
		INITIALS:
Air Conditioning - OFF	✓Checked	J.S.
Ventilation fans - ON HIGH	✓Checked	J.S.
Heater - OFF	✓Checked	J.S.
Defroster - OFF	✓ Checked	J.S.
Exterior and interior lights - ON	✓ Checked	J.S.
Windows and doors - CLOSED	✓ Checked	J.S.

ACCELERATION, GRADEABILITY, TOP SPEED

Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	1.8	1.8	1.8
20 mph	3.5	3.4	3.5
30 mph	6.5	6.3	6.4
40 mph	10.0	9.7	9.9
50 mph	15.1	14.8	15.0
60 mph	22.8	22.5	22.7
70 mph	N/A	N/A	N/A

Maximum Speed (mph): 65.1 (maximum governed speed reached using chassis dynamometer)

PERFORMANCE SUMMARY SHEET

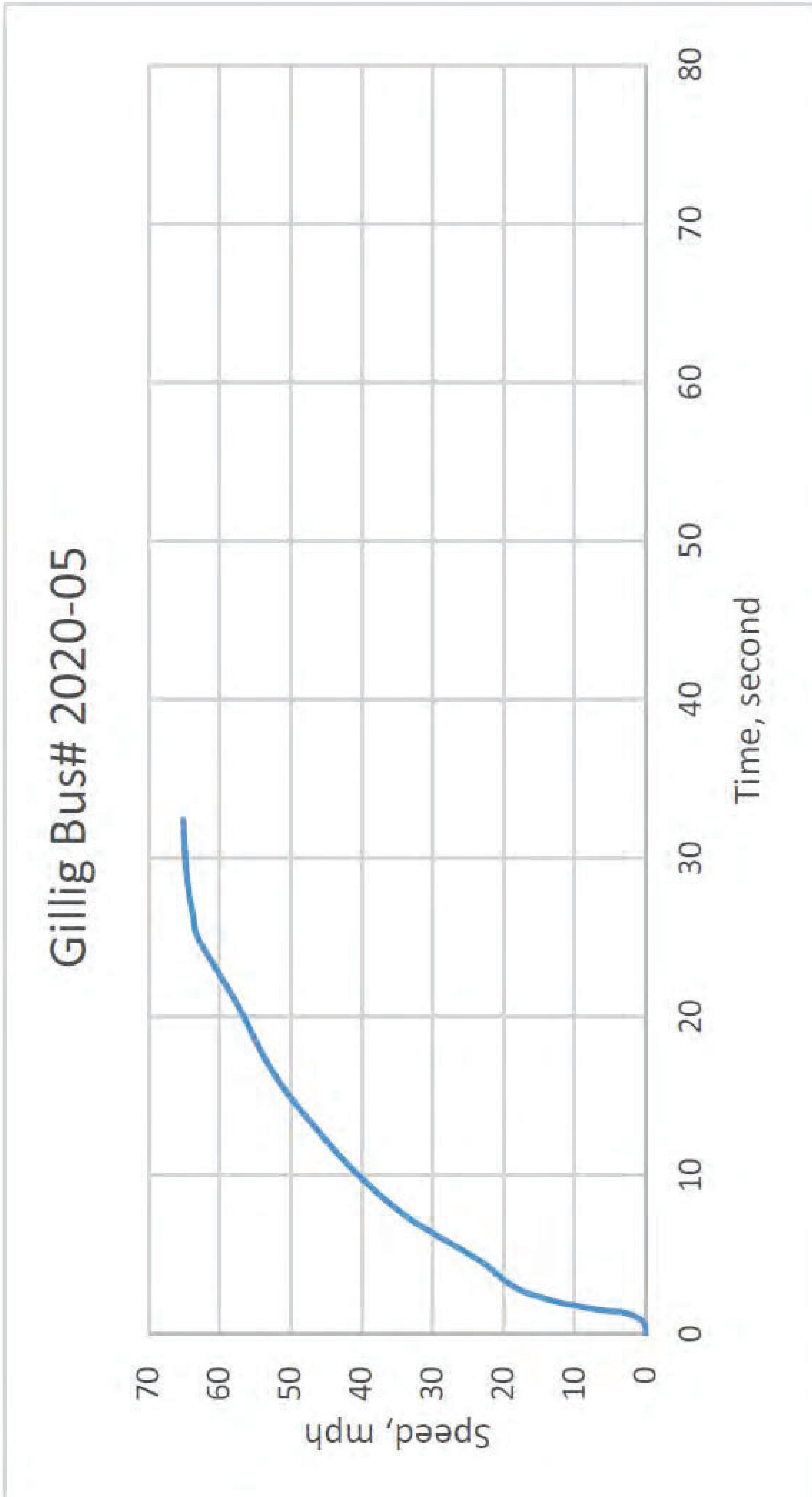
Bus Number: 2020-05	Date: 01/13/2021
Personnel: J.S. & S.I.	

Test Conditions:

Temperature (°F): 71	Humidity (%): 21
Barometric Pressure (inHg): 28.8	

Test Results:

Vehicle Speed (MPH)	Time (SEC)	Acceleration (FT/SEC^2)	Max. Grade (%)
1.0	1.0	9.04	28.1
5.0	1.5	15.79	49.1
10.0	1.8	16.94	52.6
15.0	2.4	10.38	32.3
20.0	3.5	4.32	13.4
25.0	5.1	5.45	16.9
30.0	6.4	5.57	17.3
35.0	7.9	4.18	13.0
40.0	9.9	3.39	10.5
45.0	12.2	2.79	8.7
50.0	15.0	2.48	7.7
55.0	18.6	1.61	5.0
60.0	22.7	2.00	6.2
65.0	31.2	0.19	0.6
65.1	32.4	Maximum Speed	



Gillig Bus# 2020-05
Speed, mph
Time, second
0
10
20
30
40
50
60
70
80

5.2 STRUCTURAL STRENGTH AND DISTORTION TESTS - STRUCTURAL DISTORTION

5.2-I. TEST OBJECTIVE

The objective of this test is to observe the operation of the bus subsystems when the bus is placed in a longitudinal twist simulating operation over a curb or through a pothole.

5.2-II. TEST DESCRIPTION

With the bus loaded to GVW, each wheel of the bus was raised (one at a time) to simulate operation over a curb and the following were inspected:

1. Body
2. Windows
3. Doors
4. Roof vents
5. Special seating
6. Undercarriage
7. Engine
8. Service doors
9. Escape hatches
10. Steering mechanism

Each wheel was then lowered (one at a time) to simulate operation through a pothole and the same items inspected.

5.2-III. DISCUSSION

The test sequence was repeated ten times. The first and last test is with all wheels level. The other eight tests are with each wheel 6 inches higher and 6 inches lower than the other three wheels.

All doors, windows, escape mechanisms, engine, steering and ADA accessible devices operated normally throughout the test. The undercarriage and body indicated no deficiencies. No water leakage was observed during the test. The results of this test are indicated on the following data forms. This bus passed this section of the test.

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Page 1 of 10

Bus Number: 2020-05	Date: 07/30/2020
Personnel: S.R., E.D., E.L., T.G. & P.D.	Temperature(°F): 77

Wheel Position: (check one)		
All wheels level	■ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
Windows	No Deficiencies.
Front Doors	No Deficiencies.
Rear Doors	No Deficiencies.
Escape Mechanisms/ Roof Vents	No Deficiencies.
Engine	No Deficiencies.
ADA Accessible/ Special Seating	No Deficiencies.
Undercarriage	No Deficiencies.
Service Doors	No Deficiencies.
Body	No Deficiencies.
Windows/ Body Leakage	No Deficiencies.
Steering Mechanism	No Deficiencies.

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Page 2 of 10

Bus Number: 2020-05	Date: 07/30/2020
Personnel: S.R., E.D., E.L., T.G. & P.D.	Temperature(°F): 77

Wheel Position: (check one)		
All wheels level	☐ before	☐ after
Left front	■ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies.
Front Doors	No Deficiencies.
Rear Doors	No Deficiencies.
Escape Mechanisms/ Roof Vents	No Deficiencies.
Engine	No Deficiencies.
ADA Accessible/ Special Seating	No Deficiencies.
Undercarriage	No Deficiencies.
Service Doors	No Deficiencies.
Body	No Deficiencies.
Windows/ Body Leakage	No Deficiencies.
Steering Mechanism	No Deficiencies.

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Page 3 of 10

Bus Number: 2020-05	Date: 07/30/2020
Personnel: S.R., E.D., E.L., T.G. & P.D.	Temperature(°F): 77

Wheel Position: (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	■ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies.
Front Doors	No Deficiencies.
Rear Doors	No Deficiencies.
Escape Mechanisms/ Roof Vents	No Deficiencies.
Engine	No Deficiencies.
ADA Accessible/ Special Seating	No Deficiencies.
Undercarriage	No Deficiencies.
Service Doors	No Deficiencies.
Body	No Deficiencies.
Windows/ Body Leakage	No Deficiencies.
Steering Mechanism	No Deficiencies.

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Bus Number: 2020-05	Date: 07/30/2020
Personnel: S.R., E.D., E.L., T.G. & P.D.	Temperature(°F): 77

Wheel Position: (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	■ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies.
Front Doors	No Deficiencies.
Rear Doors	No Deficiencies.
Escape Mechanisms/ Roof Vents	No Deficiencies.
Engine	No Deficiencies.
ADA Accessible/ Special Seating	No Deficiencies.
Undercarriage	No Deficiencies.
Service Doors	No Deficiencies.
Body	No Deficiencies.
Windows/ Body Leakage	No Deficiencies.
Steering Mechanism	No Deficiencies.

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Page 5 of 10

Bus Number: 2020-05	Date: 07/30/2020
Personnel: S.R., E.D., E.L., T.G. & P.D.	Temperature(°F): 77

Wheel Position: (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	■ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies.
Front Doors	No Deficiencies.
Rear Doors	No Deficiencies.
Escape Mechanisms/ Roof Vents	No Deficiencies.
Engine	No Deficiencies.
ADA Accessible/ Special Seating	No Deficiencies.
Undercarriage	No Deficiencies.
Service Doors	No Deficiencies.
Body	No Deficiencies.
Windows/ Body Leakage	No Deficiencies.
Steering Mechanism	No Deficiencies.

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Page 6 of 10

Bus Number: 2020-05	Date: 07/30/2020
Personnel: S.R., E.D., E.L., T.G. & P.D.	Temperature(°F): 77

Wheel Position: (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	■ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies.
Front Doors	No Deficiencies.
Rear Doors	No Deficiencies.
Escape Mechanisms/ Roof Vents	No Deficiencies.
Engine	No Deficiencies.
ADA Accessible/ Special Seating	No Deficiencies.
Undercarriage	No Deficiencies.
Service Doors	No Deficiencies.
Body	No Deficiencies.
Windows/ Body Leakage	No Deficiencies.
Steering Mechanism	No Deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 2020-05	Date: 07/30/2020
Personnel: S.R., E.D., E.L., T.G. & P.D.	Temperature(°F): 77

Wheel Position: (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	■ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies.
Front Doors	No Deficiencies.
Rear Doors	No Deficiencies.
Escape Mechanisms/ Roof Vents	No Deficiencies.
Engine	No Deficiencies.
ADA Accessible/ Special Seating	No Deficiencies.
Undercarriage	No Deficiencies.
Service Doors	No Deficiencies.
Body	No Deficiencies.
Windows/ Body Leakage	No Deficiencies.
Steering Mechanism	No Deficiencies.

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Bus Number: 2020-05	Date: 07/30/2020
Personnel: S.R., E.D., E.L., T.G. & P.D.	Temperature(°F): 77

Wheel Position: (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	■ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies.
Front Doors	No Deficiencies.
Rear Doors	No Deficiencies.
Escape Mechanisms/ Roof Vents	No Deficiencies.
Engine	No Deficiencies.
ADA Accessible/ Special Seating	No Deficiencies.
Undercarriage	No Deficiencies.
Service Doors	No Deficiencies.
Body	No Deficiencies.
Windows/ Body Leakage	No Deficiencies.
Steering Mechanism	No Deficiencies.

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Page 9 of 10

Bus Number: 2020-05	Date: 07/30/2020
Personnel: S.R., E.D., E.L., T.G. & P.D.	Temperature(°F): 77

Wheel Position: (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	■ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies.
Front Doors	No Deficiencies.
Rear Doors	No Deficiencies.
Escape Mechanisms/ Roof Vents	No Deficiencies.
Engine	No Deficiencies.
ADA Accessible/ Special Seating	No Deficiencies.
Undercarriage	No Deficiencies.
Service Doors	No Deficiencies.
Body	No Deficiencies.
Windows/ Body Leakage	No Deficiencies.
Steering Mechanism	No Deficiencies.

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Bus Number: 2020-05	Date: 07/30/2020
Personnel: S.R., E.D., E.L., T.G. & P.D.	Temperature(°F): 77

Wheel Position: (check one)		
All wheels level	☐ before	■ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies.
Front Doors	No Deficiencies.
Rear Doors	No Deficiencies.
Escape Mechanisms/ Roof Vents	No Deficiencies.
Engine	No Deficiencies.
ADA Accessible/ Special Seating	No Deficiencies.
Undercarriage	No Deficiencies.
Service Doors	No Deficiencies.
Body	No Deficiencies.
Windows/ Body Leakage	No Deficiencies.
Steering Mechanism	No Deficiencies.

5.2 STRUCTURAL DISTORTION TEST

RIGHT REAR WHEEL SIX INCHES HIGHER

RIGHT REAR WHEEL SIX INCHES LOWER

5.3 STRUCTURAL STRENGTH AND DISTORTION TESTS - STATIC TOWING TEST

5.3-I. TEST OBJECTIVE

The objective of this test is to determine the characteristics of the bus towing mechanisms under static loading conditions.

5.3-II. TEST DESCRIPTION

Utilizing a load-distributing yoke, a hydraulic cylinder was used to apply a static tension load equal to 1.2 times the bus curb weight. The load was applied to both the front and rear, if applicable, towing fixtures at an angle of 20 degrees with the longitudinal axis of the bus, first to one side then the other in the horizontal plane, and then upward and downward in the vertical plane. Any permanent deformation or damage to the tow eyes or adjoining structure was recorded.

5.3-III. DISCUSSION

The load-distributing yoke was incorporated as the interface between the Static Tow apparatus and the test bus tow hook/eyes. The test was performed to the full target test weight of 38,988 lb. (1.2 x 32,490 lb. CW). No damage or deformation was observed during all four pulls of the test.

STATIC TOWING TEST DATA FORM

Page 1 of 1

Bus Number: 2020-05	Date: 04/26/2021
Personnel: T.S., S.R., E.L., E.D. & J.M.	Temperature (°F): 60

Inspect right front tow eye and adjoining structure.
Comments: No damage observed.
Check the torque of all bolts attaching tow eye and surrounding structure.
Comments: Welds inspected.
Inspect left front tow eye and adjoining structure.
Comments: No damage observed.
Check the torque of all bolts attaching tow eye and surrounding structure.
Comments: Welds inspected.
Inspect right rear tow eye and adjoining structure.
Comments: N/A
Check the torque of all bolts attaching tow eye and surrounding structure.
Comments: N/A
Inspect left rear tow eye and adjoining structure.
Comments: N/A
Check the torque of all bolts attaching tow eye and surrounding structure.
Comments: N/A
General comments of any other structure deformation or failure: All 4 pulls were performed to the target test load of 38,988 lb. with no damage or deformation observed.

5.3 STATIC TOWING TEST

20° DOWNWARD PULL

20° LEFT PULL

5.4 STRUCTURAL STRENGTH AND DISTORTION TESTS - DYNAMIC TOWING TEST

5.4-I. TEST OBJECTIVE

The objective of this test is to verify the integrity of the towing fixtures and determine the feasibility of towing the bus under manufacturer specified procedures.

5.4-II. TEST DESCRIPTION

This test required the bus to be towed at curb weight using the specified equipment and instructions provided by the manufacturer and a heavy-duty wrecker. The bus was towed for 5 miles at a speed of 20 mph for each recommended towing configuration. After releasing the bus from the wrecker, the bus was visually inspected for any structural damage or permanent deformation. All doors, windows and passenger escape mechanisms were inspected for proper operation.

5.4-III. DISCUSSION

The bus was towed using a heavy-duty wrecker. The towing interface was accomplished by incorporating a hydraulic under-lift. A front lift tow was performed. No problems, deformation, or damage was noted during testing. This bus passed this section of the test.

DYNAMIC TOWING TEST DATA FORM

Page 1 of 1

Bus Number: 2020-05	Date: 01/08/2021
Personnel: T.S. & T.G.	

Temperature (°F): 28	
Wind Direction: Calm	Wind Speed (mph): 0

Inspect tow equipment-bus interface.

Comments: No problems encountered.

Inspect tow equipment-wrecker interface.

Comments: No problems encountered.

Towing Comments: A heavy duty hydraulic wheel lift wrecker was used to perform this tow test. There were no problems encountered

Description and location of any structural damage: None noted.

General Comments: None noted.

5.4 DYNAMIC TOWING TEST

TEST BUS IN TOW

5.5 STRUCTURAL STRENGTH AND DISTORTION TESTS – JACKING TEST

5.5-I. TEST OBJECTIVE

The objective of this test is to inspect for damage due to the deflated tire and determine the feasibility of jacking the bus with a portable hydraulic jack to a height sufficient to replace a deflated tire.

5.5-II. TEST DESCRIPTION

With the bus at curb weight, the tire(s) at one corner of the bus were replaced with deflated tire(s) of the appropriate type. A portable hydraulic floor jack was then positioned in a manner and location specified by the manufacturer and used to raise the bus to a height sufficient to provide 3-in clearance between the floor and an inflated tire. The deflated tire(s) were replaced with the original tire(s) and the jack was lowered. Any structural damage or permanent deformation was recorded on the test data sheet. This procedure was repeated for each corner of the bus.

5.5-III. DISCUSSION

During the deflated tire portion of the test, the jacking point clearances ranged from 3.8 inches to 11.2 inches. No deformation or damage was observed during testing. A complete listing of jacking point clearances is provided in the Jacking Test Data Form. This bus passed this section of the test.

JACKING CLEARANCE SUMMARY

Condition	Frame Point Clearance
Front axle – one tire flat	5.4
Rear axle – one tire flat	11.0
Rear axle – two tires flat	8.1

JACKING TEST DATA FORM

Bus Number: 2020-05	Date: 07/30/2020
Personnel: E.D. & E.L.	Temperature (°F): 81

Record any permanent deformation or damage to bus as well as any difficulty encountered during jacking procedure.

I= Inflated D= Deflated

Deflated Tire	Jacking Pad Clearance Body/Frame (in)	Jacking Pad Clearance Axle/Suspension (in)	Comments
Right front	9.1“I 5.4“D	7.3“I 4.1” D	Body & Axle
Left front	11.0“I 9.7“D	7.3“I 4.7“D	Body & Axle
Right rear—outside	11.9“I 11.2“D	6.4“I 5.9“D	Body & Suspension
Right rear—both	11.9“I 8.1“D	6.4“I 3.8“D	Body & Suspension
Left rear—outside	11.7“I 11.0“D	6.4“I 6.0“D	Body & Suspension
Left rear—both	11.7“I 8.4“D	6.4“I 4.0“D	Body & Suspension
Right middle or tag—outside	N/A	N/A	N/A
Right middle or tag—both	N/A	N/A	N/A
Left middle or tag—outside	N/A	N/A	N/A
Left middle or tag—both	N/A	N/A	N/A

Additional comments of any deformation or difficulty during jacking:

None noted.

5.5 JACKING TEST

JACK IN PLACE – FRONT

JACK IN PLACE – REAR

5.6 STRUCTURAL STRENGTH AND DISTORTION TESTS - HOISTING TEST

5.6-I. TEST OBJECTIVE

The objective of this test is to determine possible damage or deformation caused by the jack/stands.

5.6-II. TEST DESCRIPTION

With the bus at curb weight, the front end of the bus was raised to a height sufficient to allow manufacturer-specified placement of jack stands under the axles or jacking pads independent of the hoist system. The bus was checked for stability on the jack stands and for any damage to the jacking pads or bulkheads. The procedure was repeated for the tag/middle axles (if equipped), and rear end of the bus. The procedure was then repeated for the front, tag/middle (if equipped) axles, and rear simultaneously.

5.6-III. DISCUSSION

The test was conducted using four posts of a six-post electric lift and 19-inch jack stands. The bus was hoisted from the front wheels and then from the rear wheels, and then from the front and rear wheels simultaneously and placed on jack stands.

The bus accommodated the placement of the vehicle lifts and jack stands and the procedure was performed without any instability noted. This bus passed this section of the test.

HOISTING TEST DATA FORM

Page 1 of 1

Bus Number: 2020-05	Date: 07/30/2020
Personnel: E.D. & P.D.	Temperature (°F): 75

Comments of any structural damage to the jacking pads or axles while both the front wheels are supported by the jack stands:
None noted.
Comments of any structural damage to the jacking pads or axles while both the rear wheels are supported by the jack stands:
None noted.
Comments of any structural damage to the jacking pads or axles while both the tag axle wheels are supported by the jack stands:
N/A
Comments of any structural damage to the jacking pads or axles while the front and rear wheels are supported by the jack stands:
None noted.
Comments of any problems or interference placing wheel hoists under wheels:
None noted.

5.6 HOISTING TEST

JACK STANDS IN PLACE –REAR

JACK STANDS IN PLACE – FRONT AND REAR

5.7 STRUCTURAL DURABILITY TEST

5.7-I. TEST OBJECTIVE

The objective of this test is to perform an accelerated durability test that approximates 25 percent of the service life of the vehicle.

5.7-II. TEST DESCRIPTION

The test vehicle was driven a total of 15,575 miles; approximately 12,500 miles on the LTI Durability Test Track and approximately 3,075 miscellaneous other miles. The test was conducted with the bus operated under three different loading conditions. The first segment consisted of approximately 6,250 miles with the bus operated at GVW. The second segment consisted of approximately 2,500 miles with the bus operated at SLW. The remainder of the test, approximately 6,250 miles, was conducted with the bus loaded to CW. The loads on both axles and GVW were within their ratings with the bus loaded as specified by the manufacturer. All subsystems were running during these tests in their normal operating modes. All manufacturer-recommended servicing was followed and noted on the vehicle maintainability log. Servicing items accelerated by the durability tests were compressed by 10:1; all others were done on a 1:1 mi/mi basis. Unscheduled breakdowns and repairs were recorded on the same log as are any unusual occurrences as noted by the driver. Once a week the test vehicle was washed down and thoroughly inspected for any signs of failure.

5.7-III. DISCUSSION

The Structural Durability Test was started on August 18,2020 and was conducted until April 5, 2021. The first 6,250 miles were performed at a GVW of 43,630 lb. and completed on November 9, 2020. The next 2,500-mile SLW segment was performed at 38,520 lb. and completed on December 10, 2020 and the final 6,250-mile segment was performed at a CW of 32,490 lb. and completed on April 5, 2021.

The following mileage summary presents the accumulation of miles during the Structural Durability Test. The driving schedule is included, showing the operating duty cycle. A detailed plan view of the LTI Test Track Facility and Durability Test Track are attached for reference. Also, a durability element profile detail shows all the measurements of the different conditions. Finally, photographs illustrating some of the failures that were encountered during the Structural Durability Test are included. This bus passed this section of the test, as there were no uncorrected Class 1 or Class 2 failures and the unscheduled maintenance of 36.15 hours was less than 125 hours.

Gillig Bus# 2020-05

MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
08/17/20 TO 08/23/20	593.00	77.00	670.00
08/24/20 TO 08/30/20	714.00	32.00	746.00
08/31/20 TO 09/06/20	0.00	0.00	0.00
09/07/20 TO 09/13/20	0.00	0.00	0.00
09/14/20 TO 09/20/20	222.00	11.00	233.00
09/21/20 TO 09/27/20	610.00	25.00	635.00
09/28/20 TO 10/04/20	589.00	58.00	647.00
10/05/20 TO 10/11/20	490.00	133.00	623.00
10/12/20 TO 10/18/20	496.00	185.00	681.00
10/19/20 TO 10/25/20	423.00	78.00	501.00
10/26/20 TO 11/01/20	970.00	43.00	1013.00
11/02/20 TO 11/08/20	143.00	370.00	513.00
11/09/20 TO 11/15/20	762.00	95.00	857.00
11/16/20 TO 11/22/20	452.00	19.00	471.00
11/23/20 TO 11/29/20	151.00	7.00	158.00

Gillig Bus# 2020-05

MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
11/30/20 TO 12/06/20	194.00	8.00	202.00
12/07/20 TO 12/13/20	806.00	225.00	1031.00
12/14/20 TO 12/20/20	401.00	18.00	419.00
12/21/20 TO 12/27/20	345.00	15.00	360.00
12/28/20 TO 01/03/21	0.00	0.00	0.00
01/04/21 TO 01/10/21	593.00	123.00	716.00
01/11/21 TO 01/17/21	270.00	349.00	619.00
01/18/21 TO 01/24/21	642.00	29.00	671.00
01/25/21 TO 01/31/21	585.00	124.00	709.00
02/01/21 TO 02/07/21	39.00	2.00	41.00
02/08/21 TO 02/14/21	0.00	0.00	0.00
02/15/21 TO 02/21/21	0.00	0.00	0.00
02/22/21 TO 02/28/21	400.00	16.00	416.00
03/01/21 TO 03/07/21	837.00	37.00	874.00
03/08/21 TO 03/14/21	773.00	33.00	806.00

Gillig Bus# 2020-05

MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
03/15/21 TO 03/21/21	0.00	453.00	453.00
03/22/21 TO 03/28/21	0.00	397.00	397.00
03/29/21 TO 04/04/21	0.00	47.00	47.00
04/05/21 TO 04/11/21	0.00	66.00	66.00
TOTAL	12500.00	3075.00	15575.00

Driving Schedule for Bus Operation on the Durability Test Track.

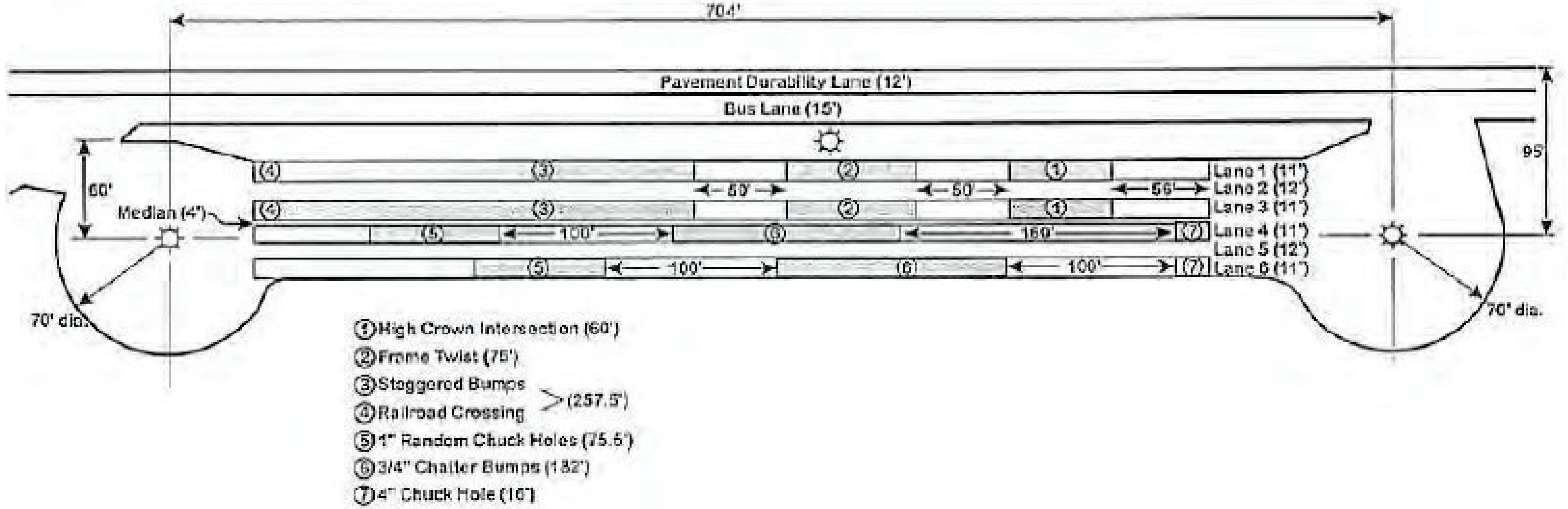
STANDARD OPERATING SCHEDULE

Monday through Friday

	HOUR	ACTION
Shift 1	midnight	D
	1:40 am	C
	1:50 am	B
	2:00 am	D
	3:35 am	C
	3:45 am	B
	4:05 am	D
	5:40 am	C
	5:50 am	B
	6:00 am	D
	7:40 am	C
	7:50 am	F
Shift 2	8:00 am	D
	9:40 am	C
	9:50 am	B
	10:00 am	D
	11:35 am	C
	11:45 am	B
	12:05 pm	D
	1:40 pm	C
	1:50 pm	B
	2:00 pm	D
	3:40 pm	C
	3:50 pm	F
Shift 3	4:00 pm	D
	5:40 pm	C
	5:50 pm	B
	6:00 pm	D
	7:40 pm	C
	7:50 pm	B
	8:05 pm	D
	9:40 pm	C
	9:50 pm	B
	10:00 pm	D
	11:40 pm	C
	11:50 pm	F

B—Break
C—Cycle all systems five times, visual inspection, driver's log entries
D—Drive bus as specified by procedure
F—Fuel bus, complete driver's log shift entries


Full-Scale Research Facilities at
the Pennsylvania Transportation Institute
Brake Slope
Large Impact Pendulum
1-Mile Oval
Vehicle Durability Course
Crash Safety Research Facility
Modified Durability Course
Vehicle Handling Area
Vehicle Research and Testing Lab
Fueling
Office Building
Bridge Research Facility
Entrance Road



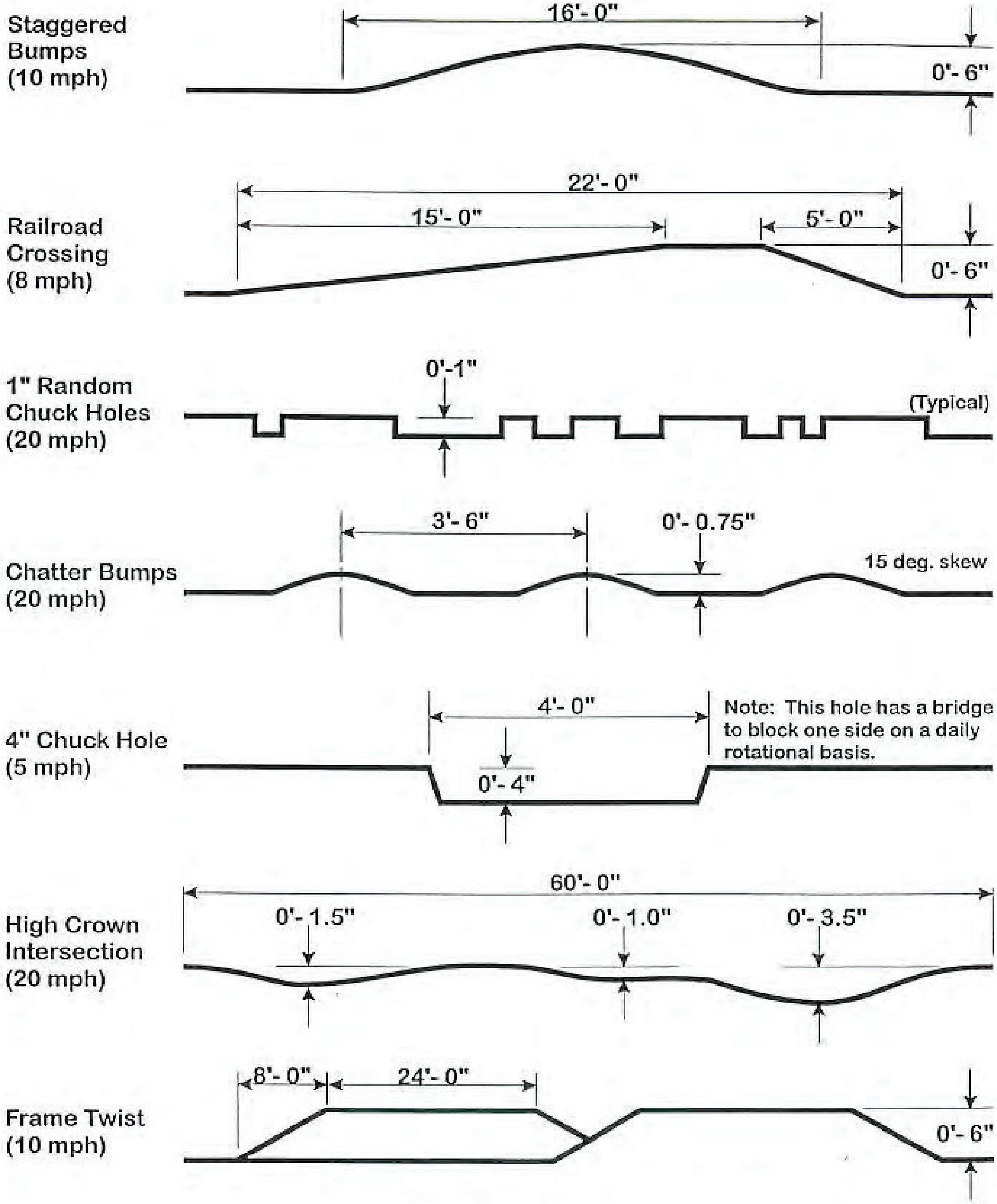
Plan View

Vehicle Durability Test Track

Track 1 (Track 2 has similar layout)

The Larson Transportation Institute

Penn State



Durability Element Profiles

The Pennsylvania Transportation Institute
Penn State

Unscheduled Maintenance
Gillig Bus# 2020-05
(Page 1 of 3)

Date	Test Miles	Issue	Action	Labor Hours	Sub-system	Class
08/26/20	1,034	Two bolts came loose on the ECM wiring connector latch.	Tightened latch bolts.	0.20	Hardware	3
08/28/20	1,416	Bus will not connect to charger.	Problem was identified as communication issue between bus and charger. Bus software was updated by Cummins.	1.00	Electrical	3
09/25/20 to 11/19/20	2,238 to 7,363	The rear cowling on the curb side right rear has broken the rivets on the inside of the cowling.	Threaded nutserts were installed in the roof for the cowling brackets. New ¼" bolts were installed and caulk was used to seal the area from weather.	1.00	Body	3
10/08/20	3,390	Bus would not start. EV wait to start light would not go out.	Cycled 24v batteries three times. Bus started.	0.20	Electrical	3
11/19/20	7,363	The front bump stops are damaged.	Damaged bump stops were removed and the new ones were installed by the bus manufacturer's representative.	1.00	Suspension	3
11/20/21	7,363	Bolts broken on power box and broken ground wire on air compressor (Bolts vibrated loose).	Replaced air compressor assembly and new ground wire.	2.00	Compressed Air	3
11/21/20 to 01/11/20	7,471 to 10,658	Bus would not build air pressure.	Had to cycle 24v batteries then bus built up air. This occurred on several different occasions. The air compressor unit was replaced and software was updated.	2.65	Compressed Air	3
12/04/20	7,748	Sheet metal/plating behind the Dynex power modules at the forward bulkhead compartment (above the driver's head) had become loose after 7 of the sheet metal screws had fallen.	Bus manufacturer's representative replaced the sheet metal screws with (7) ¼-20 screws and locknuts to secure plate.	0.10	Body	3

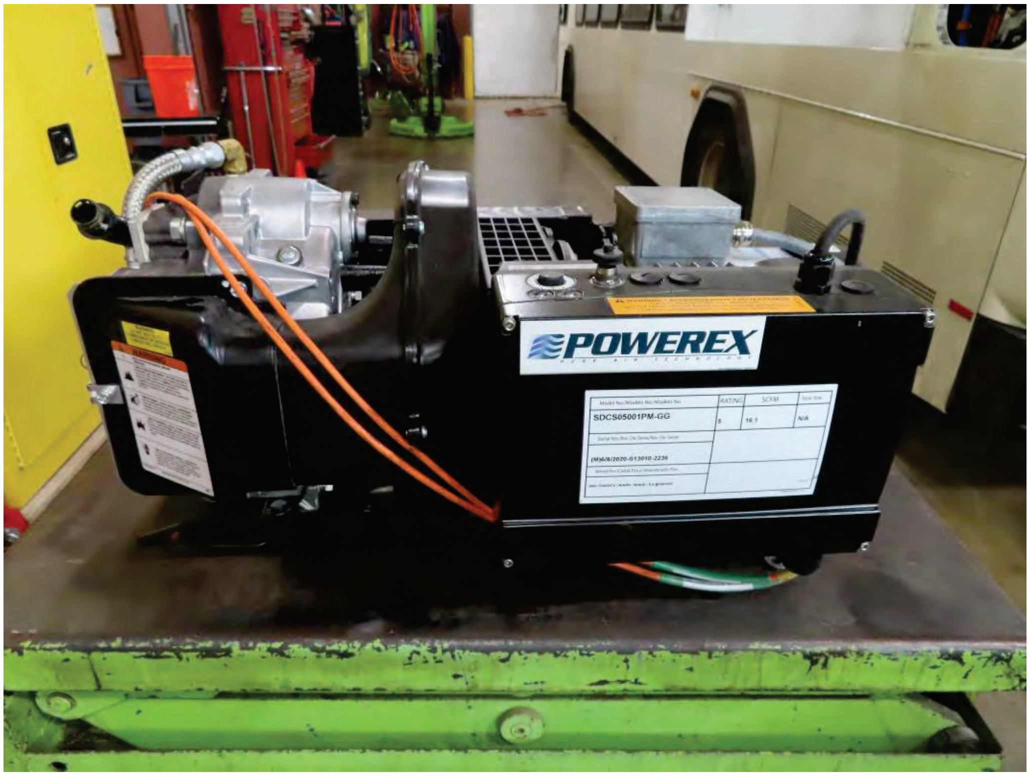
Unscheduled Maintenance
Gillig Bus# 2020-05
(Page 2 of 3)

Date	Test Miles	Issue	Action	Labor Hours	Sub-system	Class
01/06/21	10,206	Front curb side shock is leaking.	A new front, curb side shock was installed. New bolts at the bottom were installed including a new castle nut on the bottom bolt.	1.00	Suspension	4
01/22/21 to 02/23/21	11,690 to 12,522	Bus not building air pressure. On 02/04/21 the air compressor on the bus stopped working due to failure within the unit itself. It was making a very loud noise before it quit working.	The manufacturer's representative replaced the failed unit with a new one. A representative from Powerex replaced the power inverter on the compressor and validated function.	8.50	Suspension	2
01/28/21	12,354	Lower rear torque arm bushings are worn out.	Removed and replaced both lower torque arms for rear axle assembly. Installed anti-seize to bolts and torqued to manufacturer's specifications.	2.00	Suspension	3
01/29/21	12,443	A 3/8" x 3" brass pipe was broken on the supply side of the air compressor causing the bus to not build air pressure.	The broken pipe was removed and a new pipe was installed.	1.00	Compressed Air / Suspension	3
02/04/21	12,481	The brass nipple between the air compressor and check valve broke at the threads going into the valve.	The new brass nipple, p-clip and fabricated bracket were installed per manufacturer's instructions. The air line was attached making sure it was pointing down.	4.00	Compressed Air / Suspension	2
02/24/21	12,522	The bus will turn on, but the bus will not start and go into EV mode, after replacing the compressor on 02/23/2021.	The HV cable from the HV junction box to the inverter was bad. This was replaced and that resolved the problem.	1.00	Electrical	2
02/25/21 to 03/22/21	12,866 to 15,159	Bus is charging inconsistently and never charging to 100%. Check EV light is coming on. Sometimes the audible alarm is also coming on.	Battery pack # 3 had a bad cell in it. This battery pack was replaced on 03/16/21, but this did not resolve the issue. Cummins reprogrammed battery pack on 03/22/21 and the issue was resolved.	10.00	Electrical	3

Unscheduled Maintenance
Gillig Bus# 2020-05
(Page 3 of 3)

Date	Test Miles	Issue	Action	Labor Hours	Sub-system	Class
03/10/21	14,161	Air supply hose from the air compressor to the air cooler is leaking around one collar.	The damaged air hose was removed and replaced. The bus was started and no leaks were found.	0.50	HVAC	3

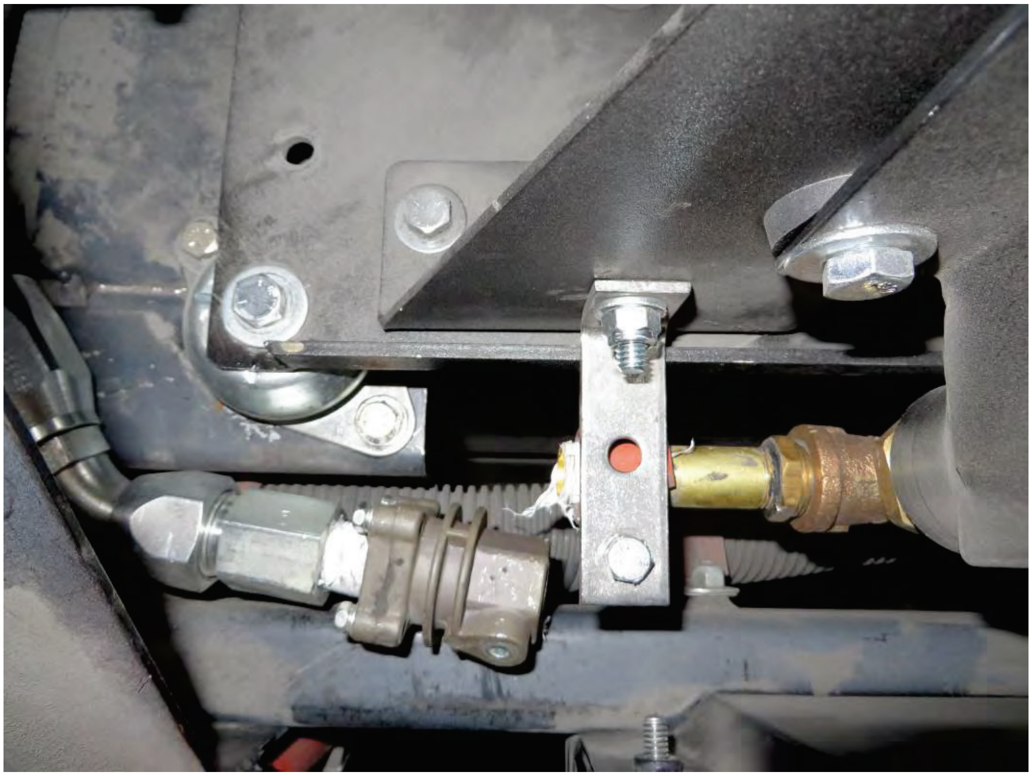
UNSCHEDULED MAINTENANCE



AIR COMPRESSOR REPLACEMENT
(7,748 TEST MILES)

LOWER REAR TORQUE ARM BUSHINGS ARE WORN OUT
(12,354 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.



BRASS PIPE BROKEN ON SIDE OF AIR COMPRESSOR
(12,443 TEST MILES)

6. ENERGY ECONOMY AND RANGE TEST – AN ENERGY CONSUMPTION AND RANGE TEST FOR BATTERY ELECTRIC BUSES USING APPROPRIATE OPERATING CYCLES

6-I. TEST OBJECTIVE

The objective of this test is to provide accurate comparable energy consumption data on battery electric transit buses produced by different manufacturers. This energy economy test bears no relation to the calculations done by the Environmental Protection Agency (EPA) to determine levels for the Corporate Average Fuel Economy Program. EPA's calculations are based on tests conducted under laboratory conditions intended to simulate city and highway driving. This energy economy test, as designated here, is a measurement of the energy consumed by a vehicle traveling a specified test operating profile, under specified operating conditions that are typical of transit bus operation. The results of this test will not represent actual energy usage but will provide data that can be used by FTA Grantees to compare buses tested using this procedure.

6-II. TEST DESCRIPTION

This test is performed in the emissions bay of the LTI Vehicle Testing Laboratory. The Laboratory is equipped with a Schenk Pegasus 300 HP, large-roll (72 inch diameter) chassis dynamometer suitable for heavy-vehicle emissions testing. The driving cycles are the Manhattan cycle, a low average speed, highly transient urban cycle (Figure 1), the Orange County Bus Cycle which consists of urban and highway driving segments (Figure 2), and the EPA HD-UDDS Cycle (Figure 3). This test is conducted at seated load weight.

This test is conducted generally as per the methods described in the SAE standard J 1634-2017. The light-duty test cycles specified in this standard are replaced by transit bus test cycles mentioned above.

The Single-Cycle test (SCT) procedure is adopted for this bus. The end of test is determined when the bus cannot keep up with the speed trace of the test cycle, as recommended by the bus manufacturer. The battery system is recharged to full SOC at the end of the test, following procedures specified in SAE J 1634-2017. During the recharge, the DC energy (into the battery system) and the AC energy (into the charger) are recorded. From these data, the average AC energy consumption, the charger efficiency (DC Energy, kWh/AC Energy, kWh) and range (miles) for each test cycle is calculated.

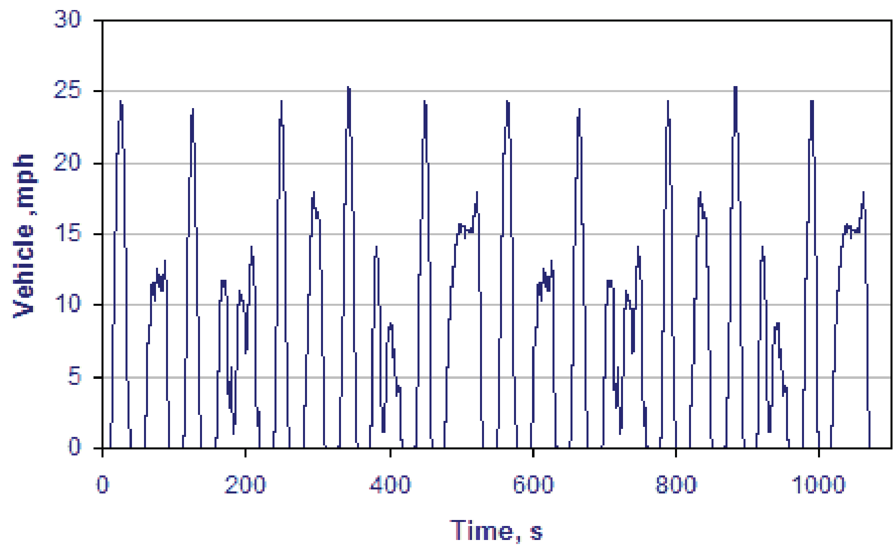


Figure 1. Manhattan Driving Cycle (duration 1089 sec, Maximum speed 25.4 mph, average speed 6.8 mph)

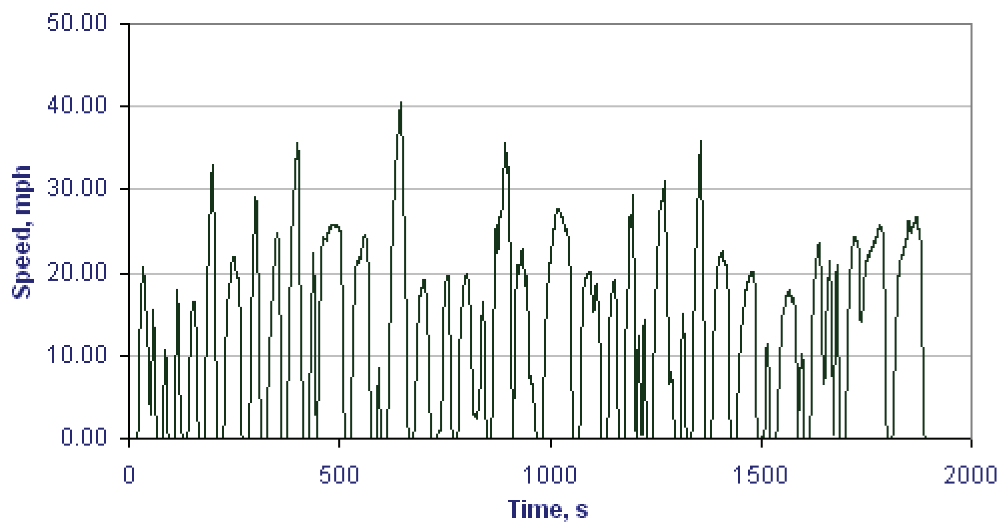


Figure 2. Orange County Bus Cycle (Duration 1909 Sec, Maximum Speed 41 mph, Average Speed 12 mph).

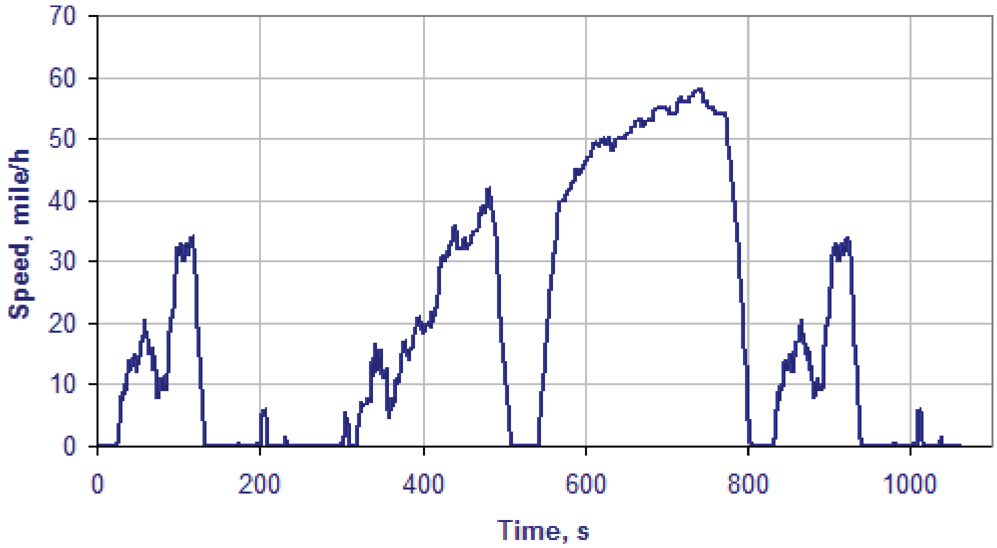


Figure 3. HD-UDDS Cycle (duration 1060 seconds, Maximum Speed 58 mph, Average Speed 18.86 mph).

6-III. DISCUSSION

The driving cycle consists of three simulated transit driving cycles: Manhattan, Orange County Bus Cycle and the HD-UDDS, as described in 6-II.

An extensive pretest maintenance check is conducted including the replacement of all lubrication fluids, if applicable. The details of the pretest maintenance are given in the first three Pretest Maintenance Forms. The fourth sheet shows the Pretest Inspection Form. Finally, the summary sheet provides the average energy consumption and range of bus for the three test cycles. The test was conducted at a seated load weight of 38,520 lbs. The average AC energy consumption for the Manhattan, OCBC and the HD-UDDS were 3,039 Wh/mile, 2,269 Wh/mile and 2,093 Wh/mile respectively. The range for the three driving cycles were 129 miles, 172 miles and 187 miles respectively.

This bus was tested using the Manhattan, Orange County and UDDS driving cycles. The energy economy and range results for buses tested using these cycles are not directly comparable to buses tested under the earlier protocol that uses the CBD, Arterial and Commuter driving cycles.

ENERGY ECONOMY PRE-TEST MAINTENANCE FORM

Page 1 of 3

Bus Number: 2020-05	Date: 03/16/2021	SLW (lb.): 38,520
Personnel: T.S., E.L. & T.G.		

ENERGY SYSTEM	OK
Install fuel measurement system	✓
Remarks: None noted.	
BRAKES/TIRES	OK
Inspect hoses	✓
Inspect brakes	✓
Check tire inflation pressures (mfg. specs.)	✓
Check tire wear (less than 50%)	✓
Remarks: None noted.	
BATTERY COOLING SYSTEM	OK
Check hoses and connections	✓
Check system for coolant leaks	✓
Remarks: None noted.	

ENERGY ECONOMY PRE-TEST MAINTENANCE FORM

Page 2 of 3

Bus Number: 2020-05	Date: 03/16/2021
Personnel: T.S., E.L. & T.G.	

ELECTRICAL SYSTEM	OK
Check battery	✓
Inspect wiring	✓
Inspect terminals	✓
Check lighting	✓
Remarks: None noted.	

DRIVE SYSTEM	OK
Drain transmission fluid	N/A
Replace filter/gasket	N/A
Check hoses and connections	N/A
Replace transmission fluid	N/A
Check for fluid leaks	N/A
Remarks: Drive motor	

LUBRICATION	OK
Lube all chassis grease fittings	✓
Lube universal joints	✓
Replace differential lube including axles	N/A
Remarks: Refer to manufacturer’s maintenance specifications for service.	

ENERGY ECONOMY PRE-TEST MAINTENANCE FORM

Page 3 of 3

Bus Number: 2020-05	Date: 03/16/2021
Personnel: T.S., E.L. & T.G.	

OTHER ITEMS	OK
Replace air filter	N/A
Inspect air compressor and air system	✓
Inspect vacuum system, if applicable	N/A
Check and adjust all drive belts	N/A
Remarks: None noted.	

STEERING SYSTEM	OK
Check power steering hoses and connectors	✓
Service fluid level	✓
Check power steering operation	✓
Remarks: None noted.	

	OK
Ballast bus to seated load weight during Coast Down	✓

TEST DRIVE	OK
Check brake operation	✓
Check transmission operation	✓
Remarks: None noted.	

ENERGY ECONOMY PRE-TEST INSPECTION FORM

Page 1 of 1

Bus Number: 2020-05	Date: 03/24/2021
Personnel: T.S. & F.T.	

PRE WARM-UP	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	T.S.
Cold tire pressure (psi): Front 130 Middle N/A Rear 130	T.S.
Energy economy instrumentation installed and working properly.	T.S.
WARM-UP	**If OK, Initial**
Interior and exterior lights on, evaporator fan on	F.T.
Air conditioner off	F.T.
Defroster off	F.T.
Windows and doors closed	F.T.
Do not drive with left foot on brake	F.T.

ENERGY ECONOMY DATA FORM
(Battery Electric Buses)

Page 1 of 1

Bus Number: 2020-05	Manufacturer: Gillig	Date: 03/25/2021
Fuel Type: Electric	Personnel: F.T. & S.I.	
Temperature (°F): 75.2	Humidity (%): 55	Barometric Pressure (inHg): 28.8
SLW (lb.): 38,520	Charger: Charge Point Express 250	

	Manhattan	**Orange County**	**UDDS**
AC Energy (Wh/mile)	3039	2269	2093
Range (miles)	129	172	187

Comments: None noted.

6.0 ENERGY ECONOMY

BUS TESTED ON CHASSIS DYNAMOMETER FOR PERFORMANCE AND FUEL ECONOMY

CHARGE POINT CHARGER

7. NOISE

7.1 INTERIOR NOISE AND VIBRATION TESTS

7.1-I. TEST OBJECTIVE

The objective of these tests is to measure and record interior noise levels and check for audible vibration under various operating conditions.

7.1-II. TEST DESCRIPTION

During this series of tests, the interior noise level was measured at several locations with the bus operating under the following three conditions:

1. With the bus stationary, a white noise generating system provided a uniform sound pressure level equal to 80 dB(A) on the left, exterior side of the bus. The engine and all accessories were switched off and all openings including doors and windows were closed. This test was performed at the LTI Test Track Facility.

2. The bus was accelerated at full throttle from a standing start to 35 mph on a level pavement. All openings were closed and all accessories were operating during the test. This test was performed on the track at the LTI Test Track Facility.

3. The bus was operated at various speeds from 0 to 55 mph with and without the air conditioning and accessories on. Any audible vibration or rattles were noted. This test was performed on the test segment between the LTI Test Track and the Bus Testing Center.

All tests were performed in an area free from extraneous sound-making sources or reflecting surfaces. The ambient sound level as well as the surrounding weather conditions were recorded in the test data.

7.1-III. DISCUSSION

For the first part, the overall average of the six measurements was 49.4 dB(A); ranging from 48.0 dB(A) at the rear passenger seats to 50.7 dB(A) at the driver's seat. The interior ambient noise level for this test was less than 30 dB(A).

For the second part, the interior noise level ranged from 71.5 dB(A) at the middle passenger seats to 75.8 dB(A) at the driver's seat. The overall average was 73.1 dB(A). The interior ambient noise level for this test was less than 30 dB(A).

No vibrations or rattles were noted during the third part of this test. This bus passed this section of the test.

INTERIOR NOISE TEST DATA FORM
Test Condition 1: 80 dB(A) Stationary White Noise
Page 1 of 3

Bus Number: 2020-05	Date: 12/15/2020
Personnel: S.R., E.D., E.L. & T.G..	
Temperature (°F): 34	Humidity (%): 44
Wind Speed (mph): 7	Wind Direction: NNW
Barometric Pressure (inHg): 30.29	
Interior Ambient Noise Level dB(A): less than 30	Exterior Ambient Noise Level dB(A): 41.3
Microphone Height During Testing (in): 45.5	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	50.7
Front Passenger Seats	49.5
In Line with Front Speaker	49.1
In Line with Middle Speaker	49.9
In Line with Rear Speaker	49.4
Rear Passenger Seats	48.0

Comments: None noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 2: 0 to 35 mph Acceleration Test
Page 2 of 3

Bus Number: 2020-05	Date: 12/10/2020
Personnel: S.R., E.L. & T.G.	
Temperature (°F): 43	Humidity (%): 60
Wind Speed (mph): 3	Wind Direction: WNW
Barometric Pressure (inHg): 30.13	
Interior Ambient Noise Level dB(A): less than 30	Exterior Ambient Noise Level dB(A): 40.3
Microphone Height During Testing (in): 45.5	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	75.8
Front Passenger Seats	73.0
Middle Passenger Seats	71.5
Rear Passenger Seats	72.1

Comments: None noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 3: Audible Vibration Test
Page 3 of 3

Bus Number: 2020-05	Date: 12/10/2020
Personnel: S.R. & E.L.	
Temperature (°F): 45	

Describe the following possible sources of noise and give the relative location on the bus.

Source of Noise	Location	Description of Noise
Engine and Accessories	N/A	N/A
Windows and Doors	Front/ Rear Entry	Road Noise
Seats and Wheelchair lifts	N/A	N/A
Other	N/A	N/A

Comment on any other vibration or noise source which may have occurred
that is not described above: None noted.
Comments: More than usual road noise at highway speed, 65 mph. inside the bus.

7.1 INTERIOR NOISE TEST

TEST BUS SET-UP FOR 80 dB(A)
INTERIOR NOISE TEST

7.2 EXTERIOR NOISE TESTS

7.2-I. TEST OBJECTIVE

The objective of this test is to record exterior noise levels when a bus is operated under various conditions.

7.2-II. TEST DESCRIPTION

In the exterior noise tests, the bus was operated at a SLW in three different conditions using a smooth, straight and level roadway:

1. Accelerating at full throttle from a constant speed starting from 35 mph.

2. Accelerating at full throttle from standstill.

3. Stationary, with the engine at low idle, high idle, and wide-open throttle, where applicable. In addition, the bus was tested with and without the air conditioning operating.

The test site is at the Larson Transportation Institute Test Track and the test procedures were performed in accordance with SAE Standards SAE J366b, Exterior Sound Level for Heavy Trucks and Buses. The test site is an open space free of large reflecting surfaces. A noise meter placed at a specified location outside the bus was used to measure the noise level.

During the test, special attention was paid to:

1. The test site characteristics regarding parked vehicles, signboards, buildings, or other sound-reflecting surfaces
2. Proper usage of all test equipment including set-up and calibration
3. The ambient sound level

7.2-III. DISCUSSION

The Exterior Noise Test determines the noise level generated by the vehicle under different driving conditions and at stationary low and high idle, with and without air conditioning and accessories operating. The test site is a large, level, bituminous paved area with no reflecting surfaces nearby.

With an outside ambient noise level of 38.0 dB(A), the average of the two highest readings obtained while accelerating from a constant speed was 65.8 dB(A) on the right side and 65.8 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 42.1 dB(A), the average of the two highest readings obtained were 62.5 dB(A) on the right side and 62.3 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 41.7 dB(A) at low idle. With the accessories and air conditioning off, the readings averaged 40.9 dB(A) at low idle. The exterior ambient noise level measured during this test was 41.4 dB(A). This bus passed this section of the test.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed

Bus Number: 2020-05	Date: 12/10/2020
Personnel: S.R., E.L. & T.G.	
Temperature (°F): 40	Humidity (%): 61
Wind Speed (mph): 5	Wind Direction: WNW
Barometric Pressure (inHg): 30.15	

Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■

Initial Sound Level Meter Calibration: 94.0 dB(A)

Exterior Ambient Noise Level: 38.0 dB(A)

Accelerating from Constant Speed Curb (Right) Side		Accelerating from Constant Speed Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	65.7	1	64.8
2	62.1	2	65.7
3	62.9	3	65.8
4	65.8	4	N/A
5	65.6	5	N/A
6	N/A	6	N/A
7	N/A	7	N/A
8	N/A	8	N/A
9	N/A	9	N/A
10	N/A	10	N/A
Average of two highest actual noise levels = 65.8 dB(A)		Average of two highest actual noise levels = 65.8 dB(A)	

Final Sound Level Meter Calibration Check: 94.0 dB(A)

Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill

Bus Number: 2020-05	Date: 12/10/2020
Personnel: S.R., E.L. & T.G.	
Temperature (°F): 40	Humidity (%): 62
Wind Speed (mph): 6	Wind Direction: W
Barometric Pressure (inHg): 30.15	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■	
Initial Sound Level Meter Calibration: 94.0 dB(A)	
Exterior Ambient Noise Level: 42.1dB(A)	

Accelerating from Standstill Curb (Right) Side		Accelerating from Standstill Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	62.9	1	61.9
2	62.1	2	62.7
3	N/A	3	N/A
4	N/A	4	N/A
5	N/A	5	N/A
6	N/A	6	N/A
7	N/A	7	N/A
8	N/A	8	N/A
9	N/A	9	N/A
10	N/A	10	N/A
Average of two highest actual noise levels = 62.5 dB(A)		Average of two highest actual noise levels = 62.3 dB(A)	

Final Sound Level Meter Calibration Check: 94.0 dB(A)
Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Stationary

Bus Number: 2020-05	Date: 12/10/2020
Personnel: S.R., E.L. & T.G.	
Temperature (°F): 41	Humidity (%): 62
Wind Speed (mph): 8	Wind Direction: W
Barometric Pressure (inHg): 30.15	
Initial Sound Level Meter Calibration: 94.0 dB(A)	
Exterior Ambient Noise Level: 41.4 dB(A)	

Air Conditioning ON

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side dB(A)
		Measured	Measured
Low Idle	N/A	42.3	41.1
High Idle	N/A	N/A	N/A
Wide Open Throttle	N/A	N/A	N/A

Air Conditioning OFF

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side dB(A)
		Measured	Measured
Low Idle	N/A	41.1	40.7
High Idle	N/A	N/A	N/A
Wide Open Throttle	N/A	N/A	N/A

Final Sound Level Meter Calibration Check: 94.0 dB(A)

Comments: No high-idle or wide-open throttle available on this test vehicle.

Fully battery/electric powered.

7.2 EXTERIOR NOISE TESTS

TEST BUS UNDERGOING EXTERIOR NOISE TESTING

FMVSS REGULATIONS

The LOW FLOOR heavy-duty transit vehicles proposed for this procurement comply with the FEDERAL MOTOR VEHICLE SAFETY STANDARDS (FMVSS) that govern design, construction, performance, and durability requirements for motor vehicles and regulated safety-related components, systems and design features.

The vehicles comply with Fire Safety Standard 302, Flammability of Interior Materials.

VEHICLE SAFETY

Side Impact Protection

The Low Floor vehicle model was tested for Crashworthiness, and the Crash Test Report along with photos and additional information, attached in this section.

The unique chassis platform of a GILLIG Low Floor consists of a stainless-steel structure with integral side impact barriers. To buffer the potential danger to passengers, the chassis of the GILLIG Low Floor incorporates unique angled stainless-steel protective side impact barriers. The force of an impending vehicle during a side impact incident is absorbed by these barriers and is directed downward and away from the passenger compartment.

Results of the side impact test are quite impressive. The impact of a 4,000-pound vehicle into the sidewall of the Low Floor bus deformed the sidewall by less than one half of an inch. This provided ample evidence to the strength of the side impact barriers. Repair of this side impact was completed in a very short time due to our quick-change panels and gusseted structure. The repair cost was less than $1000.

The robust, integral side impact barrier has been designed to afford maximum collision security to passengers inside the low floor section of the bus. This fifteen inch high barrier also provides a significant structural element by equipping the center section of the frame with a sturdy perimeter.

DRIVER'S SAFETY

For the driver's safety, GILLIG provides a Stainless driver's platform integrated into the bus chassis. This platform allows the driver to be protected from the typical accident strike zone. It also provides better driver visibility and allows the seated driver to be at a similar level as a passenger standing in the step well.

Stainless Steel Drivers Platform

PASSENGER SAFETY

Roof Hatches
GILLIG provides roof hatches located in the front and rear of the bus. The roof hatches provide an exit for passengers in the event of an emergency. The roof hatches also provide for additional ventilation w/ option electric fan.

Emergency Roof Hatch

Windows

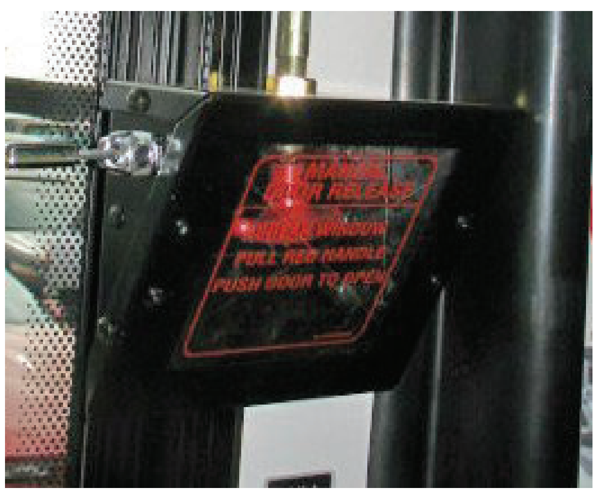
Egress windows are located in the low floor passenger area of the bus. These windows are designed to open outward by pulling red handles located on each side of the window providing an exit for passengers in an emergency.

Emergency Exit Windows

Rear (Exit) Door

GILLIG provides a Rear door in all size (30’, 35’ 40’) models of the Low Floor bus. The rear door provides for a quick and easy exit for passengers. In the event of an emergency, a manual door release is located next to the rear door. Passengers can remove the clear shield and pull the release lever which releases the door enabling easy exiting of the bus.

Rear (Exit) Door



Rear Door Emergency Release

Fire Extinguisher and Reflective Triangles

For added safety, GILLIG provides a manual 5lb Fire Extinguisher and a Reflective Triangle Kit located behind the driver’s seat for easy accessibility.

Fire Extinguisher and Reflective Triangle Kit

Lighting

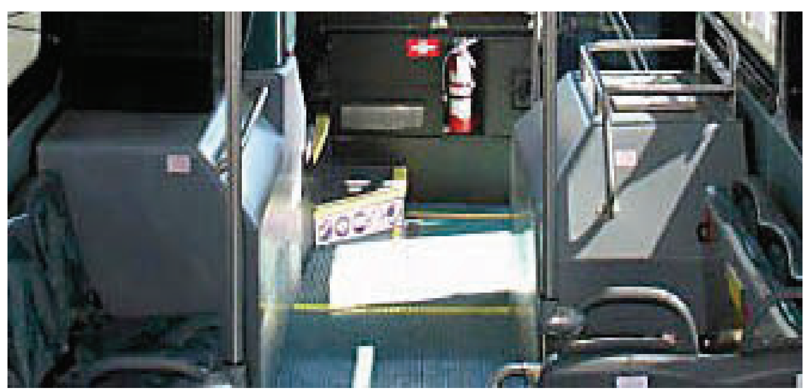
To ensure passenger safety in low light situations, GILLIG provides LED lighting in the passenger area, at the doors as well the interior steps leading to the mezzanine level. Additionally, if optional floor risers are used, LED aisle lighting is provided for added safety.

Front door LED light

Interior Step LED Light

Interior Design

The GILLIG LOW FLOOR bus interior was designed to maximize accessibility allowing for safe, quick and easy boarding and alighting of passengers. Utilizing a 1:8 slope wheelchair ramp provides the safest and easiest access available in the industry for the mobility impaired. Our 36” opening between the front wheel housing allows for safe and easy access for all passengers. Spacious low floor area allows for seating to be arranged maximizing passenger movement easily and safely. Enhanced interior and aisle lighting provide greater passenger visibility.

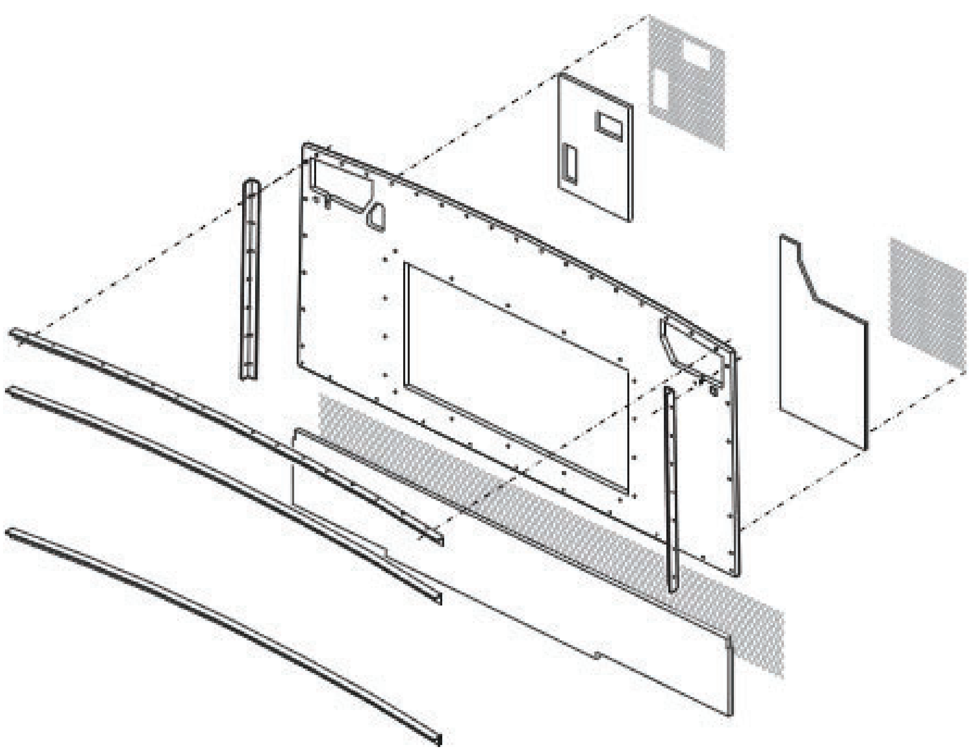


GILLIG MAXIMIZES SAFETY THROUGH ACCESSIBILITY

BULKHEAD FIRE PROTECTION

A galvanized steel engine compartment heat shield is bolted to the metal tube frame above the engine compartment to provide a mounting platform for the air conditioning unit and the inner bulkhead. The shield forms a protective barrier, shielding the AC system, which is mounted on top, from excess heat from the engine. Various holes are cut into the heat shield for component placement. UL classified polyurethane foam, available from GILLIG Parts, is used as a fire sealant on large openings on the heat shield panel where pipes, cables, and hoses pass through. This shield is not insulated and does not require maintenance.

The inner bulkhead consists of 3/4" thick plywood with sheets of 18-gauge steel laminated on the engine side and .05" aluminum laminated on the interior side. Air conditioning system controls are accessible through the hinged grille in the center of the bulkhead, and vent holes are cut into either side of the control access. The AC system is attached to the bulkhead with bolts. Silicon fire sealant is used throughout the AC compartment and the engine compartment in small gaps and corners. One-inch thick baryfoil insulation is glued and clamped in place. Special fire-retardant stainless-steel transition ducts are mounted with self-tapping screws to the vent holes to provide air flow into the bus.



Applus IDIADA KARCO

TEST REPORT FOR:

GILLIG LLC

GILLIG eBUS GEN2 Pilot Design

TESTED TO:

25.0 mph Moving Deformable Barrier Side Impact

PREPARED FOR:

GILLIG LLC

451 Discovery Drive

Livermore, CA 94551

TEST REPORT NUMBER:

TR-P40122-01-NC

REPORT DATE:

July 2, 2020

TEST DATE:

May 11, 2020

Applus IDIADA KARCO Engineering, LLC.
Automotive and Safety Testing Facility
9270 Holly Road, Adelanto, CA 92301
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Tested By:	Mr. Amjad A. Jadallah Project Engineer
Report By:	Mr. Amjad A. Jadallah Project Engineer
Reviewed By:	Mr. Andrew J. Espindola Quality Assurance Manager
Approved By:	Mr. Michael L. Dunlap Director of Operations
Approval Date:	July 2, 2020

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REVISION CONTROL LOG

TR-P40122-01

Revision	Date	Description
-NC	07/02/20	Original Test Report

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TABLE OF CONTENTS

SECTION 1
INTRODUCTION

PURPOSE

A lateral moving barrier impact test was performed for GILLIG, LLC. The test was performed to obtain impact data on a GILLIG Bus, eBus GEN2 Pilot Design.

SUMMARY

A 4001 lb moving deformable barrier impacted the left side of a GILLIG eBus GEN2 Pilot Design Bus at 102.75 inches rear of the front axle. The test weight of the GILLIG eBus GEN2 Pilot Design was 33,240 lb. ~~The CNG tanks were depressurized prior to test.~~ The test was conducted on May 11, 2020 by Applus IDIADA KARCO Engineering, LLC. in Adelanto, California. Test vehicle information is presented in Data Sheet 1. Appendix A contains pre- and post-test photographs. Appendix B presents data plots for instrumentation on the sled, the test vehicle at the centerline, and the interior side wall at the impact location. *An SAE Class 60 Filter was applied to the data, as outlined in the SAE J211-1 Instrumentation for Impact Test*, as a recommended practice for total vehicle comparison. The accelerometers were installed at the locations specified by GILLIG, LLC using the sign conventions outlined in the SAE J1733.The impact was documented by two (2) real time cameras and four (4) high speed video cameras.

6/12/2021

The moving deformable barrier laterally impacted the GILLIG eBus GEN2 Pilot Design at a velocity of 24.91 mph. Upon impact the GILLIG eBus GEN2 Pilot Design front tires translated laterally 20.7 inches and the rear tires translated 5.3 inches. Exterior and interior intrusion scans can be found on Data Sheet 4.

SECTION 2

DATA SHEETS

Test Program: 25.0 mph Moving Deformable Barrier Side Impact Project No.: P40122-01

Test Vehicle: GILLIG eBus GEN2 Pilot Design Test Date: 5/11/2020

CONVERSION FACTORS

Quantity	Typical Application	Std Units	Metric Unit	Multiply By
Mass	Vehicle Weight	lb	kg	0.4536
Linear Velocity	Impact Velocity	miles/hr	km/hr	1.609344
Length or Distance	Measurements	in	mm	25.4
Pressure	Tire Pressures	lbf/in^2	kPa	7.0
Volume	Liquid	gal	liter	3.785
Temperature	General Use	°F	°C	=(Tf -32)/1.8
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf/ft	Nm	1.3558

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DATA SHEET 1

TEST VEHICLE INFORMATION

Test Program: 25.0 mph Moving Deformable Barrier Side Impact Project No.: P40122-01

Test Vehicle: GILLIG eBus GEN2 Pilot Design Test Date: 5/11/2020

TEST VEHICLE INFORMATION

Make	GILLIG
Model	eBus GEN2 Pilot Design
Body Style	Bus
VIN	15GGD2813J3191448
Color	White
Date of Manufacture	03/11/19

FINAL TEST VEHICLE WEIGHT

Left Front Axle	lb	5,442.1
Right Front Axle	lb	5,525.9
Left Rear Axle	lb	11,671.3
Right Rear Axle	lb	10,600.9
Front Total	lb	10,968.0
Rear Total	lb	22,272.2
Total Weight	lb	33,240.2

DATA SHEET 2

MOVING BARRIER DATA

Test Program: 25.0 mph Moving Deformable Barrier Side Impact   Project No.: P40122-01

Test Vehicle: GILLIG eBus GEN2 Pilot Design   Test Date: 5/11/2020

MOVING BARRIER TEST WEIGHT				
	Units	As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total
Left	lb	1069.0	901.0	1970.0
Right	lb	1109.0	922.0	2031.0
Ratio	%	54.4%	45.6%	100.0%
Total	lb	2178.0	1823.0	4001.0

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DATA SHEET 3
TEST SUMMARY DATA

Test Program: 25.0 mph Moving Deformable Barrier Side Impact — Project No.: P40122-01

Test Vehicle: GILLIG eBus GEN2 Pilot Design — Test Date: 5/11/2020

TEST IMPACT DATA

Date	05/11/20
Time	2:15 PM
Ambient Temperature (ºF)	80
Trap No. 1 Reading (mph)	24.91
Trap No. 2 Reading (mph)	24.89

VEHICLE ATTITUDES

Position	Pre-Test (Inches)	Post-Test (Inches)
Left Front	42.7	42.9
Right Front	43.1	40.5
Left Rear	42.5	42.9
Right Rear	42.9	43.0

LATERAL TRANSLATION OF VEHICLE

	Inches
Left Front	20.7
Left Rear	5.3

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*Interior intrusion measurements were taken at the centerline of the impact location near the window base and at the seat side rail using a tape measure

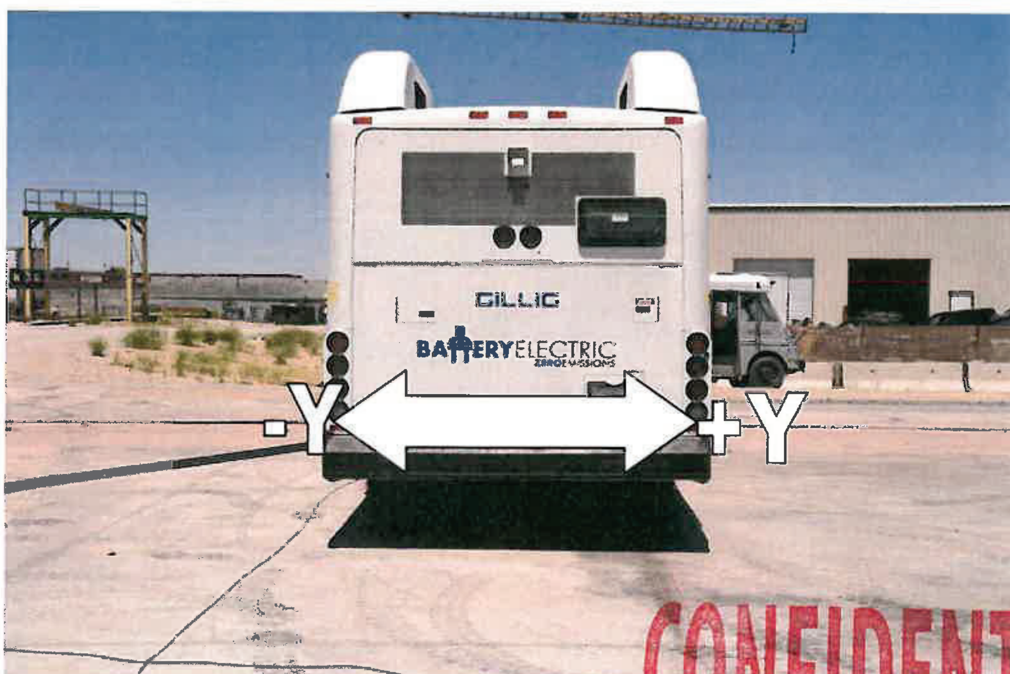
DATA SHEET 4

VEHICLE COORDINATE SYSTEM

Test Program: 25.0 mph Moving Deformable Barrier Side Impact Project No.: P40122-01

Test Vehicle: GILLIG eBus GEN2 Pilot Design Test Date: 5/11/2020

The origin of the bus was taken along the rear centerline. The coordinate system of the vehicle setup is shown below.



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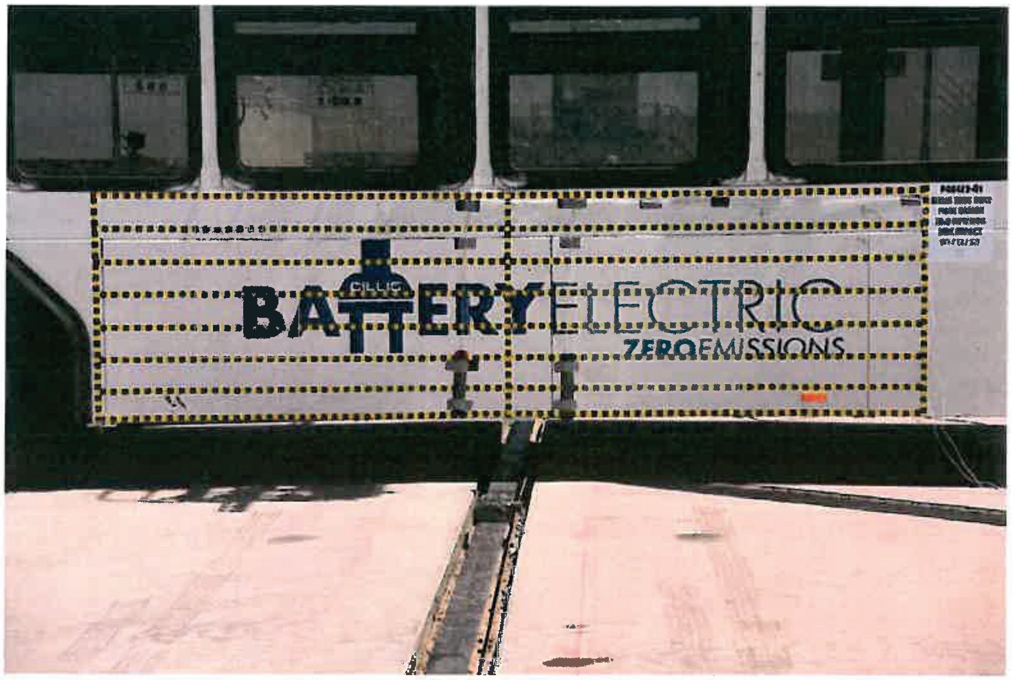
DATA SHEET 5

VISUAL OF SCAN LOCATIONS

Test Program: 25.0 mph Moving Deformable Barrier Side Impact Project No.: P40122-01

Test Vehicle: GILLIG eBus GEN2 Pilot Design Test Date: 5/11/2020



Scan Height Locations on Exterior of Bus

Scan Height Locations on Interior of Bus

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TRAINING OVERVIEW

GILLIG wishes to advise the Commonwealth that all training programs presented by GILLIG instructors are individually tailored to be representative of the vehicle specifications and equipment supplied on the buses at the time of delivery. These programs may also be modified further to meet the needs and/or time constraints of the customer at the preproduction meeting, if GILLIG is the successful bidder.

GILLIG's field service technicians and trainers are GILLIG employees with the experience and knowledge to provide the Authorized Users with training customized to your bus. Operator and Maintenance orientation and familiarization training will be provided during the post-delivery inspection, which generally takes place within the week following delivery of the units to your location. This training will be customized to your buses, is provided in addition to the training requirements specified in the RFP and is provided at no additional cost. As well, the field service technicians who perform the post-delivery inspection typically will work with the maintenance staff as they perform any necessary repairs in order to provide further training contemporaneously with the repair.

More in-depth training will be scheduled and provided by GILLIG trainers on a mutually agreed upon schedule based upon the Authorized User's needs. These training classes are specified in the GILLIG bid and class descriptions are provided therein. However, as it is GILLIG's desire to provide the best and most effective training for our customers, we encourage the Authorized User's training coordinators to contact the GILLIG Training Department prior to the class start dates, to pass along any items or issues that you wish to be elaborated on, or items that need not be covered. This allows the trainer to further tailor the class to best meet the needs of the Authorized User's personnel.

GILLIG strives to go above and beyond all minimum requirements to ensure that we provide the best customer service in the industry. Providing the tailored training that our customers need to make them as efficient as possible is just another example of our commitment to this philosophy.

The GILLIG proposal includes the training modules as outlined below.

1. Operator Instruction – provided during PDI
2. GILLIG will provide a complete set of Low Floor training video's on USB

Additional Training may be purchased separately and can be quoted upon request.

Attached is our **AVAILABLE OPTIONAL – TRAINING PROGRAM** with additional information on training that is available.

GILLIC

EXECUTIVE DIRECTOR, CUSTOMER CARE
Victor Doran

REGIONAL SERVICE MANAGERS
Eric Ocampo
Mark Bittner
Thomas Seymour

WARRANTY MANAGER
Michelle Tejeras

TECHNICAL SERVICE ADVISOR
Bo Vongamath

TECHNICAL TRAINERS	BASED
Russ Ando	Seattle, WA
Lyle Archambeau**	St. Paul, MN
Blaine Fagel	Charlotte, NC
Kevin Hardesty	Columbus, OH

FIELD SERVICE REPRESENTATIVES *	BASED
Cody Campeau	St. Paul, MN
Max Camper	Columbus, OH
Jason Fairclough*	Salt Lake City, UT
Jose Garcia	San Francisco, CA
Armando Garibay	Southern California
Matthew Gerbasi	Lowell, MA
Thomas Johnson	Phoenix, AZ
Scott Kovaly	Pittsburgh, PA
Tim Lopez	San Francisco, CA
William Lovelady	Jackson, TN
Sam Nicoara	Atlanta, GA
Paul Oden, Jr.	Cincinnati, OH
Joe Rhea*	Dallas, TX
Ken Riley	Charlotte, NC
Richard Salas*	San Francisco, CA
Steven Sayne*	Seattle, WA
Jason Schwalbert	Phoenix, AZ
Matthew Sharp	San Antonio, TX
Sang Tran*	Los Angeles, CA

FIELD SERVICE & WARRANTY

Phone - 800-735-1500
Fax- 510-785-1348

Victor Doran	Exec.Director, Customer Care	victor.doran@gillig.com
Eric Ocampo	Regional Service Manager	eocampo@gillig.com (call to schedule training)
Mark Bittner	Regional Service Manager	mark.bittner@gillig.com
Thomas Seymour	Regional Service Manager	Thomas.seymour@gillig.com
Michelle Tejeras	Warranty Manager	michelle.tejeras@gillig.com
Branden Andersen	Supervisor Service Engineering	branden.andersen@gillig.com
Steve Finley	Field Service Engineer	steve.finley@gillig.com
Johnny Phothipanya	Warranty Processing Specialist	johnny.phothipanya@gillig.com
Bo Vongamath	Technical Advisor Warranty	bo.vongamath@gillig.com
Dominic Nava	Parts Specialist	dominic.nava@gillig.com
Field Service	Customer Care Coordinator	FieldService@gillig.com
Warranty Claims	Warranty Admin	WarrantyClaims@gillig.com
Warranty Parts	Parts Specialist	WarrantyParts@gillig.com
Kristina Aldana	Administrative Assistant	kristina.aldana@gillig.com
Jacqueline Hernandez	Customer Care Admin	jacqueline.hernandez@gillig.com

Training instructors employed by GILLIG are fully qualified service personnel with extensive “hands on” experience on our coaches. They have been trained in all phases of coach repair including, but not limited to major component replacement and repair, electrical troubleshooting, suspension and frame repair as well as repair of all ancillary components and systems.

* Performs pre-delivery service at the customer site, as well as ongoing field product support services.
** ASE Certified Mechanic

GILLIG

FIELD SERVICE QUALIFICATIONS

VICTOR DORAN - Executive Director, Customer Care
Victor is responsible for all areas of Field Service, Warranty, Customer Acceptance, and coordinates the efforts of the entire department. Victor utilizes his many years of experience with heavy-duty motor vehicle production to lead a team of more than 30 on site and field-based representatives ensuring 100% customer satisfaction. Victor earned a Bachelor of Science in Mechanical Engineering Technology from Kent State University in Ohio.

ERIC OCAMPO – Service Manager
Eric has been with GILLIG since January 1987. He came to GILLIG from A.C. Transit where he worked for 2 ½ years involved in special projects. He has 1 year in R.O.C. diesel technology and electrical and 5 years as an automotive technician. He also received training on DDEC, Allison, Lift-U wheelchair lifts and Luminator destination signs for troubleshooting and repair. Eric spent 10 years as a Field Service Representative and was a Field Service Trainer from 1996-2013. In April 2002, he completed training with Cummins I.S.L. troubleshooting and familiarization, and in November 2004, he completed training with Allison Hybrid electric drives. Since 1999, he has received numerous extensive training classes from I.O. Controls Multiplex Systems covering the T-1, T-2, G-3 and the latest G-4 systems. In 2013, he became the Warranty Administrator.

MARK BITTNER – Regional Service Manager
Mark joined our GILLIG family in 2019. He brings extensive knowledge and experience in transit bus maintenance and troubleshooting. He grew up in Pittsburgh, PA and is a graduate of Steel Center Technical School and Ohio Diesel Technical Institute. He began his career in 1986 with a Pittsburgh based Detroit Diesel Allison distributor. There he served in troubleshooting, repair and overhaul of all Detroit Diesel Allison Propulsion systems. From 1993 through 2018 Mark worked for the Port Authority of Allegheny County in Pittsburgh, PA. There he performed all aspects of transit bus maintenance, troubleshooting and repairs. While there he became a bus maintenance technical trainer and developed many vehicle maintenance, overhaul programs and provided technical support. Since 2005 Mark has been working with GILLIG busses at the Pittsburgh Port Authority of Allegheny County. Mark also enjoyed owning a business in Pittsburgh, PA with his two sons where they design and build racing engines and offer field service repairs for a diesel propulsion systems. Mark and his family now reside in the Florida.

THOMAS SEYMOUR – Regional Service Manager
Tom has been with GILLIG since November of 2018. Prior to joining GILLIG, he worked at the Kansas City Area Transportation Authority. He spent 13 years as a Class A Mechanic, and 1 year as the Maintenance trainer. He has multiple ASE certifications, HVAC Type II certification, and is a Certified CNG fuel Cylinder and Systems inspector. He holds a Class A CDL w/passenger endorsement. He has been trained on Voith transmissions, Allison transmissions, Cummins engines, Agility fuel systems, Lift-U, Thermo King Intelligaire I & II, Dinex T2/G3/&G4, J1939, and Amerex fire suppression. He has competed and won multiple awards at the APTA International Bus Roadeo.

MICHELLE TEJERAS – Warranty Manager
Michelle has been with GILLIG since March 2022. She comes from a Manufacturing and Distribution industry primarily in the Customer Support and Service Operations Arenas. Michelle has many years of experience in Warranty Operations Management. She has also been instrumental in the implementation of many major system installations including a Warranty Operations system, a Contact Management (CRM) System, and a Dealer Management System.

RUSS ANDO - Trainer
Russ resides in Washington State and covers the Pacific Northwest Region. Russ Joined GILLIG in March 2001 and worked in several areas on the production line, including line foreman. In July 2002, Russ joined the Field Service Department. He has done classic auto restoration since 1979 and has completed several body-off, frame-up restorations. Along with his knowledge of mechanics and hands on approach to his job, he earned a BFA with honors in illustration from California College of Arts and Crafts.

LYLE ARCHAMBEAU – Trainer
Lyle lives in St. Paul, MN and covers the Midwest region. He has been employed at GILLIG since 1989. He has three years' experience in Heavy vehicle Maintenance while stationed in the U.S. Army. Also, Lyle has five years' experience in the Automotive Maintenance Industry. He is ASE Certified in Auto Electric, Brakes, Suspension, Engine Performance and Engine Rebuilding. He has attended classes at Auto tech for Air Conditioning, and Engine Electronics Controls and Diagnosing.

BLAINE FAGEL – Trainer
Blaine joined GILLIG as an FSR in 2006 and moved to Trainer in 2010. He began in the trucking industry in 1990. He has been in the transit industry since 1995. He has fueled trucks/buses and performed preventative maintenance. He has also been a technician, union officer, shop supervisor, technical spec writer and QA officer. He worked for Lynx Orlando from 1995-2003 and Charlotte CATS from 2003-2006. He has been ASE Certified for heavy truck steering and suspension, A/C refrigerant recovery and recycle, as well as for bus/truck air brakes. Blaine is also a Type I & II Certified A/C Technician. He has taken many classes for electrical, preventative maintenance, suspension, hydraulics, brakes, A/C, wheelchair lift (Lift-U), Cummins, Detroit Diesel, Allison, Amerex as well as many managerial courses in people skills, time management, computer software for transit specific products, Excel, Word, Outlook, Adobe Professional, and PowerPoint.

KEVIN HARDESTY – Trainer
Kevin has been a technical coach trainer since 1987. He has been a field service trainer for GILLIG since 2005. Prior to being employed as a field service trainer for GILLIG, Kevin operated his own technical training company for 9 years. Kevin started as a technical trainer for the Flxible Corporation in 1987. He also spent 2 years at the Central Ohio Transit Authority as the Training Supervisor. During his time at these positions, he has performed technical writing and created numerous training classes using PowerPoint software. His other duties have included various field service tasks as required.

CODY CAMPEAU – Field Service Representative
Cody lives in New Richmond, WI and covers the Midwest region, he joined the GILLIG family in 2019 after working as a contractor for GILLIG since 2010. During that time he gained experience from many hands on repairs and projects he was involved with.

MAX CAMPER – Field Service Representative
Max joined GILLIG in July 2022. He came from the Central Ohio Transit Authority where he spent nearly 30 years as a Diesel and Hybrid Technician, Supervisor, Warranty Compliance Coordinator and Senior Technical Trainer. Max started his career in the United States Army, receiving training in the United States Army Ordnance Center and School, Track Vehicle Repair. Max has participated in the APTA International Bus Roadeo and holds a Class B CDL with passenger endorsement. He is a certified CNG Fuel System Inspector, obtained his Universal 608 and has received factory training from Cummins, Detroit Diesel, International, Bendix, TK and more. Max is located in Columbus, OH.

JASON FAIRCLOUGH – Senior Field Service Representative
Jason has been employed with GILLIG since March 2001. He has 3 years' experience as a Quality Engineering Technician for Nova Bus Inc. Where he had taken several classes: Kizan, Metrology, Paint and Body. Jason also has a certificate from the National Fire Academy, for Hazardous Materials Incident Analysis, Hydraulics and Fluidics. While at GILLIG, Jason has taken classes in I/O, Air Systems, Allison Electric Drive, and Service Training. In addition, Jason has been building and racing vehicles since 1989.

JOSE GARCIA - Field Service Representative
Jose joined GILLIG in the Production Department in 2015. He started in second shift and became a lead after four months. After one year, he moved to first shift labor pool and worked various departments before joining Field Service. Before GILLIG, Jose worked for 15 years as an auto mechanic. He started as a lube mechanic as a tech 1, then became a tech 4 master mechanic. He attended De Anza College and completed the automotive program. He also completed 3 ASE certified tests.

SCOTT KOVALY – Field Service Representative
Scott was born and raised in Pittsburgh PA where he currently live with his wife, son and daughter. He graduated from Rosedale Technical College in 1988. After Rosedale he worked for GM, VW and Ford as the transmission and drive-ability specialist until 1994. He began his transit career with the Port Authority of Allegheny County in 1993 where he held various positions to include, hourly technician, materials control specialist, maintenance technical trainer, assistant manager of maintenance, manager of maintenance and bus procurement specialist. Scott holds ASE Master Technician status in Transit, Automotive and Heavy disciplines. He joined the GILLIG family in October of 2019 with the Field Service Department.

TIMOTHY LOPEZ – Field Service Representative
Tim has been employed with GILLIG since January 2007. He worked in Labor Pool for five years and three years in Ready Row. Two of the three years in Ready Row he obtained his Commercial Driving License. While working in Ready Row he took customers on test drives on their new buses and explained the functionality of the bus. He studied Automotive Maintenance and Repair along with Machine Shop in High School Regional Occupation Center (R.O.C.). He received an Associate of Occupational Studies degree from Universal Technical Institute.

SAMUEL MAC NICOARA - Field Service Representative
Sam was born in Romania and immigrated to the US in 1980. In 1994, he graduated Sierra Academy of Aeronautics in Oakland, CA and received an aeronautical degree in Airframe & Powerplant as well as flight engineering. He applied his training in the aviation field and helped expand a superconducting magnet fabricating plant that he managed for over 10 years. In 2014, he joined GILLIG and worked as a troubleshooter in the Electrical Department. In 2016, he joined Field Service as a field service representative, servicing customers nationwide.

PAUL ODEN, JR. – Field Service Representative
Paul has in-depth experience working on GILLIG buses. For 19 years, he has served as a mechanic for the South Western Ohio Regional Transit Authority in Cincinnati, maintaining GILLIG buses and Cummins powertrains. He particularly enjoyed working on schematics and using his problem-solving skills. Paul joined GILLIG in October of 2019.

JOE RHEA - Senior Field Service Representative
Joe has been employed with GILLIG since 1988 and has had training in Voith, Transmission troubleshooting, & Lift-U Wheelchair lifts and Luminator Electric Destination Signs. He has also attended training classes by the GILLIG trainer in the Electrical System, Air System and Hydraulic systems on the GILLIG buses. Joe lives in Central Texas and covers the Southern Region.

RICHARD SALAS – Senior Field Service Representative
Richard has been employed with GILLIG since 1998. He worked in Labor Pool for one year and worked 4 years as a Working Foreman in in the Trim department. He was also the Working Foreman for the Maintenance Department on 3rd shift. He has attended training courses for the Dinex and Air systems. He is based out of the San Francisco area.

STEVEN SAYNE – Field Service Representative
Steven has been employed with GILLIG since June 2003. He worked with 1st shift Maintenance Department for 3 years. He was also the Working Foreman for the Maintenance Department on 2nd shift for 5 years. He has 10+ years of automotive and machine service and repair experience. He also has 10+ years of electrical and electronics service and repair experience. He has attended training courses for the Dinex and Air systems. He resides in Washington State and covers the Pacific Northwest Region.

JASON SCHWALBERT – Field Service Representative
Jason has been employed with GILLIG since December of 2017. Prior to that, he worked in the Phoenix Transit System for over 17 years as a Project Lead performing duties ranging from Transit Bus Maintenance to Shop Management. Jason has accumulated many Certifications and Licensing over the years including 3 ASE Master Certifications, Both A/C Section 608 Universal, & Section 609 certifications, and a Class B CDL w/Passenger Endorsement. He has earned an Associate Degree in Automotive, Diesel, and Industrial Technologies from Universal Technical Institute. Jason lives just outside Phoenix in Goodyear AZ.

SANG TRAN – Senior Field Service Representative
Sang joined GILLIG in March 1997. He first started out in Dept. 04 for a few months then transferred to the Labor Pool in late 1998. For the following years, he worked throughout most departments, and spent most of his time in Dept. 03 (Electrical), performing work duties such as front dash harnesses/main electrical panel installations, engine power trouble shooting for buses to start before they get into Rack area (Dept.09). In mid-2001, Sang became a Field Service Representative and relocated to Fairfax County in State of Virginia. During his service years, he had attended training courses for Dinex and Air Systems. Before joining GILLIG, Sang worked for Morehouse Foods Co. in Emeryville, CA as a lead machinist and oversaw the high volume of bottling, labeling, capping machines, and performed electrical trouble shooting problems as required. Upon CNG market demand in Southern California, Sang lives in Orange County, CA in and covers the Pacific Southwest region.

BO VONGAMATH – Technical Service Advisor
Bo has been with GILLIG since January of 1999. He worked 2 years in the Labor Pool, 3 years in the Electrical Department and 4 years as a Quality Inspector in the Field Service Department. He also received training on Allison Electric Drive, Certified ASE Refrigerant Recovery and Recycling. Before GILLIG, Bo worked at Chuck E. Cheese as their Electronic Technician for 10 years.

AVAILABLE OPTIONAL - TRAINING PROGRAM

All training programs presented by GILLIG are individually tailored to be representative of the vehicle specifications and equipment supplied on the buses at the time of delivery. These programs may also be modified further to meet the needs and/or time constraints of the customer at the pre-production meeting. GILLIG's training program is designed to instruct your transportation and maintenance personnel in the proper methods of operating, maintaining, and servicing the buses. Your training program has been specifically addressed in the appropriate section of this proposal and we are certain it will exceed your expectations.

Our training programs have been well accepted by other transit agencies as described in the attached customer testimonials.

You will also note that our technical trainers have extensive Mechanical Maintenance experience and hold numerous training certifications.

To further aid in the training of your maintenance group, GILLIG will supply a set of bus training DVD's.

GILLIG FIELD SERVICE TRAINING PROGRAM

OBJECTIVE:

Our training programs are specifically designed to acquaint our customers with their new GILLIG transit bus and to ensure their understanding for proper operation, maintenance, diagnosis and repair of their coach, which employs the latest in “state of the art” bus technology.

These programs will help our customers maximize the potential of the GILLIG transit bus throughout its life.

All training programs presented by GILLIG instructors are individually tailored to be representative of the vehicle specifications and equipment supplied on the buses at the time of delivery. These programs may also be modified further to meet the needs and/or time constraints of the customer.

PROGRAM PLAN:

The basic programs shall be presented as follows:

- Operator Instruction (Including Battery Electric Bus If Equipped)
- Maintenance Department General Vehicle Orientation
- Air Systems and Brake
- Basic Bus Electrical System
- Multiplex Electrical System
- CNG System
- Hydraulic System
- EFAN System
- Allison Hybrid Familiarization
- BAE hybrid Familiarization
- Gillig Battery Electric Bus Safety & Familiarization
- Gillig Emissions
- Entrance/Exit Door Systems

TRAINING PROGRAM

OPERATOR INSTRUCTIONS:

This class will take approximately four hours and class size should not exceed six drivers. This is a “hands-on” program to familiarize the driver in the proper operation of the GILLIG transit bus and requires that a coach be made available by the customer for this instruction. Topics included in this program are:

A. Seat and Seat Belt Operation and Adjustments

B. Steering Column Adjustments

C. Switches and Controls
  1. Location
  2. Proper Operation
  3. Function

D. Instrumentation and Warning Lights

E. Entrance and Exit Door Operation

F. Wheelchair Ramp Operations
  1. Safety Precautions

G. Brake Interlock
  1. Safety Precautions

H. Speed Switch Circuit
  1. Verbal Explanation
  2. Demonstration
  3. Safety Precautions

I. Engine Protection System
  1. Controlling Functions
  2. Shut Down Sequence
  3. E.P.M. Override
     a. Purpose
     b. Proper Usage

J. Gillig Battery Electric Bus Operation if Equipped

MAINTENANCE DEPARTMENT GENERAL VEHICLE ORIENTATION

OBJECTIVE:

This is an on-vehicle instruction program to acquaint the mechanic with the operational aspects of the GILLIG transit bus, as well as the components employed in its operation and their locations. It also provides brief explanations and demonstrations of how and when various systems interface with each other. These explanations and demonstrations are designed to provide the mechanic with a better understanding of the system logic employed and ultimately result in more rapid and accurate diagnosis and repair. Other areas covered in this orientation program are maintenance items and can be tailored for in-depth instruction on the door system, hydraulic system, steering system, Hybrid Drives, CNG and suspension systems.

This class will take approximately eight hours to complete with a maximum class size of twelve mechanics. A coach must be made available for this instruction by the customer. Please be aware that any identified system can be expanded on and discussed more in- depth in subsequent classes. Topics included in this program are:

A. Seat and Seat Belt Operation and Adjustments

B. Steering Column
  1. Adjustments
  2. Maintenance

C. Switches and Controls
  1. Location
  2. Proper Operation
  3. Function
  4. System Interfacing
  5. Diagnostic Tips on the More Complex Systems

D. Instrumentation and Warning Lights

E. Engine Protection System
  1. Controlling Functions
  2. Shut Down Sequence
  3. E.P.M. Override
     a. Purpose
     b. Proper Usage

F. Brake Interlock
1. Components
2. Operational Description
3. Explanation of Circuits that Apply Interlock
4. Interlock Air Pressure Adjustment
5. Override
6. Safety Precautions

G. Under 3 MPH Speed Switch Circuit
1. Operational Description
2. Diagnosis of Circuit
3. Safety Precautions

H. Wheelchair Ramp
1. Components and Component Location
2. Operation
3. Safety Device
4. Safety Precautions

I. Entrance Door
1. Components and Component Location
2. Operation
3. Door Panel Adjustment
4. Door Motor Adjustments
5. Proximity Switch Adjustments

J. Exit Door
1. Components and Component Location
2. Operation
3. Door Panel Adjustments
4. Door Motor Adjustments
5. Micro/Proximity Switch Adjustments

K. Compartment by Compartment Tour of Bus
1. Components and Component Location
2. Operational Descriptions of Systems Viewed
3. Maintenance Information
4. Diagnostic Tips and Test Procedures
5. Safety Precautions

L. Vanner Equalizers
1. Component Location
2. Operational Description
3. Test Procedures

M. Hydraulic System
1. Component and Component Location
2. Description of Components and Maintenance Required
3. Explanation of Fan Drive Circuit and Its Function
4. Explanation of Steering Circuit and Its Function
5. Presentation of Flow and Pressure Specifications for Fan Drive and Steering Circuits
6. Description and Explanation of Test Equipment Needed to Properly Diagnose Hydraulic System Problems
7. Safety Precautions

N. EFAN System (If equipped)
1. Individual Fan Location and Function
2. Location and Function of the EFAN Controller
3. Use of EFAN Controller LED's for Diagnostics
4. Location and Function of EFAN Fuses Panel
5. Reverse Fan Operation
6. Safety Precautions

O. Fire Alarm System
1. Components and Component Location
2. Operational Description
3. Test Procedures

P. Steering and Front Suspension
1. Explanation of Front Ride Height Adjustment and Specifications
2. Explanation of Adjustment Points for Front End Alignment
3. Explanation of Front Shock Absorber
4. Explanation of Steering and Suspension Maintenance Requirements

Q. Rear Suspension
1. Components and Component Location
2. Discuss Inspection of Welds
3. Discuss Inspection of Suspension Components
4. Discuss Bushing Wear and Bushing Replacement
5. Explanation of Rear Ride Height Adjustment and Specifications
6. Explanation of Adjustment Points for Rear End Alignment

R. Engine Cooling System
1. Components and Component Location
2. Explanation of Cooling System Maintenance Requirements
3. Safety Precautions

S. Hybrid Drive System
1. System Components and Component Location
2. Drive System Theory of Operation
3. Drive System Component Interface
4. High Voltage Safety

T. CNG System (Compressed Natural Gas). (If equipped)
1. CNG Components and Location
2. Roof Mounted Tanks, Lines and PRD's
3. Fill Panel Components
4. Fueling/Defueling Procedures
5. CNG Safety

U, Gillig Battery Electric Bus (If Equipped)
1. System Components and Component Location
2. Drive System Theory of Operation
3. High Voltage Safety
4, LOTO Discussion

<u>AIR SYSTEM AND BRAKES</u>:

SCOPE:

This is a sixteen hour program of which approximately the first thirteen hours of instruction will take place in a classroom setting utilizing a color coded air system drawing projected from a laptop with a projector. Each student will have a copy of the drawing and a detailed power point handout to follow along through the air system circuits. The remaining time will be spent applying the classroom information to the vehicle in "hands-on" tests and adjustments.

The customer shall make available a suitable room for training that is appropriately equipped, keeping in mind the class size shall not exceed twelve mechanics, and a bus for the last segment of the training program.

OBJECTIVE:

This program will focus primarily on providing the mechanic with a better understanding of the air system, its components, and their operation under various operating conditions. The class participants accomplish this by viewing and following along with the colored air flow charts for normal brake operation, brake operation with loss of primary air, brake operation with loss of secondary air, brake interlock, and anti- compounding circuits to facilitate diagnosis of air leaks. Presentation of a comprehensive systematic air system test procedure will also be included in this program. The air flow charts, when used in conjunction with these air system tests, will aid the mechanic in determining if the components in the air and braking systems are operating properly and may also be used as a tool in the diagnosis and isolation of a problem or air leak in the system.

The secondary focus of this program is on the mechanical aspects of the braking system such as but not limited to the operational principles of the Haldex slack adjuster, initial set up and adjustments of the Haldex slack adjuster, maximum push rod travel, and push rod angles, air dryer operation and compressor troubleshooting. Additional topics will be covered upon request by the customer based on their particular need or desire. ABS and Traction control systems will also be discussed.

Brief overview of disc brake system including wheel end overview and differences to air system.

BASIC BUS ELECTRICAL SYSTEM:

SCOPE:

This is a twenty-four hour program for a maximum of twelve mechanics. The program will take place in both the classroom setting utilizing the supplied power point handout and on the coach for practical application of the classroom material. The customer shall make available a suitable room for training that is appropriately equipped. The customer will also make available for training the schematics for the bus that the class is training on.

OBJECTIVE:

This program is designed to help the mechanic utilize the GILLIG electrical diagrams and schematics to the fullest extent possible. This will promote a better understanding of the system logic, resulting in less time consuming and more accurate diagnosis. Topics included in this program are:

A. Review of Basic Electrical Principles
1. Use of Digital VOM
2. Open Circuits
3. Completed Circuits
4. Shorted Circuits
    a. Dead Short
    b. Cross Short
5. Series Battery Connections
    a. Results
    b. Benefits
6. Parallel Battery Connections
    a. Results
    b. Benefits
7. Series Circuits
    a. Benefits
8. Parallel Circuits
    a. Benefits
9. Voltage Drop
    a. Demonstration of How to Use Voltage Drop for Diagnostic

Purposes

B. Relays Used in GILLIG busses
1. Description of Internal Operation
2. Symbols as Represented on Drawings
3. Functional Diagrams

C. Diodes
1. Explanation of Operational Principles
2. Uses
3. Symbols and How to Determine Directional Flow
4. Test Procedures

D. Transistors
1. PNP's
2. NPN's
3. Test Procedures

E. General Electrical Symbols
1. Fuses
2. Circuit Breakers
3. Resistors
    a. Fixed Resistors
    b. Variable Resistors
4. Coils
5. Normally Open Contacts
6. Normally Closed Contacts
7. Pressure Switches

F. Information Supplied on GILLIG Electrical Diagrams
1. Print Number
2. Revision
3. Part Numbers
4. Torque Specifications
5. Drawing Size
6. Component Location
7. Wiring Connector Locations
8. Wiring Numbering System
9. Wiring Color Coding

G. Typical Electrical Diagrams or Schematics Used to Determine System Logic
1. Battery Cables with Cut Off Switch
    a. For Charging System Diagnosis
    b. For Vanner Equalizer System Diagnostic

H. Typical Electrical Diagrams or Schematics Used to Determine System Logic (cont.)
   2. Ignition, Start, Fast Idle
      a. For Front Run Diagnosis
      b. For Rear Run Diagnosis
      c. For Fast Idle Diagnosis
   3. Wheelchair Ramp
      a. For Wheelchair Ramp Interface Diagnosis
   4. Kneeling
      a. For Kneeling Diagnosis
      b. For Raise Diagnosis
   5. Stop Request
   6. Fire Alarm
      a. For Engine Fan Circuit Diagnosis
      b. For Fire Alarm Diagnosis
   7. Rear Door
      a. For rear Door Operation Diagnosis
      b. For sensitive Edge Diagnosis
      c. For Door Alarm Diagnosis
   8. Interlock
      a. For Under 3 MPH Circuit Diagnosis
      b. For Interlock Diagnosis

Different or additional circuits will be covered upon the customer's request.

MULTIPLEX ELECTRICAL SYSTEM G5 – FOR BATTERY ELECTRIC BUS

SCOPE:

This is a twenty-four hour program for a maximum of twelve technicians. The program will be split between a classroom setting and on the bus. The classroom portion will use the supplied handout and the specific vehicle schematics. Using a digital projector the instructor will cover the supplied handout. The customer shall make available a suitable room for training that is appropriately equipped.

OBJECTIVE:

This program is designed to help the technician utilize the GILLIG electrical schematics and ladder diagrams to the fullest extent possible. This will promote a better understanding of the system logic, resulting in less time consuming and more accurate diagnosis. Topics included in this program are:

A. General Information Supplied in the Gillig Electrical Schematics
   1. Vehicle Identification Numbers and Bus (Fleet) Numbers

2. Safety Precautions
3. Print Numbers
4. Part Numbers
5. Torque Specifications
6. Welding Precautions
7. Component Locations
8. Wire Circuit Identification
9. Power Cables and Wire Color Coding
10. Different Types of Wire Connectors that Gillig uses
11. Wire Connector Location Guide

B. General Electrical Symbols Used in the Gillig Electrical Schematics
1. Ground Symbols and How to Identify and their Locations on the bus
2. Fuses and Locations of the Main Power Fuses
3. Circuit Breakers, Circuit Breaker Numbers, and Locations
4. Resistors
5. Different Types of Switches (Toggle, Push Button, Rotary, Proximity, Pressure Type)
6. Wire Connector Symbol and How to use the Information Provided Inside the Symbol
7. Normally Open Contacts
8. Normally Closes Contacts
9. L.E.D. (Light Emitting Diode) Benefits and where we use them
10. Diodes and Diode Pack – Test Procedures, Locations, Where Used

C. Review of Basic Electrical Principles
1. Open Circuits and How to Troubleshoot
2. Shorted Circuits (Direct Short and Cross Short) and how to Troubleshoot
3. Completed Circuits
4. Series Battery Connections
5. Results
6. Benefits
7. Parallel Battery Connections
8. Results
9. Benefits
10. Series Circuits and their Benefits
11. Parallel Circuits and their Benefits
12. Voltage Drop Demonstrations to use for Diagnostic Purposes.

D. Introduction to Multiplex
1. What is and Why Multiplex
2. Why Gillig uses Multiplexing Systems
3. How Multiplex Works in a bus
4. Benefits of having a Multiplex system

E. Coach Zone Concept
1. Zone Layout
2. Zone Function
3. View of Each Zone
4. Communication Process of each Zone
5. Communication Harness and Location
6. Diagnostic Fault Codes for Communication

F. I/O Controls Corporation “Dinex” Components
1. Power Management Module(PMS)
2. High Speed Cell Network Control Module (D2)
3. Main Bus Controller (MBC)
4. Digital Input/Output Module (A1,B2,B3,B4,C1,D3,D4)
5. 816 Modules
6. 16/16 Modules
7. Digital 32 Input Module (A2)

G. I/O Controls Corporation “Dinex” Components (cont.)
1. The “Smart” Indicator Light Bar (B1)
2. Digital 24 Output Module (B5) if Applicable
3. Multi-Function Display (MFD)
4. Explanation of the module I.D.’s
5. Explanation of each Different Colored L.E.D.’s on each Module
6. Component Function and Location
7. System Interface Using the Multiplex Inputs and Outputs Chart

H. Ladder Logic Diagrams
1. Why we use Ladder Logic Diagrams
2. How to read a Ladder Logic Diagram
3. How to use a Ladder Logic Diagram for Troubleshooting the System

I. Electrical System Interface
1. Multiplex System Power
2. Starting System
3. Charging System with Vanner Equalizer
4. Tail and Marker Lights
5. Turn Signals
6. Kneeling System
7. Wheelchair Ramp Power
8. Fast Idle
9. Brake and Throttle Interlock System
10. Senders and Switches and Engine Shutdown System

Different or Additional Circuits will be covered upon Customers Request.

J. J1939 Controller Area Network
   a. J1939 Theory

   b. Gateway Function
   c. Backbone Construction and Troubleshooting
   d. Stub and Extension Cable Troubleshooting
   e. Complete Network Troubleshooting

K. Diagnostics and Troubleshooting
1. Using the L.E.D.'s for Circuit Integrity
2. Using the Ladder Logic Diagrams
3. Using the Gillig Electrical Schematics
4. Using the "Dinex" Diagnostic Tools
   a. G3-MK-TEST KIT
   b. G3-MK-ID-WRITER
   c. G3-MK-PROGRAM KIT
   d. Real Time Logic (RTML)
5. Create Defects in the bus Multiplex Electrical Systems for the Technicians to Locate and Repair.

HYDRAULIC SYSTEM:

SCOPE:

This is an eight hour program of which approximately the first four hours of instruction will take place in a classroom setting utilizing a hydraulic system drawing projected from a laptop with a projector. Each student will have a copy of the drawing and a detailed power point handout to follow along through the hydraulic system. The remaining time will be spent applying the classroom information to the vehicle in "hands-on" tests and adjustments.

The customer shall make available a suitable room for training that is appropriately equipped, keeping in mind the class size shall not exceed twelve mechanics, and a bus for the last segment of the training program.

OBJECTIVE:

This program will focus primarily on providing the mechanic with a better understanding of the hydraulic system, its components, and their operation under various operating conditions. The class participants accomplish this by viewing and following along with the hydraulic system

drawing. The hydraulic flow charts will aid the mechanic in determining if the components in the hydraulic system are operating properly and may also be used as a tool in the diagnosis and isolation of a problem in the system. Safety precautions, maintenance, and troubleshooting will also be discussed.

A. Hydraulic Safety

B. Hydraulic Reservoir
   1. System/Reservoir Capacity
   2. Fluid type
   3. Filter/Fluid Change Intervals

C. Hydraulic Pump
   1. Type
   2. Flow Rates
   3. Inspection

D. Hydraulic Manifold
   1. Valve Identification/Ratings
   2. Flow through The Valves
   3. Inspection

E. Steering Gear Box
   1. Flow Through the Box
   2. Inspection
   3. Flow Rates Needed
   4. Gear Box Bleeding Procedures

F. Fan Drive Motor
   1. Motor Operation
   2. Motor Inspection
   3. Required Motor Speeds

G. Fan Drive Controller
   1. Required Wiring
   2. J1939 Interface
   3. Controller Logic
   4. Verification of Operation

H. Hydraulic Cooler
   1. Location
   2. Maintenance
   3. Cooler Pressure Relief

EFAN SYSTEM

SCOPE:

This is a four to six hour program of which approximately the first four hours of instruction will take place in a classroom setting utilizing a detailed system handout. The handout material will be projected from a laptop and projector while each student follows along. The remaining time will be spent applying the classroom information to the vehicle in "hands-on" tests and adjustments.

The customer shall make available a suitable room for training that is appropriately equipped, keeping in mind the class size shall not exceed twelve mechanics, and a bus for the last segment of the training program.

OBJECTIVE:

This program will focus primarily on providing the mechanic with a better understanding of the EFAN systems, their components, and operation under various operating conditions. While Gillig utilizes two different EFAN systems, the scope and objective for each system is the same. The class participants accomplish system understanding by viewing and following along with the system handouts. Presentation of a comprehensive EFAN system test procedure will also be included in this program. The handout, when used in conjunction with the system tests, will aid the mechanic in determining if the components in the EFAN system are operating properly and may also be used as a tool in the diagnosis and isolation of a problem in the system. Safety precautions, maintenance, and troubleshooting will also be discussed.

A. EFAN Safety
   1. System Do's and Don'ts

B. Cooling Module
   1. Engine Radiator
      A. Radiator Construction and Airflow
      B. Inspection and Maintenance
   2. Charge Air Cooler
      A. Construction and Airflow
      B. Inspection and Maintenance
   3. Hybrid Cooler (If Equipped)
      A. Construction and Airflow

      B. Inspection and Maintenance

C. Physical Description Cooling Module
1. Electric Motor Fan Banks
   A. Fan Make and Model
   B. Fan Wiring
   C. Fan Operation and Speeds
   D, Fan Inspection/Maintenance/Reverse
   E. Fan Troubleshooting

D. EFAN Controllers
1. Controller Overview
2. Controller Logic
3. Controller Wiring
4. Controller Protection Features

E. Overall System Maintenance and Troubleshooting

F. Diagnostic Software (If Applicable)

GILLIG BATTERY ELECTRIC BUS SAFETY AND FAMIALIZATION

SCOPE:

This is a twelve hour program for a maximum of twelve technicians. The program will be split between a classroom setting and on the bus. The classroom portion will include using a digital projector to cover a PowerPoint handout that will be supplied to the technicians. The projector will also be used to cover all applicable schematics for the Battery Electric Bus system. The on hands portion will cover component location, function and operation. The customer shall make available a suitable room for training that is appropriately equipped.

OBJECTIVE:

After completion of the GILLIG Battery Electric Bus Safety and Familiarization program, each mechanic will be familiar with BEB system component identification, location and operation. We will also cover electrical accessory systems and their operation. Safety precautions and troubleshooting will also be discussed with focus on High Voltage Safety. This will promote a better understanding of the BEB system components and their operation resulting in less time consuming and more accurate diagnosis. High voltage safety will also be discussed.

A. History of High Voltage Vehicles Used in Transportation
B. System Operating Voltages and Safety
C. Importance of Arc Flash, Lock Out Tag Out, and Fall Protection Training
D. First Responders Card and Emergency Shutdown Procedures
E. Gillig/Cummins Parts
F. Discuss PPE in Detail

The Following Components Will Be Covered in Detail

A. ESS
1. Battery Composition
2. MSD's
3. Battery CAN
4. Battery ID's
5. Power and Ground
6. Battery Isolation

B. ESS Junction Box
1. High Voltage Disconnect Switch
2. High Voltage Contactors
3. Fuses

C. High Voltage Junction Box
1. Fuses

D. Propulsion Invertor and Wiring

E. Traction Motor and Wiring
1. Speed Sensor and Tone Wheel

F. DC To DC Convertors and Wiring

G. DC to AC Convertors and Wiring

H. System Controllers and Wiring
1. SCM (System Control Module)
2. Charger Control Unit
3. BMS (Battery Management Controller)

I. Charging receptacles and charging procedures

J. Ebus Specific Indicator Lights

K. Kissling Battery Saver Function

L. High Voltage cabling and Inspection

M. High Voltage Shut Down and Verification Using Meter

N. High Voltage Safety Equipment (PPE)

O. HVIL (High Voltage Interlock)

P. Battery Thermo Management System
   1. Operation and Components
   2. Maintenance
   3. Fill Procedures

Q. Air Compressor and Maintenance

R. Power Steering Maintenance

S. Electronics Cooling Package (ECP)
   1. Operation and Components
   2. Maintenance

GILLIG EMMISIONS

SCOPE:

This is a six to eight hour program of which approximately the first four hours of instruction will take place in a classroom utilizing an emissions system handout. The handout will be projected from a laptop with a projector. Each student will have a copy of the power point handout to follow along through the emission system. The remaining time will be spent applying the classroom information to the vehicle in “hands-on” inspection of the components.

The customer shall make available a suitable room for training that is appropriately equipped, keeping in mind the class size shall not exceed twelve mechanics, and a bus for the last segment of the training program.

OBJECTIVE:

This program will focus primarily on providing the mechanic with a better understanding of the emission system, its components, and their operation under various operating conditions. The class participants accomplish this by viewing and following along with the supplied handout and time spend on the bus. By applying this information the mechanic will be able to determine if the components in the emission system are operating properly and may also be used as a tool in the diagnosis and isolation of a problem in the system. Safety precautions, maintenance, and troubleshooting will also be discussed.

A. EPA Requirements and Target Emission Numbers

B. System Overview

C. DPF Operation, Components and Maintenance
   1. Inlet Section
   2. DOC Section
   3. DPF Section
   4. Outlet Section

D. DPF Sensors
   1. Temperature Sensors
   2. Pressure Sensors

E. Regeneration Strategies
   1. Passive
   2. Active
   3. Manual or Stationary

F. Procedure for Forcing Regenerations
   1. Bus Regen Toggle Switch
   2. Cummins Insite

G. Bus Indicator Lights for DPF/SCR Function and Malfunctions

H. Decomposition Chamber and Dosing Valve

I. SCR Operation and Sensors

J. Support Components for Correct SCR Operation
   1. Heat Shield and Piping
   2. Urea/DEF Explained
   3. DEF Tank Components and Sensors
   4. DEF Tank Heating Components

   5. Heated Lines
   6. Dosing Valve
   7. Supply Module and All Incorporated Components
   8. Inspection/Maintenance Of all Listed Components

K. ODB HD 3 Compliance (Starting in 2013)
   1. 2350 Cummins ECM
   2. Ambient/fuel level sensors
   3. MIL and Wait to Start Light
   4. Additional Laptop Connector in Drivers Area

L. Bus Changes to Accommodate Emissions Equipment

ENTRANCE/EXIT DOOR SYSTEM:

SCOPE:

This is a four to eight hour program for a maximum of twelve technicians. The program will be conducted entirely on the bus. The customer shall make available a suitable bus for training that is appropriately equipped.

OBJECTIVE:

This program is designed to help the technician be familiar with and understand the mechanical, pneumatic, and electrical componentry of the entrance and exit door systems.

This will promote a better understanding of the system, resulting in less time consuming and more accurate diagnosis. Topics included in this program are:

A. Entrance Door Motor Operation of Both Pneumatic and Electric Doors.

1. Differential/Electric Door Motor Discussion
2. Opening, Closing and Cushioning Speed Adjustments (Pneumatic Motor)
3. Opening, Closing and Cushioning Speed Adjustments (Electric Motor)
4. Emergency Dump/Unlock Valve

B. Entrance Door Mechanical Adjustments

1. Door Rods
2. Door Centering
3. Roller Brackets
4. Checking Door Opening for Square
5. Door Lubrication

C. Entrance Door Electrical Adjustments

1. Door Open Solenoid
2. Door Air Switch Location and Function
3. Proximity Switches
4. Electric Door Motor Adjustments and Speed Programing

A. Exit Door Pneumatics

    1. Door Motor
    2. Opening, Closing and Cushioning Speed Adjustments

B. Exit Door Mechanical Adjustments

    1. Door Stops
    2. Door Motor Shaft
    3. Door Rods
    4. Door Unlock Solenoid
    5. Emergency Release System Maintenance
    6. Door Closing Spring
    7. Door Lubrication

C. Exit Door Electrical Adjustments

    1. Micro/Proximity Switch Adjustments
    2. Electric Motor Speed Adjustments and Software
    3. Door Open Solenoid

Timeless Styling for Your Fleet Workhorse

The Low Floor bus is the fleet workhorse for transit throughout the U.S., and the foundation for each of GILLIG's designs. Durable, reliable, and cost-effective to maintain and operate, the stainless steel chassis and aluminum body equate to a light-weight, high-strength bus with timeless styling.

Our Low Floor is available in 29', 35', and 40' lengths, powered by Clean Diesel, Diesel-Electric Hybrid, or Compressed Natural Gas.

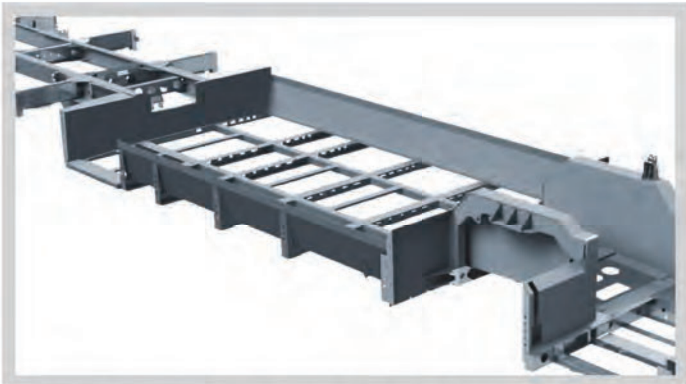
LOW FLOOR DIESEL

LOW FLOOR HYBRID

LOW FLOOR CNG

GILLIG

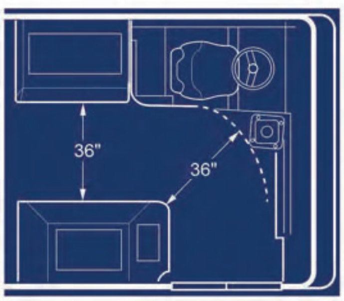
LOW FLOOR
Features and Benefits



A unitized stainless steel chassis with unique side impact barrier adds strength and corrosion resistance to the Low Floor bus and protects passengers in the event of a collision.

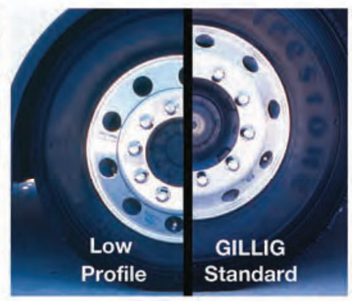
GILLIG's Low Floor body structure of lightweight, high-strength aluminum with anodized side posts resists corrosion and greatly simplifies collision repairs. Its reduced weight saves on fuel costs and its aluminum components are recyclable.

The Driver's Station is comfortable and ergonomic. Controls are convenient, easy-to-read, and logically located to ensure better vehicle control, ride comfort, and safety.



The Front Vestibule Area is designed for quick and easy entry and is one of the largest in the industry. A 1:6 ramp makes access even easier and reduces dwell time.

Quick-Change Skirt Panels keep the bus out of the body repair shop and back on the road for a potential collision repair savings of $10,000/bus over 12 years.



Standard-Sized Tires last up to 60% longer than low profile tires, and their lower rolling resistance saves fuel. Coupled with a lighter body and an efficient drivetrain, the labor and fuel savings could equal $24,000/bus over 12 years.

Bus Length - Low Floor	29'	35'	40'
Maximum Seating	28	34	42
Maximum Height	(D) 122", (H) 131", (C) 133"	(D) 123", (H) 133", (C) 133"	(D) 123", (H) 133", (C) 133"
Outside Turning Radius	30'	37'	44'
Maximum Fuel Capacity	75 gal / 21,600 scf	120 gal / 25,000 scf	120 gal / 25,000 scf
GVWR (lbs.)	34,500	39,600–41,600 *	39,600–41,600 *

(D) = Diesel (H) = Hybrid (C) = CNG

* GVWR varies with brake type: 14.5x10" Drum = 39,000 lbs., 16.5x8.625" Drum = 41,000 lbs., Disc = 41,000 lbs.

Specifications and features are for reference only and subject to change without notice or obligation.

CNG

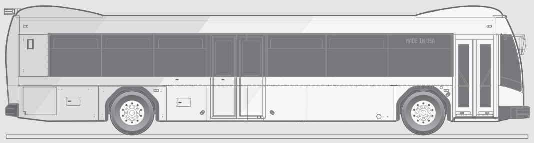
A Natural Alternative

GILLIG Compressed Natural Gas (CNG) Buses

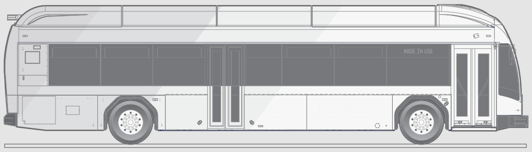
The GILLIG CNG bus is a combination of the latest CNG technology and GILLIG's well-known reliability, safety, and efficiency. The proven design of our CNG bus recorded the highest reliability and the best fuel economy of any CNG bus tested at the Altoona Bus Research and Testing Center.

The maintenance-friendly design incorporates an integrated fuel-management panel and easily serviceable components. The Cummins L9N engine provides near-zero emissions for the cleanest CNG bus in the industry.

Our CNG is available in 29', 35', and 40' lengths with optional BRT, BRT Plus, and Low Floor Plus styling.



BRT

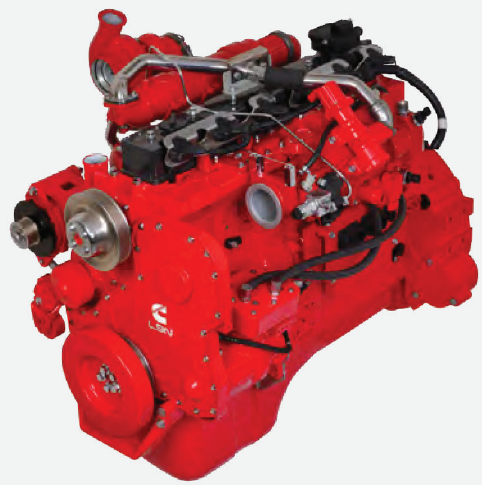


BRT Plus

Low Floor Plus

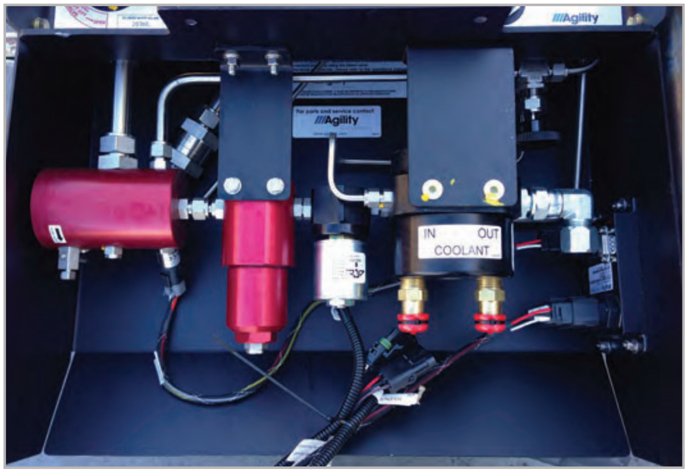
LOW FLOOR CNG

FEATURES AND BENEFITS



Cummins L9 Engine

- Certified to California Air Resources Board and Environmental Protection Agency Optional Low NOx emissions standards of 0.02ghr
- Maintenance-free aftertreatment system (Three-Way Catalyst)
- Capable of CNG or Renewable Natural Gas
  - Carbon negative when using Renewable Natural Gas (Waste Water Sludge/Landfill Gas)
- 80% parts commonality with Cummins L9 diesel
- Backed by Cummins Sales and Service Network



Maintenance-Friendly Mounting Locations for CNG Serviceable System Components

Integrated CNG Fuel Management Panel

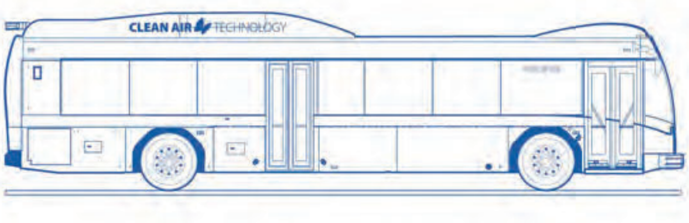
Bus Length - Low Floor	29’	35’	40’
Maximum Seating	28	34	42
Maximum Height	133”	133”	133”
Outside Turning Radius	30’	37’	44’
Maximum Fuel Capacity	20,100 scf	20,100 scf	20,100 scf
GVWR (lbs.)	35,000	41,600	41,600

Specifications and features are for reference only and subject to change without notice or obligation.

Proven Reliability, Cleaner & Quieter Technology

GILLIG has been building diesel-electric hybrid buses for nearly two decades, and we offer the best and most complete hybrid product line. Altoona test results show that the GILLIG Hybrid is quiet, reliable, and fuel efficient. Our customers attest to its smooth acceleration, quiet operation, and the ease of assimilating our Hybrids into their fleets. With rising fuel prices and increased environmental awareness, GILLIG hybrids are a smart addition to any fleet.

Our Hybrid is available in 29', 35', and 40' lengths with optional BRT, BRTPLUS, or Trolley styling.



GILLIG

LOW FLOOR HYBRID
Features and Benefits

Allison Hybrid

BAE SYSTEMS

GILLIG HYBRID

GIVES YOU OPTIONS

- GILLIG Hybrid with Allison Parallel Drive and optional Vanner HBA
- GILLIG Hybrid with BAE Series Drive and Auxiliary Power System

EFFICIENT STOP-AND-GO DRIVING

- Hybrid technology is ideally suited to the demands of transit stop-and-go duty cycle. Electric motors develop maximum torque at slow speed during frequent starts, and regenerative braking converts and stores energy in the roof-mounted batteries during braking.
- Engine start/stop technology allows engine-off operation when the vehicle is stopped, and electric-only propulsion and zero emissions when the battery state of charge is sufficient.

SAVES ENERGY

- GILLIG Hybrids use approximately 25% less fuel than diesel buses.*
- GILLIG Hybrids allow for the use of electric components that reduce fuel consumption.

REDUCED EMISSIONS

- GILLIG Hybrids can be approximately 90% cleaner than the 12-year-old buses they replace.
- GILLIG Hybrids can also run on domestic B20 biodiesel for greener performance.

REDUCES OPERATING COSTS

- GILLIG Hybrids help reduce fuel expense.
- GILLIG Hybrids help reduce the frequency of brake changes.
- Electric accessories reduce wear and tear on engine components and eliminate some maintenance items from the bus.

* Results may vary depending on application.

Bus Length - Low Floor	29'	35'	40'
Maximum Seating	28	34	42
Maximum Height	(D) 122", (H) 131", (C) 133"	(D) 123", (H) 133", (C) 133"	(D) 123", (H) 133", (C) 133"
Outside Turning Radius	30'	37'	44'
Maximum Fuel Capacity	75 gal / 21,600 scf	120 gal / 25,000 scf	120 gal / 25,000 scf
GVWR (lbs.)	34,500	39,600–41,600 *	39,600–41,600 *

(D) = Diesel (H) = Hybrid (C) = CNG

* GVWR varies with brake type: 14.5x10" Drum = 39,000 lbs., 16.5x8.625" Drum = 41,000 lbs., Disc = 41,000 lbs.

Specifications and features are for reference only and subject to change without notice or obligation.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2022 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION
AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: **GILLIG LLC**
(U.S. Manufacturer or Importer)

Certificate Number: NGLG2VOCVHHD-002

Effective Date: **01/01/2022**

Expiration Date: **12/31/2022**

Byron J. Bunker, Division Director
Compliance Division

Issue Date: **07/16/2021**

Revision Date: **07/16/2021**

Model Year: 2022
Vehicle Family: NGLG2VOCVHHD
Vehicle Regulatory Sub-category: Transit and other bus
Averaging Set: Transit and Other bus

CO2 Emission Standard (g CO2/ton-mile): 300
Highest Projected CO2 Family Emission Limit (g/ton-mile): 320
Lowest Projected CO2 Family Emission Limit (g/ton-mile): 276

Pursuant to Section 206 of the Clean Air Act (42 U.S.C. section 7525), 40 CFR Part 1037 and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test vehicle which represents the vehicle family, and is subject to the terms and conditions prescribed in those provisions. This certificate of conformity covers only those new motor vehicles which conform in all material respects to the design specifications that applied to those vehicles described in the documentation required by 40 CFR Part 1037 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 1037.

This certificate of conformity is conditional upon compliance of said manufacturer with the averaging, banking and trading provisions of 40 CFR Part 1037, Subpart H. Failure to comply with these provisions may render this certificate void *ab initio*.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 1068. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 1068.

This certificate does not cover vehicles sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

CUMMINS L9 ENGINE

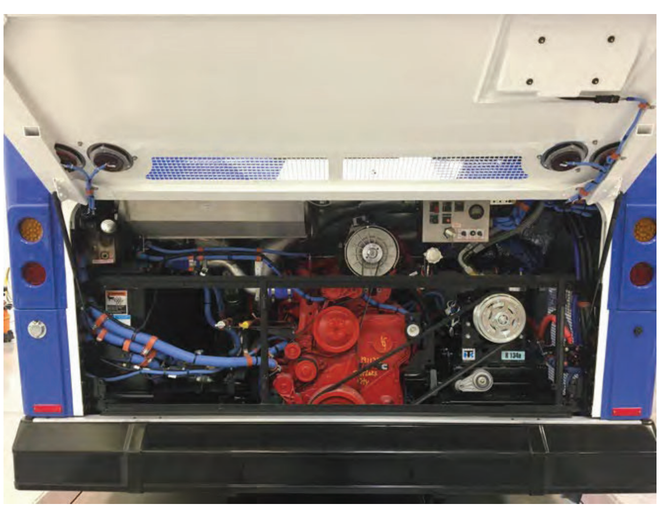
GILLIG utilizes the Cummins L9 diesel engine in the 29', 35' and 40' Low Floor buses. The engine utilizes a single, high-capacity Electronic Control Module (ECM) which provides fully integrated control over the engine and aftertreatment system, for optimized performance and improved engine lamp strategy.

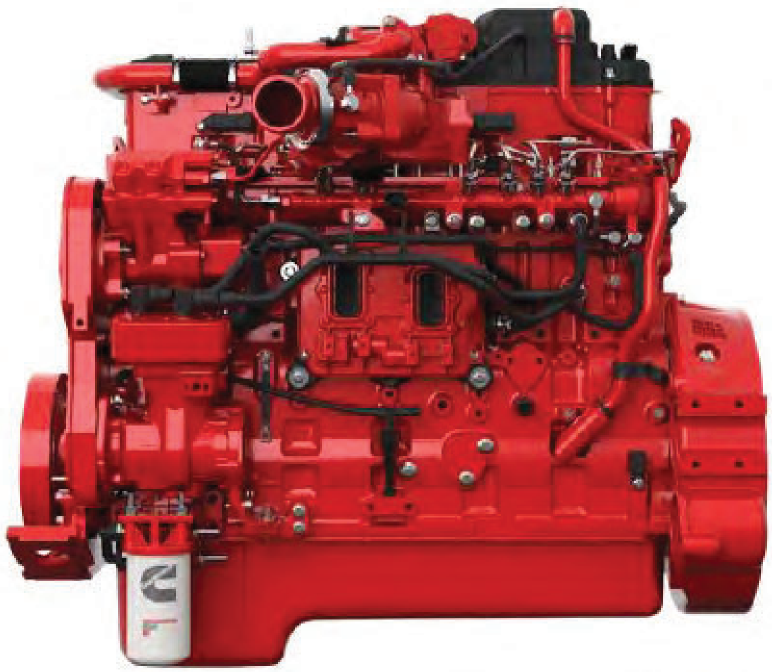
The proposed engine meets all applicable Federal EPA requirements currently in effect and Cummins has committed to meeting future requirements during the contract period.

The U.S. Environmental Protection Agency (EPA) regulations call for the addition of On-Board Diagnostics (OBD) for on-highway diesel engines. The OBD system continuously monitors the engine and aftertreatment system, recognizing the potential for an out-of-range event and thus providing a real-time alert of the entire emissions control system.

GILLIG works extensively with the engine manufacturers and vibration control system suppliers to develop "best practices" for engine isolation and mounting. Every engineering design is specifically tailored to address each individual engine installation. GILLIG engineers, using testing data collected by our engine suppliers, evaluate isolation mounts based on both velocity and accelerations of the drive train on a frequency analysis. We carefully look at both transmissibility and resultant vibration in the coach at the driver's floor, middle floor and rear floor. Based on the analysis, GILLIG has selected to use Metalastic mountings at the flywheel housing and at the pad mount under the accessory drive.

The straightforward design of the Low Floor bus allows for easy removal of the engine and transmission by 1 or 2 maintenance people. The removal of either the engine and/or transmission should only be required for major overhaul. Due to the accessibility provided in the Low Floor, all other repair work can be accomplished with the components in the bus.





Technical specifications

	L9™
Advertised Horsepower	280 & 350 hp
Peak Torque	925 & 1150 lb-ft
Governed Speed	1900 rpm
Clutch Engagement Torque	575 lb-ft
Number of Cylinders	6
Bore and Stroke	114 mm x 145 mm
Engine (Dry)	1695 lb

Source: Cummins

Smart Support™

To provide unparalleled service and support for transit authorities, Cummins now offers the SmartSupport™ program, by which Cummins will proactively replace critical engine components to reduce unscheduled downtime for end customers. The proactive replacement will utilize Cummins Connected Diagnostics™ to keep transit fleets operating with maximum reliability and minimum downtime. SmartSupport is currently available on L9-powered transit applications, but will be cascaded through the lineup in the near future. Contact your local Cummins representative for updates.

Connected Diagnostics™

The Lifeline For Your Engine.

Cummins Connected Diagnostics wirelessly connects your Cummins-powered transit and shuttle buses to product experts at Cummins. Available on 2007 and newer diesel and natural gas engines, Connected Diagnostics instantly transmits key data surrounding the event through your vehicle's existing telematics system to Cummins for immediate analysis.

A notification based on the most probable cause is sent instantly to you via email or the free Connected Diagnostics mobile app, so you know exactly what action to take. That reduces guesswork and allows operators to safely proceed on their trip with the knowledge of the probable cause and information on when service can wait or if it needs to be performed immediately.

Key service event information that can be accessed using the Connected Diagnostics app includes the following:

- Derate notice banner
- Active and inactive faults
- Suggested root cause
- Derate notice details
- Possible performance impact
- Equipment information
- Cummins Service Locator
- Cummins contact information
- Current status of service events

Connected Diagnostics is designed to maintain complete service histories attached to each engine. Information about your transit or shuttle bus fleet is available on the Connected Diagnostics web portal anywhere you have Internet access. Learn more at cumminsengines.com/connected-diagnostics.

Source: Cummins

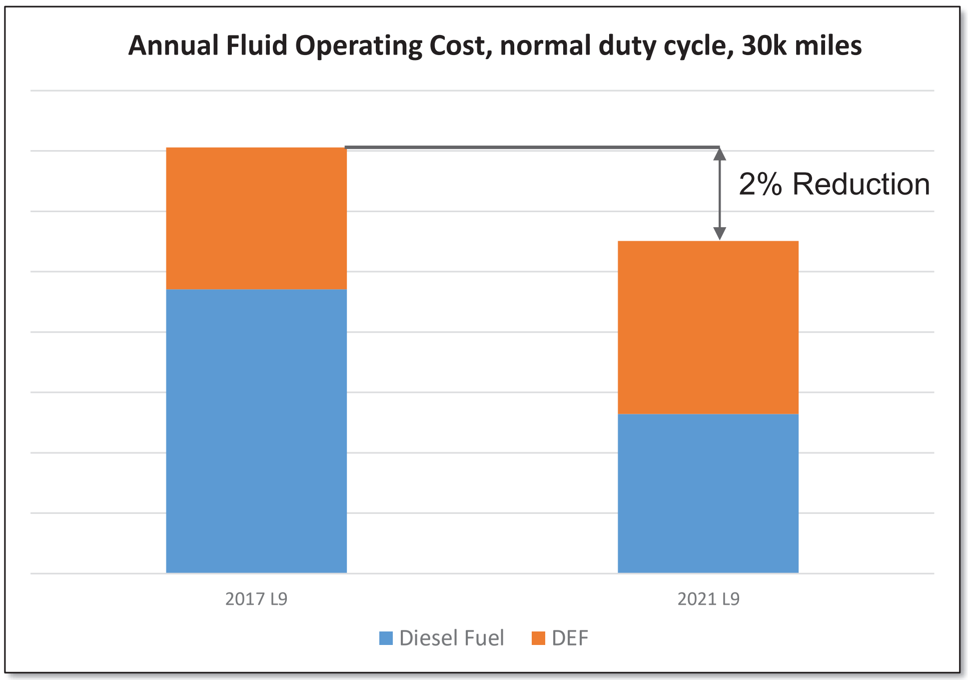
L9 | 2021 Maintenance Changes

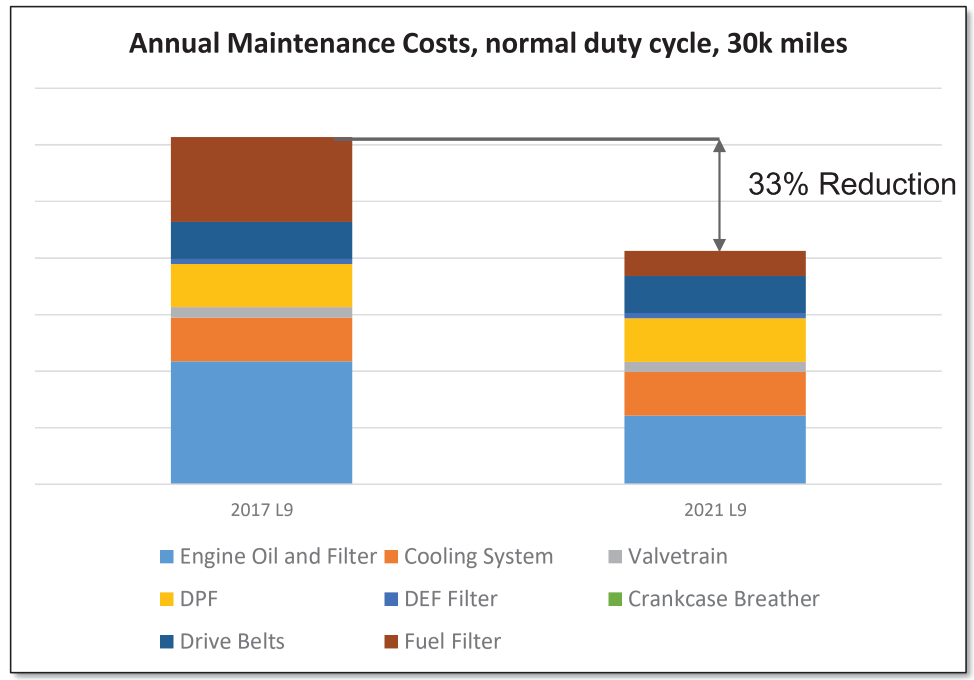
Maintenance Event	EPA 2017 L9	EPA 2021 L9
Oil and Filter Change	Up to 35K miles / 1000 hours / 18 months (duty cycle dependent)	Up to 50K miles / 1500 hours/ 18 months (duty cycle dependent)
Fuel Filter Change	15K miles / 500 hours / 6 months	50K miles / 1500 hours / 18 months
Crankcase Ventilation Filter ("Breather") Change	60K miles / 2000 hours	MAINTENANCE FREE
Valve Lash Adjust	150K miles / 5000 hours	150K miles / 4500 hours
DPF Clean	200K miles / 6500 hours	200K miles / 6000 hours
DEF Filter Change	200K miles / 6500 hours	200K miles / 6000 hours

See Owner's Manual for full recommended maintenance schedules

L9 Transit Bus Annual Operating Cost Reduction

The 2021 L9 focused on delivering reductions in operating costs. Compared to the 2017 product, the 2021 L9 provides an additional ~2% reduction in fluid costs and 33% in maintenance item costs.





*based on 30,000 mile annual distance

2021 L9 Engine Profile Summary

Differences between the EPA 2017 L9 and EPA 2021 L9 engine profiles.

	EPA 2017	EPA 2021
RATINGS (BY FAMILY)	Productivity: 260-350 hp/720-1150 lb.-ft. Performance: 370-380 hp/1250 lb.-ft.	280 & 350 hp/925 & 1150 lb.-ft.
ENGINE WEIGHT (DRY)	1695 lbs.	Same as 2017
FUEL EFFICIENCY	Base	Up to 1.5%
DEF (% OF FUEL USAGE)	4%	5%
WIRING	Base	Same vehicle Input/Output
DIMENSIONS	Base	Similar to 2017
SOFTWARE	Base	New to meet 2021 requirements
WATER PUMP	Fixed ratio	Improved efficiency; same flow rate as 2017
CONTROL MODULE	CM2350	CM2450 (Same Input/Output)
WARRANTY	2 years/unlimited miles	Same as 2017
MAINTENANCE (DUTY CYCLE DEPENDENT)	Up to 30,000 miles/1000 hours oil drain interval and fuel filter	Up to 50,000 miles/1500 hours oil drain interval and fuel filter; Maintenance-free crankcase filter
AFTERTREATMENT	Modular Aftertreatment with Bosch Dosing System	Performance improvements added the UL2.0 w/ NG Nozzle and UL2.2 Supply Module

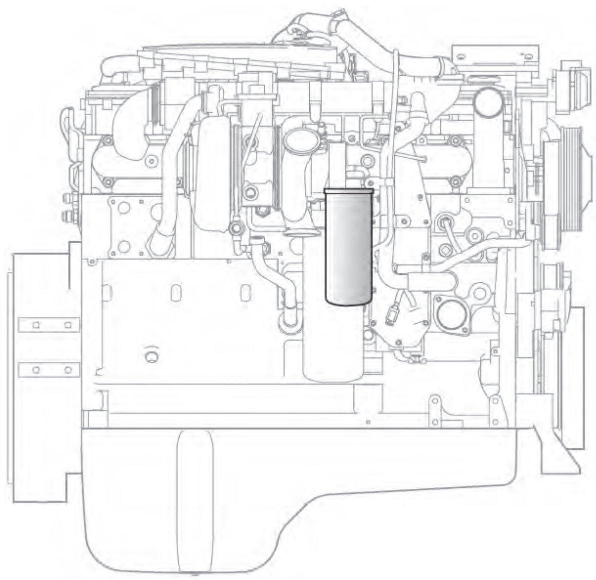
Medium Duty Base Warranty - Transit

2021 B6.7 & L9 Transit base warranty maintained at 2 years / unlimited miles

- **2 Year / Unlimited Warranty**
- Confidence in ultra-reliable product
- Further peace of mind, beyond proven dependability
- 100% Coverage for:
  - Parts and labor on warrantable failures
  - Aftertreatment
  - Consumables used in the repair
- Travel / Towing is covered
- All with no deductible

2 years /
Unlimited miles

Oil Filter
All L9 engines are furnished by Cummins with a full flow engine oil filter mounted under the filter head, just below the oil cooler on the street side of the bus. These full flow filters include a higher filtration bypass section. This spin on filter is made by Fleetguard, a division of Cummins and contains an internal venture that provides filter bypass oil flow through a stacked disc section of the filter. The oil, supplied to the engine by the oil pump, passes through the full flow filter before reaching the various moving parts of the engine.



Oil Sampling
The optional Probalyzer™ brass mini-gauge sampling valve allows for easy engine oil sampling without shutting down the unit. Sampling with the Probalyzer plug requires the compatible Probalyzer I cap, which screws onto standard 4-ounce sample bottles, or the Probalyzer II Bottle, which is a self-contained sampling bottle.

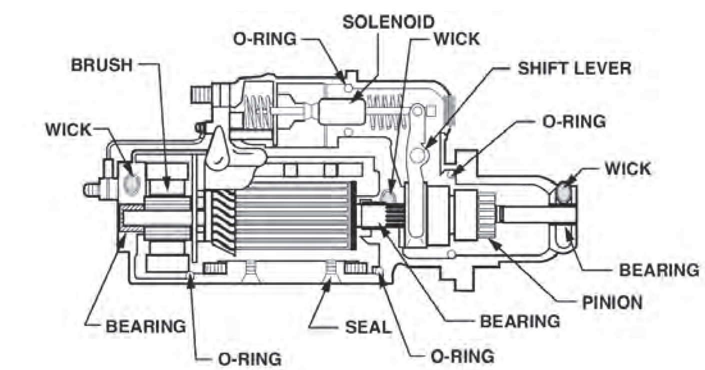
The starting system includes the batteries, starter motor, starter solenoid, starter control relay, rotary ignition switch and other circuit breakers, switches and wiring.

When the starter circuit is energized, the solenoid operates the shift lever to move the pinion into mesh with the flywheel ring gear. At the end of the solenoid travel, the solenoid makes electrical contact to complete the circuit for the starter motor. The motor then cranks the engine. The pinion remains engaged until the starter solenoid circuit is interrupted. If the pinion fails to engage the ring gear, the motor will not be energized, thus preventing damage to the pinion and gear teeth.

When the engine starts, the pinion overrunning clutch protects the armature from excessive speed until the switch is opened, at which time the return spring cause the pinion to disengage.

After the engine has started, the engine ECM will disable the starter circuit to prevent the starter from being engaged again, which precludes damage to the starter from engagement with the rotating flywheel ring gear.

The electrical starter motor is a heavy duty, solenoid operated unit. The armature shaft is supported in sintered bronze bushings in three places: the commutator end frame, the shift lever housing and the nose housing. O-ring seals are used between the commutator end frame and the field frame and between the shift lever housing and the field frame. A spring-loaded lip-type oil seal, together with an O-ring seal in the shift lever housing and a boot over the solenoid plunger prevent entry of oil into the armature, field coils and the solenoid case.



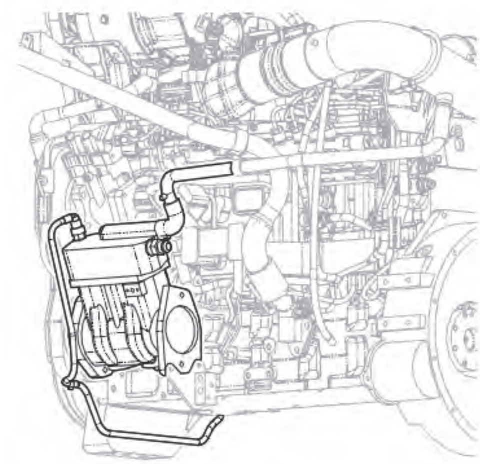
To prevent overheating and possible damage, the starter motor is equipped with an overcrank protection system. A thermostatically controlled mechanical circuit breaker is installed adjacent to the starter brush ground lead. The breaker connects to the starter magnetic switch. When the starter reaches the danger point, the circuit breaker opens, interrupting the ground circuit to the starter magnetic switch and de-energizing the solenoid. When the motor cools to a safe operating temperature, the circuit breaker automatically resets, allowing the starter to operate again.

AIR SYSTEM

The compressed air system operates the service brakes, emergency/parking brakes, suspension system, passenger door and the driver's seat. The basic air system is composed of an air compressor, air governor, air dryer, air reservoir tanks, overpressure (relief) and check valves, and the tubing, hoses and fittings necessary to connect all the components.

The air compressor is flange mounted to the curbside of the engine and is coupling driven. The air compressor is accessible through the rear engine door. Inlet air, oil lubrication, and coolant are supplied from the engine. The flow of air is controlled by an air governor mounted to the curbside A/C compressor outrigger.

The Cummins 30.4 air compressor provides and maintains air under pressure to operate devices in the air brake and auxiliary air systems of the bus. It consists of two major subassemblies: the cylinder head and the crankcase/cylinder block. The cylinder head contains the inlet, discharge, and unloader valving, as well as an integral relief valve. The cylinder head is mounted on the crankcase/ cylinder block. The crankcase/ cylinder block contains the cylinder bores, pistons, bearings, crankshaft, governor port, and connecting rods.

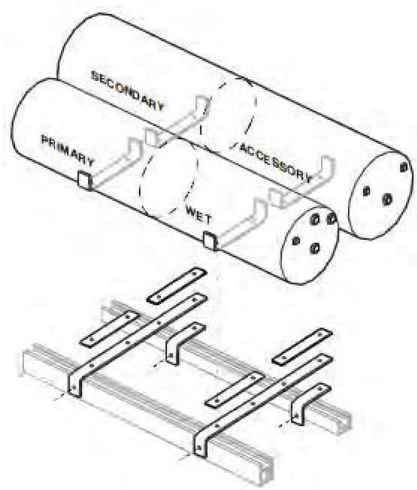


The air compressor provides compressed air through a braided stainless steel hoses, in order to dissipate heat, to the ping tank where the pulses form the air compressor are absorbed, providing smoother and quieter operation. The air dryer removes moisture from the compressed air. Accumulated moisture is regularly expelled from the air dryer onto the ground beneath the bus and will account for the occasional air discharge heard. The compressed air fills the air tanks.

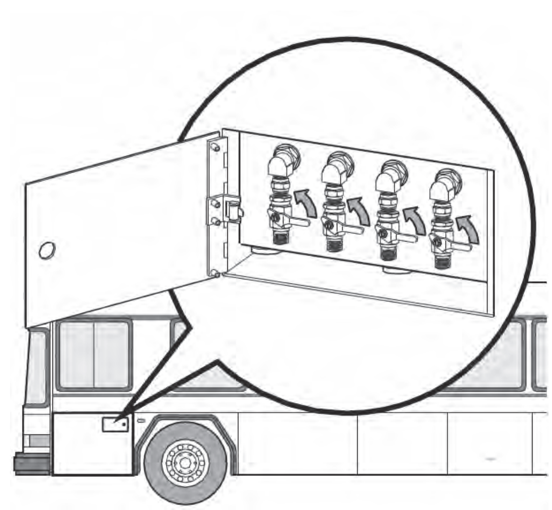
The SKF-2000 air governor, operating in conjunction with the air compressor unloading mechanism, automatically controls air pressure in the air brake or air supply system between the predetermined maximum and minimum pressures. The air compressor runs continuously while the engine runs, but actual compression of air into the vehicle air system is controlled by the governor which stops or starts compression when the maximum or minimum reservoir pressures are reached.

The air dryer and the wet tank also have a relief valve to prevent overpressure should the air governor fail. Dry air is delivered to the wet tank reservoir and from there, compressed air is supplied to the other three air reservoir tank. The four air reservoirs are located in a ceiling compartment in the front section of the bus.

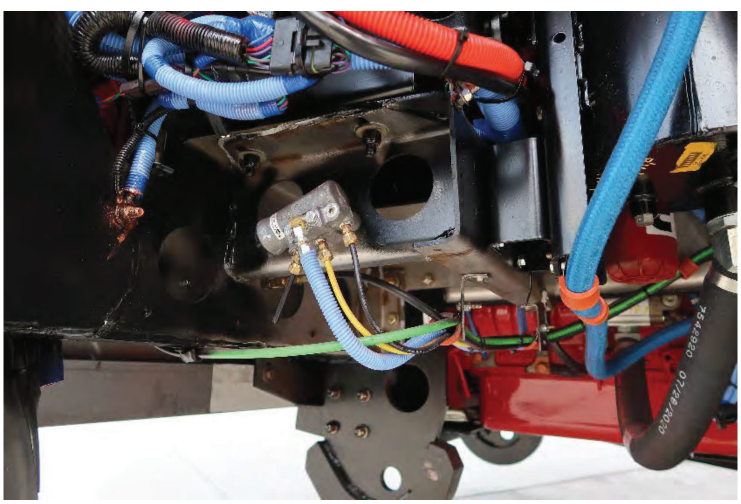
There are two tanks, each partitioned into two separate reservoirs, providing four separate reservoirs. These tanks are, in order of priority, the wet tank, primary tank, secondary tank and accessory tank. The primary and secondary tanks supply the rear and front brakes, respectively. Air from the accessory supply tank operates the suspension system, the passenger doors and the driver's seat. The air reservoirs also serve to cool the air and condense water and oil vapors out of the compressed air. Most of this condensation takes place in the air dryer and the wet supply reservoir. The GILLIG air system is FMVSS 121 compliant.



Each reservoir has a check valve at the supply port to maintain pressure in that tank if other reservoirs or air lines were to leak. Each tank is fitted with a standard manual drain valve. GILLIG Low Floors incorporate these drain valves inside the battery compartment door at the front, driver's side of the bus. The drain lines discharge at street level below the floor of the bus.



CURBSIDE ACCESS DOOR



AIR GOVERNOR

AIR DRYER

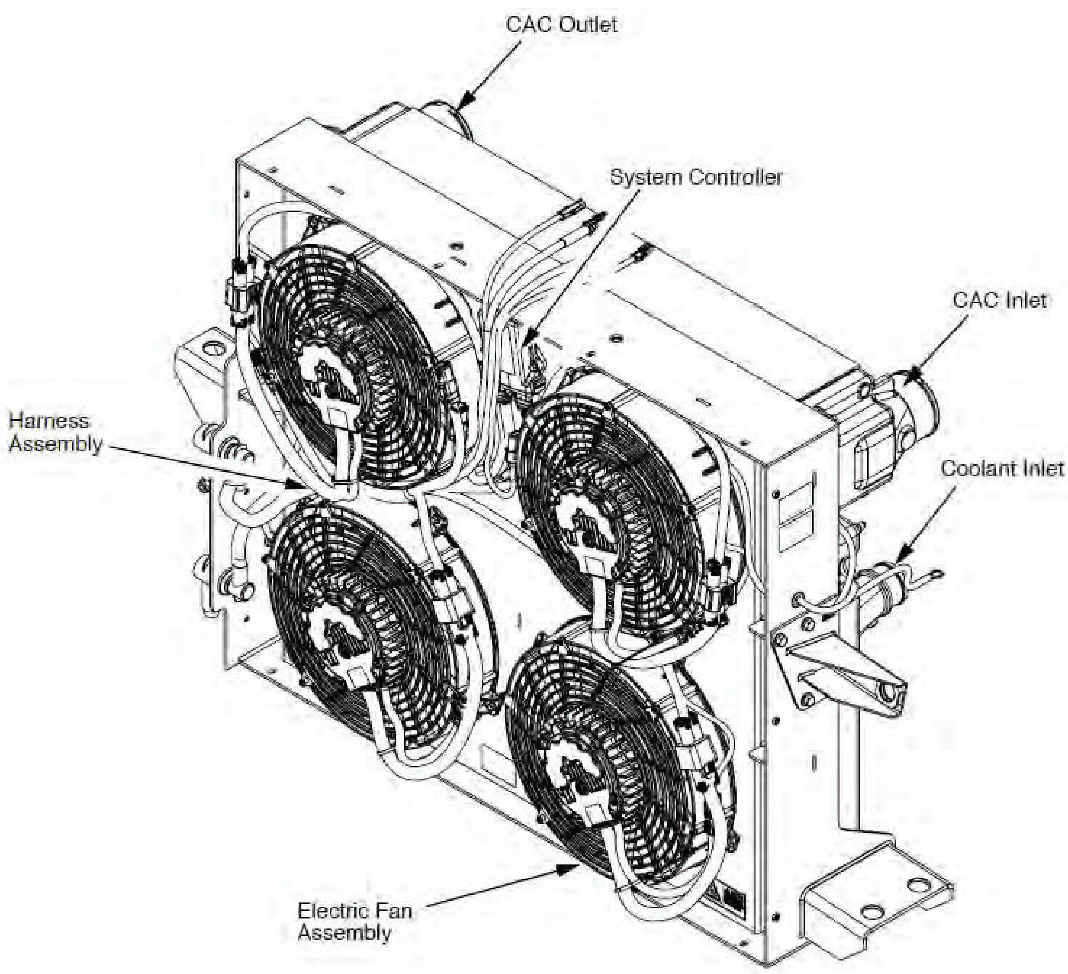
INTERIOR AIR TANK COMPARTMENT

EXTERIOR AIR TANK DRAIN VALVES

The heat generated by the engine is dissipated by a coolant solution that is circulated under pressure within the cooling system. The cooling system includes the pump, radiator, surge tank, engine thermostat and the piping to connect the components.

The recovery tank allows routine maintenance of coolant levels. The thermostat is located in the thermostat housing on the engine. When a cold engine is started or when the coolant temperature is below operating temperature, the coolant flow to the radiator is blocked or restricted by the thermostat. A bypass provides coolant circulation within the engine during the warm-up period. Coolant from the engine pump is circulated through the transmission fluid cooler to absorb heat from the transmission fluid.

The cooling module assembly consists of the engine coolant radiator and the charge air cooler, which receives hot air from the engine turbocharger and cools it before it returns to the engine. The cooling module assembly is mounted on chassis outriggers at the left rear corner of the bus in the engine compartment. Rubber vibration mounts isolate the cooling module assembly from chassis vibrations. Hot coolant enters the radiator through the upper piping, circulates through the core, and returns to the engine through the lower piping. The EMP cooling system uses eight small electric fans to push air through the radiator and over the engine for cooling.

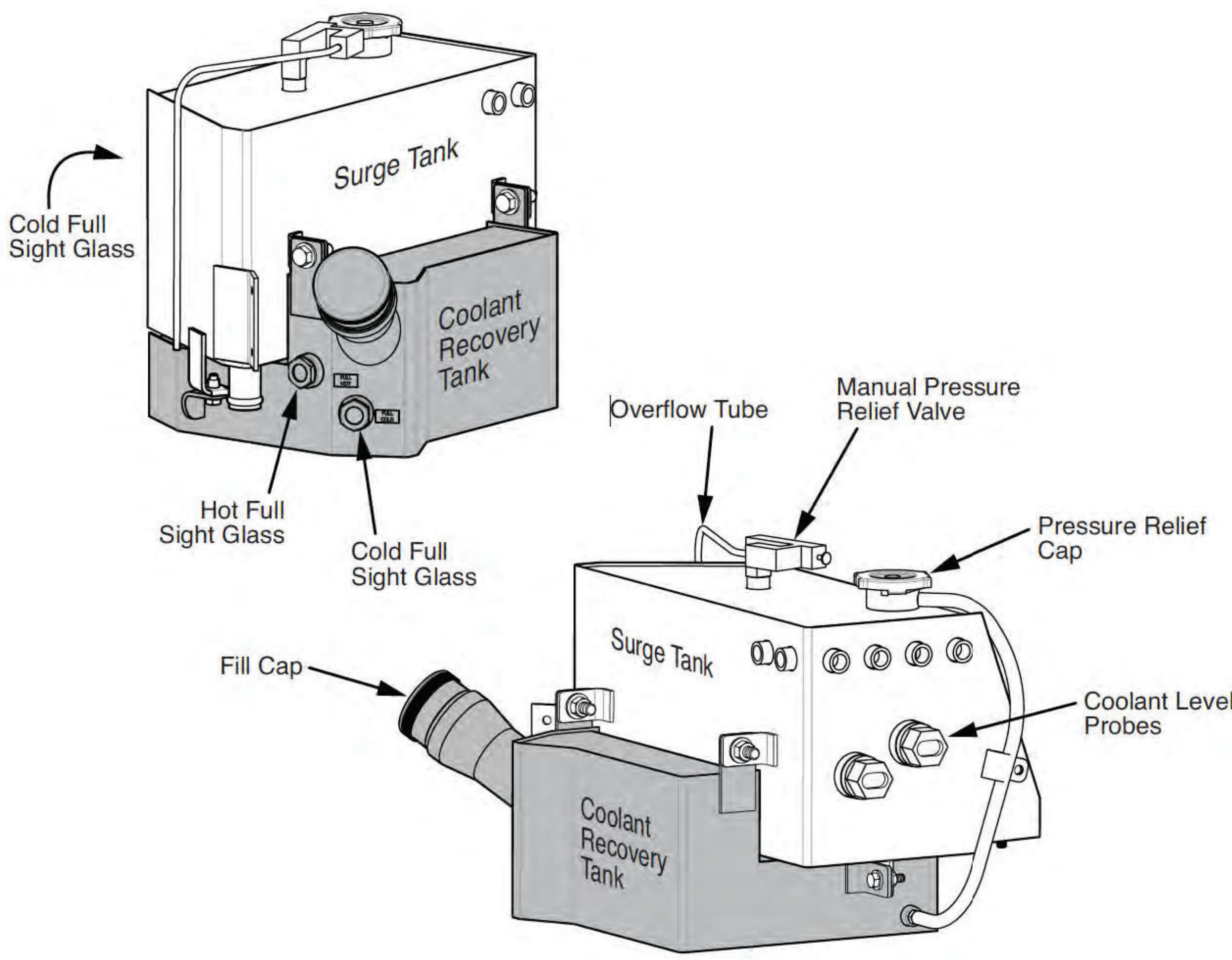


Surge Tank and Recovery Tank

The cooling system is filled through the surge tank. A pressure cap at the surge tank maintains pressure within the cooling system.

The surge tank is attached to the coolant recovery tank and mounted in the left rear corner of the engine compartment separately from the cooling module assembly. The surge tank has one sight glass and the recovery tank has two sight glasses.

The automatic pressure relief cap releases excess pressure when the system heats up and allows coolant back into the surge tank without air when the system cools down. The manual pressure relief valve allows for safe relief of system pressure to perform maintenance or system inspections.



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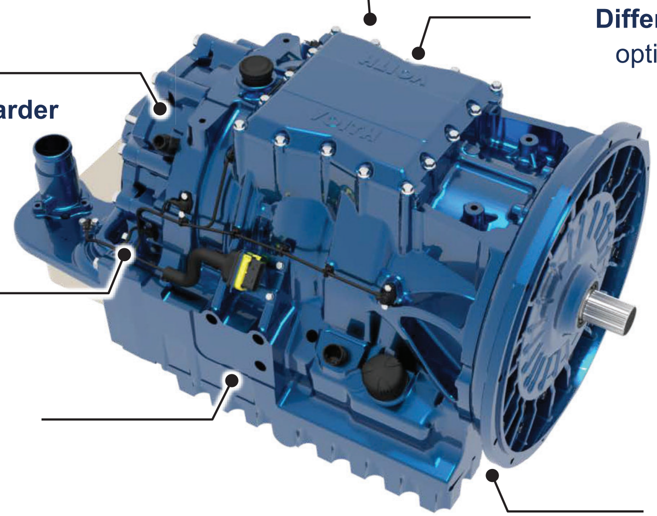
VOITH

Voith US Inc
DIWA NXT

VTI–2020-05-22

DIWA NXT
Product Review

Key Design Changes, as compared to DIWA.6



Product Enhancements:

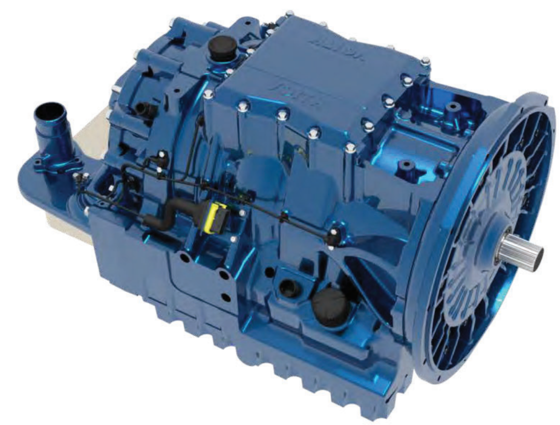
- Measurable Fuel Savings
- Improved Durability
- Improved Comfort
- Low Noise Emissions

DIWA NXT
7 Speed Transmission

VOITH

Gear Ratio - DIWA.NXT D867.8

	1st Gear	2nd Gear	3rd Gear	4th Gear	5th Gear	6th Gear	7th Gear
DIWA.NXT	6.2	1.36	1.09*	1.0	0.8*	0.74	0.59*



* 3rd Gear & 5th Gear Are Intermediate Gear Ranges And Are
Used In Specific Driving Situations To Optimize Fuel Economy.

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for Generations

GILLIG

CUMMINS L9N ENGINE

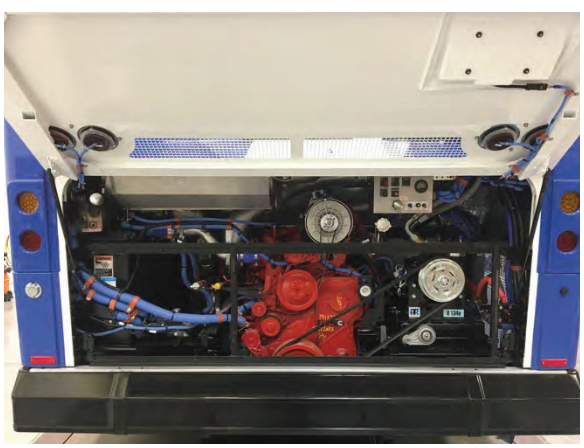
GILLIG utilizes the Cummins Westport L9N CNG engine in the 29’, 35’ and 40’ Low Floor buses. The engine utilizes a single, high-capacity Electronic Control Module (ECM) which provides fully integrated control over the engine and aftertreatment system, for optimized performance and improved engine lamp strategy.

The proposed engine is certified to EPA and California ARP Optional Low NOx standards. Cummins has committed to meeting future requirements during the contract period.

The U.S. Environmental Protection Agency (EPA) regulations call for the addition of On-Board Diagnostics (OBD) for on-highway CNG engines. The OBD system continuously monitors the engine and aftertreatment system, recognizing the potential for an out-of-range event and thus providing a real-time alert of the entire emissions control system.

GILLIG works extensively with the engine manufacturers and vibration control system suppliers to develop “best practices” for engine isolation and mounting. Every engineering design is specifically tailored to address each individual engine installation. GILLIG engineers, using testing data collected by our engine suppliers, evaluate isolation mounts based on both velocity and accelerations of the drive train on a frequency analysis. We carefully look at both transmissibility and resultant vibration in the coach at the driver's floor, middle floor and rear floor. Based on the analysis, GILLIG has selected to use Metalastic mountings at the flywheel housing and at the pad mount under the accessory drive.

The straightforward design of the Low Floor bus allows for easy removal of the engine and transmission by 1 or 2 maintenance people. The removal of either the engine and/or transmission should only be required for major overhaul. Due to the accessibility provided in the Low Floor, all other repair work can be accomplished with the components in the bus.



GILLIC

CUMMINS L9N ENGINE

L9N™

L9N Specifications

NOx emission	0.02 g / bhp-hr. (90% below EPA)
Maximum Horsepower	320 HP | 239 kW
Peak Torque	1,000 LB-FT | 1,356 Nm
Governed Speed	2200 RPM
Type	4-cycle, spark-ignited, in-line 6 cylinder, turbocharged, CAC
Engine Displacement	540 CU IN | 8.9 LITERS
Number of Cylinders	6
Operating Cycles	4
Net Weight (dry)	1,625 lb | 737 KG
Fuel Type	CNG / LNG / Biomethane
Aftertreatment	Three-Way Catalyst
Base Warranty	2 Years, 250,000 Miles (402,336 KM) Truck 2 Years, Unlimited Miles Transit/Shuttle

Source: Cummins

Smart Support™

To provide unparalleled service and support for transit authorities, Cummins now offers the SmartSupport™ program, by which Cummins will proactively replace critical engine components to reduce unscheduled downtime for end customers. The proactive replacement will utilize Cummins Connected Diagnostics™ to keep transit fleets operating with maximum reliability and minimum downtime. SmartSupport is currently available on L9-powered transit applications, but will be cascaded through the lineup in the near future. Contact your local Cummins representative for updates.

Connected Diagnostics™

The Lifeline For Your Engine.

Cummins Connected Diagnostics wirelessly connects your Cummins-powered transit and shuttle buses to product experts at Cummins. Available on 2007 and newer diesel and natural gas engines, Connected Diagnostics instantly transmits key data surrounding the event through your vehicle's existing telematics system to Cummins for immediate analysis.

A notification based on the most probable cause is sent instantly to you via email or the free Connected Diagnostics mobile app, so you know exactly what action to take. That reduces guesswork and allows operators to safely proceed on their trip with the knowledge of the probable cause and information on when service can wait or if it needs to be performed immediately.

Key service event information that can be accessed using the Connected Diagnostics app includes the following:

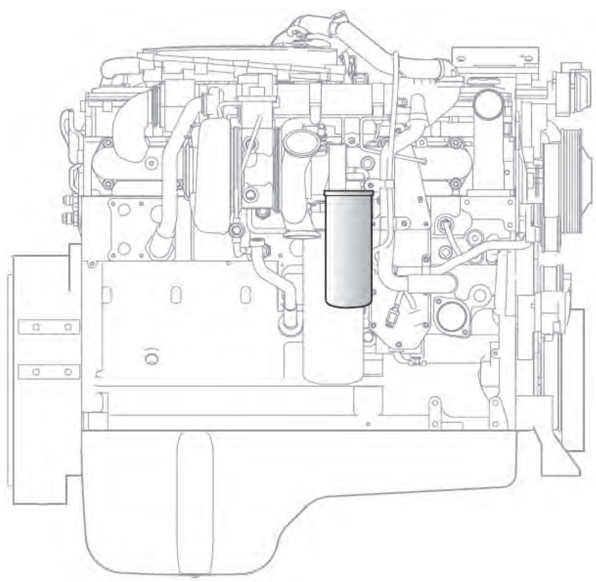
- Derate notice banner
- Active and inactive faults
- Suggested root cause
- Derate notice details
- Possible performance impact
- Equipment information
- Cummins Service Locator
- Cummins contact information
- Current status of service events

Connected Diagnostics is designed to maintain complete service histories attached to each engine. Information about your transit or shuttle bus fleet is available on the Connected Diagnostics web portal anywhere you have Internet access. Learn more at cumminsengines.com/connected-diagnostics.

Source: Cummins

Oil Filter

All L9 engines are furnished by Cummins with a full flow engine oil filter mounted under the filter head, just below the oil cooler on the street side of the bus. These full flow filters include a higher filtration bypass section. This spin on filter is made by Fleetguard, a division of Cummins and contains an internal venture that provides filter bypass oil flow through a stacked disc section of the filter. The oil, supplied to the engine by the oil pump, passes through the full flow filter before reaching the various moving parts of the engine.



Oil Sampling

The optional Probalyzer™ brass mini-gauge sampling valve allows for easy engine oil sampling without shutting down the unit. Sampling with the Probalyzer plug requires the compatible Probalyzer I cap, which screws onto standard 4-ounce sample bottles, or the Probalyzer II Bottle, which is a self-contained sampling bottle.

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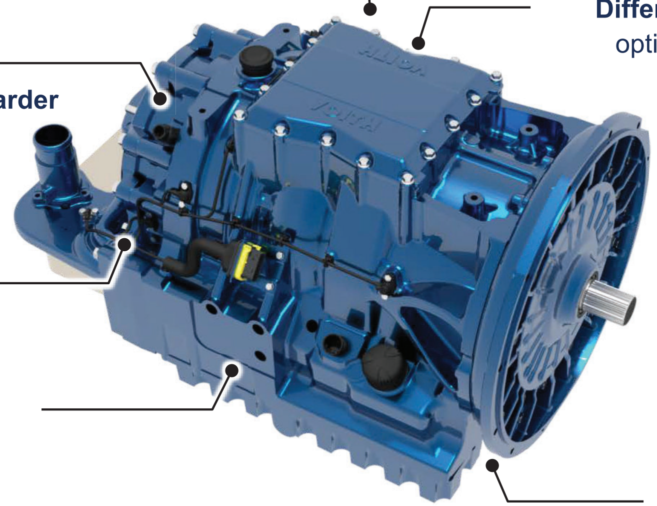
Voith US Inc
DIWA NXT

VTI–2020-05-22

DIWA NXT
Product Review

Key Design Changes, as compared to DIWA.6



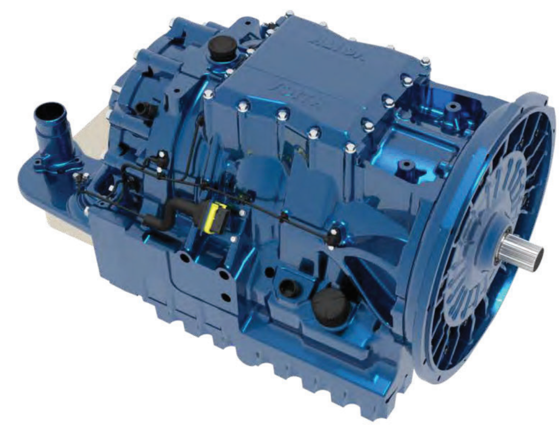
Product Enhancements:

- Measurable Fuel Savings
- Improved Durability
- Improved Comfort
- Low Noise Emissions

DIWA NXT
7 Speed Transmission

Gear Ratio - DIWA.NXT D867.8

	1st Gear	2nd Gear	3rd Gear	4th Gear	5th Gear	6th Gear	7th Gear
DIWA.NXT	6.2	1.36	1.09*	1.0	0.8*	0.74	0.59*



* 3rd Gear & 5th Gear Are Intermediate Gear Ranges And Are Used In Specific Driving Situations To Optimize Fuel Economy.

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Description

The fuel system includes roof-mounted tanks, a fuel management panel—which includes a high-pressure fuel filter, regulator, and solenoid valve—and a low-pressure fuel filter.

High pressure gas flows from the roof-mounted tanks to the high-pressure fuel filter located in the fuel management panel. This filter is a coalescent type filter that captures oil contaminants and moisture typically found in compressed natural gas.

The filtered gas passes through the high-pressure regulator, also located inside the fuel management panel. Engine coolant is plumbed through the regulator to prevent icing caused by the low temperature of the expanding gas.

The gas then passes through the low-pressure filter to further remove oil and other contaminants.

After exiting the low pressure filter, the gas then passes through the low pressure regulator that reduces the gas pressure to approximately 50 psi.

The fuel system and the roof-mounted tanks must be inspected at regular intervals.

Fuel Filters

The high pressure fuel filter used on your bus is a Polar EP. The low pressure fuel filter is a Fleetguard NG5900. To maintain warranty coverage, replace each filter element with the identical make and model. Both the high pressure and low pressure filters mount remotely from the engine. The high pressure fuel filter is located in the fuel fill panel. The low pressure fuel filter is mounted to the curbside chassis outrigger. Both filters are accessible through the curbside access door.

Oil collected by the filters needs to be drained periodically. Typically, the low pressure fuel filter should be drained daily. The high pressure fuel filter needs to be drained less frequently. The interval for draining and replacing the fuel filters is dependent on the fuel station and will vary by location.

Smart Gauge

The CNG smart gauge, located in the CNG fuel management panel (Figure 3-5) next to the two mechanical pressure gauges, displays individual tank pressures and displays warnings if the tanks have been overfilled or if there are excessive differences in pressure between the tanks.

The two warnings which can be displayed are:

1. Displays “High Tank Pressure” if the pressure in any tank is greater than 4,400 psi.
2. Displays “Unequal Tank Pressure” if pressure difference between tanks exceeds 300 psi.

If the high tank pressure warning is displayed, the CNG filling equipment should be tested to ensure that the correct gas pressure is being supplied by the filling equipment, and the electric solenoid tank valves should be tested to determine if any are not opening properly when energized.

If the unequal tank pressure warning is displayed, an electric solenoid tank valve might have failed to open or close properly.

If either warning is displayed, use the CNG smart gauge to measure individual tank pressures and the Agility electric solenoid tank valve test procedure to test the valves and determine the required repairs.

Once the over pressure or unequal pressures have been corrected, the CNG smart gauge will automatically stop displaying the warning.

Inspecting CNG Cylinders

The CNG fuel storage cylinders are housed in aluminum frames bolted to the roof. These structures are designed to protect the cylinders in the event of a collision. Each individual cylinder has a valve at one end which allows fuel in that cylinder to be isolated from the rest of the fuel system. During regular operation, all cylinder valves are open. Additionally, the Fuel Management Module (FMM) is equipped with a 1/4-turn manual shut off valve which isolates the fuel storage system from the engine for emergency situations.

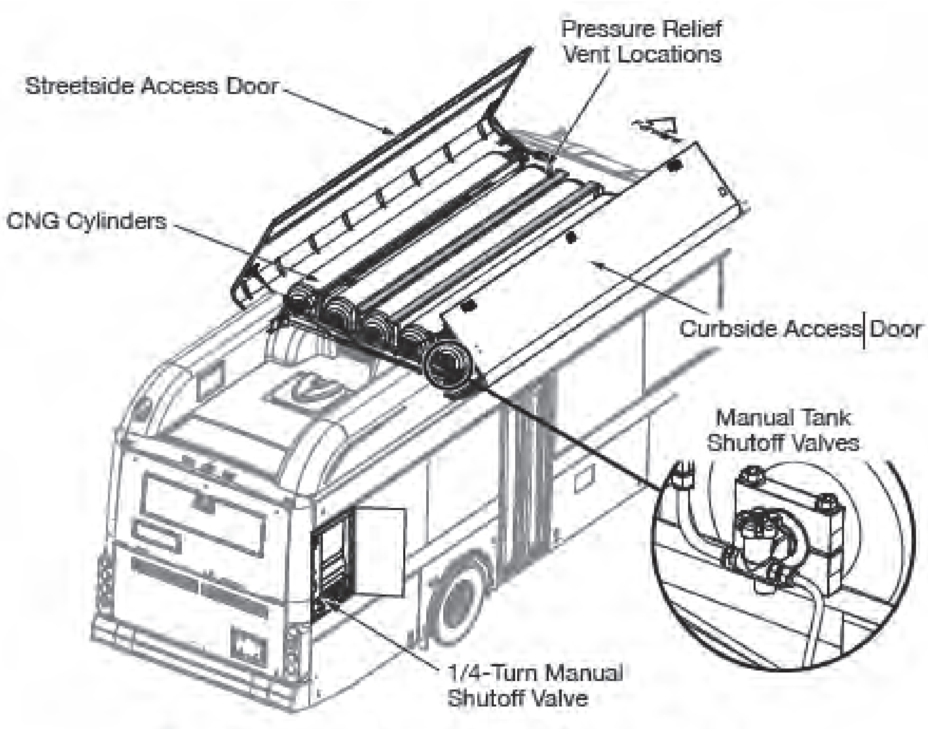

Figure 3-9, Roof-Mounted CNG Storage System

GILLIG

CUMMINS B6.7 ENGINE

GILLIG utilizes the Cummins B6.7 diesel engine in the 35' and 40' Hybrid Low Floor buses. The engine utilizes a single, high-capacity Electronic Control Module (ECM) which provides fully integrated control over the engine and aftertreatment system, for optimized performance and improved engine lamp strategy.

The proposed engine meets all applicable Federal EPA requirements currently in effect and Cummins has committed to meeting future requirements during the contract period.

The U.S. Environmental Protection Agency (EPA) regulations call for the addition of On-Board Diagnostics (OBD) for on-highway diesel engines. The OBD system continuously monitors the engine and aftertreatment system, recognizing the potential for an out-of-range event and thus providing a real-time alert of the entire emissions control system.

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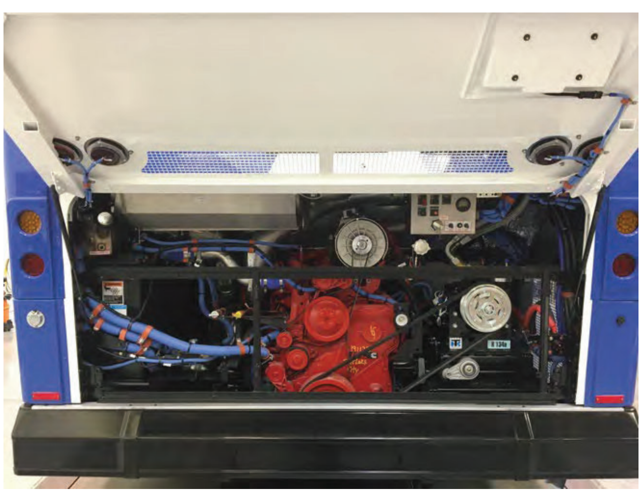

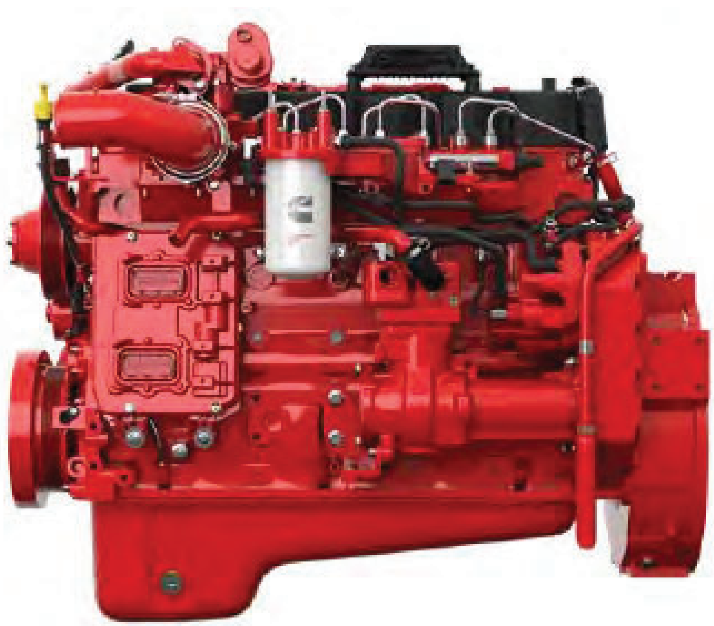

Technical specifications

B6.7™

Advertised Horsepower	280 hp
Peak Torque	660 lb-ft
Governed Speed	2600 rpm
Clutch Engagement Torque	400 lb-ft
Number of Cylinders	6
Bore and Stroke	107 mm x 124 mm
Engine (Dry)	1150 lb

Source: Cummins

Smart Support™

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Connected Diagnostics is designed to maintain complete service histories attached to each engine. Information about your transit or shuttle bus fleet is available on the Connected Diagnostics web portal anywhere you have Internet access. Learn more at cumminsengines.com/connected-diagnostics.

Source: Cummins

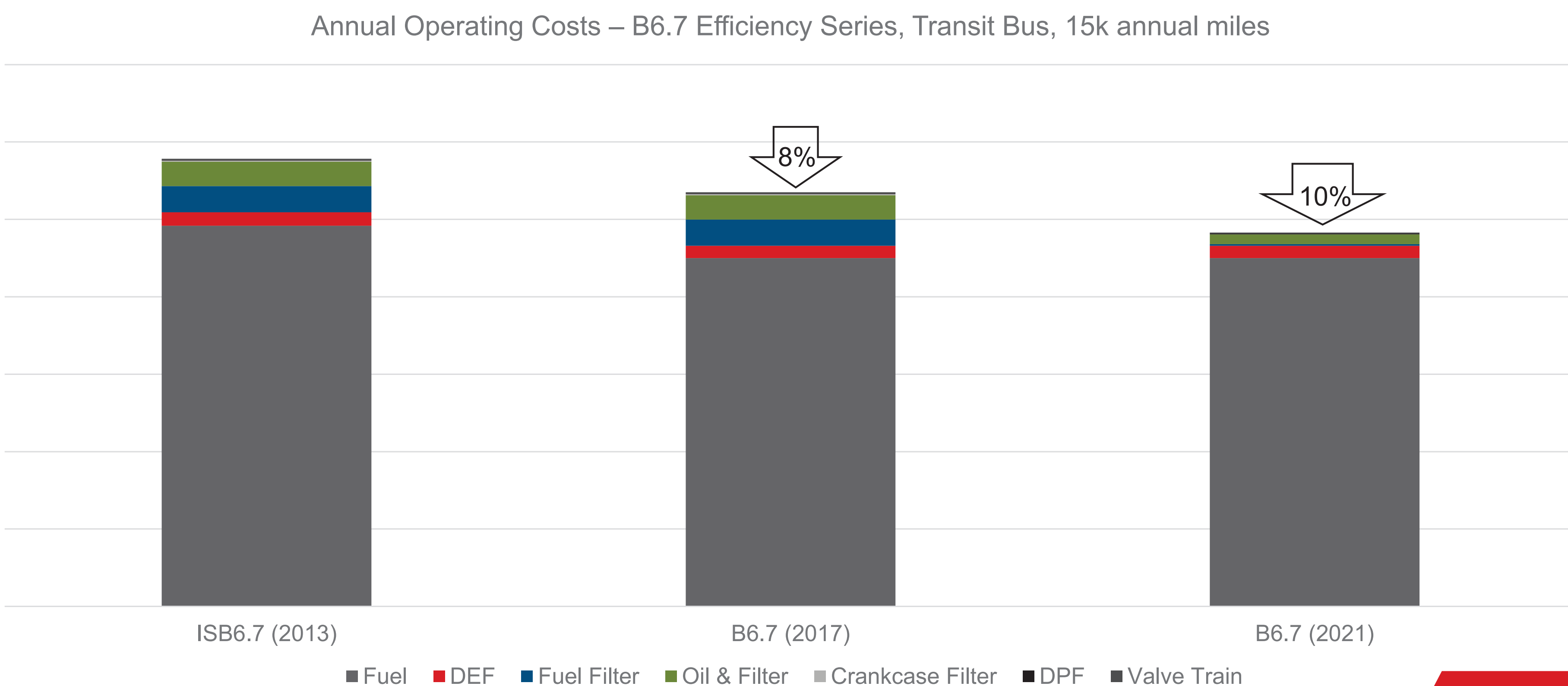
B6.7 | 2021 Maintenance Changes

Maintenance Event	EPA 2017 B6.7	EPA 2021 B6.7
Oil and Filter Change	Up to 20K miles / 550 hours / 12 months (duty cycle dependent)	Up to 30K miles / 1000 hours / 18 months (duty cycle dependent)
Fuel Filter Change	15K miles / 500 hours / 12 months	60K miles / 2000 hours / 18 months
Crankcase Ventilation Filter (“Breather”) Change	75K miles / 2500 hours	MAINTENANCE FREE
Valve Lash Adjust	150K miles / 5000 hours	150K miles / 5000 hours
DPF Clean	200K miles / 6500 hours	200K miles / 6500 hours
DEF Filter Change	200K miles / 6500 hours	200K miles / 6500 hours

See Owner’s Manual for full recommended maintenance schedules

B6.7 Bus Operating Cost Reduction

The 2021 B6.7 continues to deliver reductions in operating costs. Compared to the 2017 product, the 2021 B6.7 provides an additional ~10% reduction in TCO for transit bus through improvements in maintenance.



2021 B6.7 Engine Profile Summary

Differences between the EPA 2017 B6.7 and EPA 2021 B6.7 engine profiles.

	EPA 2017	EPA 2021
RATINGS (BY FAMILY)	280 hp/600 lb.-ft.	280 hp/600 lb.-ft.
ENGINE WEIGHT (DRY)	1150 lbs.	Same as 2017
FUEL EFFICIENCY	Base	Similar to 2017
DEF (% OF FUEL USAGE)	3.7%	Similar to 2017
WIRING	Base	Same vehicle Input/Output
DIMENSIONS	Base	Similar to 2017
SOFTWARE	Base	New to meet 2021 requirements
WATER PUMP	Fixed ratio	Same as 2017
CONTROL MODULE	CM2350	CM2450 (Same Input/Output)
WARRANTY	2 years/unlimited mileage	Same as 2017
MAINTENANCE (DUTY CYCLE DEPENDENT)	Up to 20,000 miles/550 hours oil drain interval and fuel filter	Up to 30,000 miles/1000 hours oil drain interval and fuel filter; Maintenance-free crankcase filter
AFTERTREATMENT	Single Module with UL2.0	Performance improvements with same packaging/interfaces

Medium Duty Base Warranty - Transit

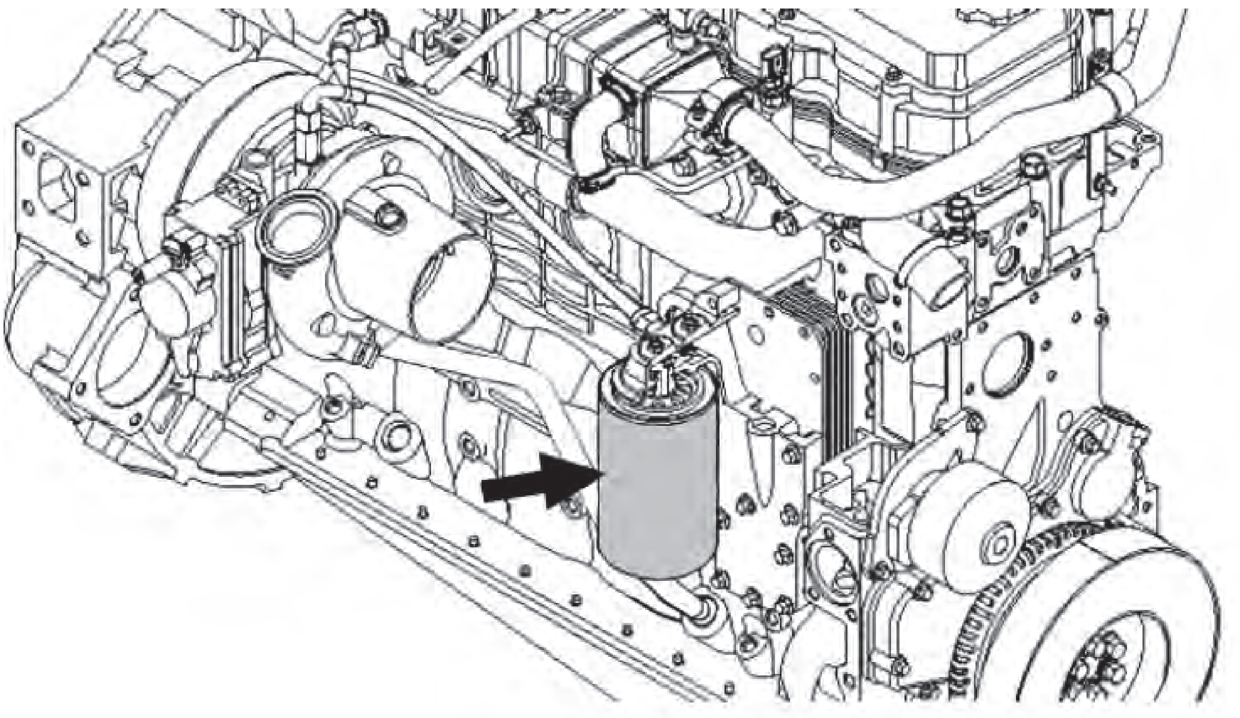
2021 B6.7 & L9 Transit base warranty maintained at 2 years / unlimited miles

- **2 Year / Unlimited Warranty**
- Confidence in ultra-reliable product
- Further peace of mind, beyond proven dependability
- 100% Coverage for:
  - Parts and labor on warrantable failures
  - Aftertreatment
  - Consumables used in the repair
- Travel / Towing is covered
- All with no deductible

2 years /
Unlimited miles

Oil Filter

All B6.7 engines are furnished by Cummins with a full flow engine oil filter mounted under the filter head, just below the oil cooler on the street side of the bus. These full flow filters include a higher filtration bypass section. This spin on filter is made by Fleetguard, a division of Cummins and contains an internal venture that provides filter bypass oil flow through a stacked disc section of the filter. The oil, supplied to the engine by the oil pump, passes through the full flow filter before reaching the various moving parts of the engine.



Oil Sampling

The optional Probalyzer™ brass mini-gauge sampling valve allows for easy engine oil sampling without shutting down the unit. Sampling with the Probalyzer plug requires the compatible Probalyzer I cap, which screws onto standard 4-ounce sample bottles, or the Probalyzer II Bottle, which is a self-contained sampling bottle.

Allison Transmission

eGen Flex™

Electrify Your Fleet with Allison's Revolutionary Electric Hybrid – eGen Flex™

eGen Flex.™ Delivering the flexibility to meet your changing needs.

We're always developing new hardware and technologies that will lead to a cleaner future. As community requirements change, so do our products. Allison is committed to zero-emission technologies, so we've evolved our electric hybrid propulsion solution to use geofencing to automatically switch to full electric drive in designated Zero Emission Zones and depot zones. We're not slowing down on the road to full electrification and cleaner, quieter communities.

Reduce Dependence on Fossil Fuels at the Pump

- Improved fuel economy up to 25% versus conventional diesel bus
- Operate accessories such as air conditioning and heat at their optimal efficiency with clean and quiet electric power

Enhance Quality of Life

- No engine emissions or noise while loading and unloading passengers and in dense pedestrian areas

Protect the Environment

- Electric vehicle operation in Zero Emission Zones and bus depots with geofencing capability
- Up to 10 miles electric range, duty-cycle and axle-ratio dependent
- Reduced CO_2 emissions

Reduce Downtime and Maintenance Costs

- Eliminate inefficient belt-driven accessories and reduce the load on the engine
- Reduced brake wear through electric hybrid regenerative braking
- Industry's most reliable name in electric hybrid propulsion

Proven Solution. Enhanced Value.

Revolutionary Components Provide Enhanced Capability

Drive Unit

- Same proven industry-leading reliability
- Disconnect clutch added to enable disengaging input shaft from the engine
- Provides propulsion while the engine is at zero speed, enabling full engine-off propulsion capability

Dual Traction Inverter (DTI)

- Improved efficiency
- Improved packaging – one-third the size and 50 lbs lighter than the current component
- WEG cooling – no oil-coolant lines from drive unit, reducing installation complexity and maintenance costs

Rechargeable Energy Storage System

- Lithium Titanate (LTO) chemistry that is ideal for electric hybrid operation
- Increased energy capacity – industry-leading 10-mile electric range capable
- Industry-leading battery design life of eight years
- Faster charging than other chemistries

A Global Leader in Transit Electric Hybrid Propulsion Solutions

- First to launch an electric hybrid solution for both articulated and non-articulated buses
- 9,000 hybrid propulsion systems delivered globally
- Serving 230 cities
- 2.6 billion miles of reliable operation
- 305 million gallons of fuel saved
- 3 million metric tons of CO_2 emissions prevented
- Only propulsion partner with solutions available for diesel, natural gas and electric hybrid buses

Power into the future of propulsion.
Visit allisontransmission.com/egen-flex today to get started.

Allison Transmission eGen Flex™

Ratings

Model	Continuous	Rated Input Torque	Rated Input Speed	Dry Weight	Wet Weight
	hp (kW)	lb-ft (N•m)	rpm	lbs (kg)	lbs (kg)
eGen Flex 40 Drive Unit - Transit Bus[1]	280 (209)	910 (1234)	2300	913 (414)	938 (425)
eGen Flex 50 Drive Unit - Suburban Coach/ Articulated Bus[2]	330 (246)	1050 (1424)	2300	913 (414)	938 (425)
H 40 - Transit Bus	280 (209)	910 (1234)	2300	913 (414)	938 (425)
H 50 - Transit/Coach	330 (246)	1050 (1424)	2300	913 (414)	938 (425)
Rechargeable Energy Storage System (RESS)				1201.5 (545)	
Dual Traction Inverter (DTI)	260 kW continuous 3-phase AC			48 (22)	

1 Applicable for H 40 EP, eGen Flex 40, eGen Flex 40 CertPlus, eGen Flex 40 Max, eGen Flex 40 Max CertPlus 2 Applicable for H 50 EP, eGen Flex 50, eGen Flex 50CertPlus, eGen Flex 50 Max, eGen Flex 50 Max CertPlus

Features

	eGen Flex™ 40/50	eGen Flex™ 40/50 CertPlus	eGen Flex™ 40/50 Max	eGen Flex™ 40/50 Max CertPlus
Allison Drive Unit with disconnect clutch	✓	✓	✓	✓
Allison 26 kWh Lithium Titanate (LTO) Rechargeable Energy Storage System (RESS)	✓	✓	✓	✓
Allison Dual Traction Inverter (DTI)	✓	✓	✓	✓
Allison 5th Generation Controls	✓	✓	✓	✓
Acceleration Rate Management	✓	✓	✓	✓
Hybrid Mode	✓	✓	✓	✓
Increased Accessory Power 2 (IAP2) - Accessory electrification capability	✓	✓	✓	✓
Engine Start-Stop	✓	✓	✓	✓
EV Mode	Not Available	Not Available	✓	✓
Pre-Charge Mode	Not Available	Not Available	✓	✓
Depot Mode	Not Available	Not Available	✓	✓
Zero-Emission Zone Mode	Not Available	Not Available	✓	✓
Up to 10-mile EV Mode operation	Not Available	Not Available	✓	✓
Geofencing (to support Zero Emission Zones, Pre-Charge Mode, and Depot Mode)	Not Available	Not Available	✓	✓
California Air Resources Board (CARB) Certified	No	✓	No	✓

A World of Support

From our headquarters in Indianapolis, Indiana, USA, to our plants in Hungary and India, to approximately 1,500 Allison Authorized Distributors and Dealers around the globe, you are never far from the products, training, service and support you demand.

Our support starts from the moment an Allison transmission is specified. We work with you to ensure that the model and ratings fit your engine to create a tailored package of powerful performance and reliable efficiency. When you need parts or service, you can count on global access to factory-trained specialists and Allison Genuine Parts.™

One Allison Way
Indianapolis, Indiana USA 46222-3271

Information or specifications subject to change without notice or obligation.

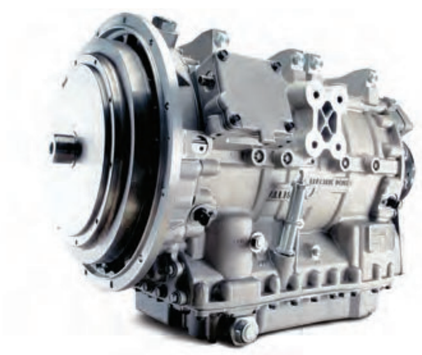
allisontransmission.com

SA8830EN (2021/03)

Allison Transmission®

The Next Step on the Road to Full Electrification

Allison Transmission is leading the charge when it comes to innovative propulsion solutions. Now we're taking our tried and tested H 40/50 EP™ electric hybrid propulsion systems to the next level with the Allison eGen Flex™ electric hybrid, which provides revolutionary capabilities and fully electric propulsion when you need it, without the added infrastructure requirements of full EV.



Our electric hybrid systems continue to demonstrate bottom-line operating benefits for local authorities and fleets all over the world while delivering industry-leading performance, reliability and durability.

Delivering the Flexibility to Meet Your Changing Needs

We're always developing new hardware and technologies that will lead to a cleaner future. As local requirements change, so do our products. Allison is committed to zero-emission technologies, so we've evolved our electric hybrid propulsion solution to use geofencing and switch automatically to full electric drive in designated Zero Emission Zones and depot zones. We're not slowing down on the road to full electrification and cleaner, quieter communities.

Reduce dependency on fossil fuels at the pump

- Fuel economy improved by up to 25% compared with conventional diesel buses
- Operate accessories such as air conditioning and heating at optimum efficiency using clean, quiet electricity

Enhance quality of life

- No engine emissions or noise in busy pedestrian areas and while loading and unloading passengers

Protect the environment

- Operation of electric vehicles in Zero Emission Zones and at bus depots with geofencing capability
- Electric range of up to 10 miles, depending on duty cycle and axle ratio
- Reduced CO2 emissions

Reduce downtime and maintenance costs

- Eliminate inefficient belt-driven accessories, and reduce load on the engine
- Reduce brake wear by means of electric hybrid regenerative braking
- Industry's most reliable name in electric hybrid propulsion

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One Allison Way
Indianapolis, Indiana USA 46222-3271

SA8840EN (2021/04)

allisontranmission.com

Allison Transmission

Bus Series™ Ratings

Model	Ratio	Park Pawl	Gross Input Power (With Torque Management)	Gross Input Torque (With Torque Management)	Net Turbine Torque (With Torque Management)	Gross Input Power (Without Torque Management)	Gross Input Torque (Without Torque Management)	Net Turbine Torque (Without Torque Management)	Max GVW	Max GCW
			hp (kW)	lb-ft (N•m)	lb-ft (N•m)	hp (kW)	lb-ft (N•m)	lb-ft (N•m)	lbs (kg)	lbs (kg)
B 210[1]	Close	No	270 (201)	575 (780)	850 (1152)	230 (172)	520 (705)	850 (1152)	29,000 (13,150)	29,000 (13,150)
B 220[1]	Close	Yes	270 (201)	575 (780)	850 (1152)	230 (172)	520 (705)	850 (1152)	29,000 (13,150)	29,000 (13,150)
B 295	Close					230 (172)	620 (841)	1370 (1857)	33,000 (14,968)	33,000 (14,968)
B 300	Close					280 (209)	735 (997)	1370 (1857)	38,000 (17,236)	38,000 (17,236)
B 400 - Transit	Close					300 (224)	925 (1254)	1370 (1857)	45,000 (20,412)	45,000 (20,412)
B 400 - Tour Coach	Close					330 (246)	1000 (1356)	1600 (2170)	45,000 (20,412)	45,000 (20,412)
B 3400 xFE	Close					300 (224)	925 (1254)	1370 (1857)	45,000 (20,412)	45,000 (20,412)
B 500 - Transit	Close					420 (313)	1300 (1763)	2450 (3322)	-	-
B 500 - Intercity Coach	Close					550 (410)	1700 (2305)	2450 (3322)	-	-

1 - Available with xFE

Model	Continuous	Rated Input Torque	Rated Input Speed	Dry Weight	Wet Weight
	hp (kW)	lb-ft (N•m)	rpm	lbs (kg)	lbs (kg)
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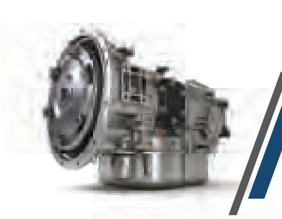
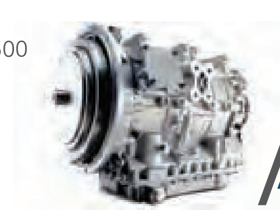
1 Applicable for H 40 EP, eGen Flex 40, eGen Flex 40 CertPlus, eGen Flex 40 Max, eGen Flex 40 Max CertPlus 2 Applicable for H 50 EP, eGen Flex 50, eGen Flex 50CertPlus, eGen Flex 50 Max, eGen Flex 50 Max CertPlus



B 210
B 220
B 295

B 300
B 400
B 3400xFE

B 500



H 40
H 50
eGen Flex

The FuelSense® 2.0 Advantage

Allison's FuelSense® 2.0 delivers upgraded features that provide transit vehicles with a precise balance of fuel economy and performance:

DynActive® Shifting is innovative shift scheduling that uses an algorithm to choose the most efficient shift point, based on your specifications, vehicle and environmental parameters.

Acceleration Rate Management mitigates aggressive driving by automatically controlling engine torque. It offers five levels of control and more precision by limiting vehicle acceleration to a customized calibrated rate.

Neutral at Stop trims fuel consumption and emissions by reducing or eliminating the load on the engine when the vehicle is stopped.

Our Promise

Provide the most reliable and valued propulsion solutions in the world to enable our customers to work more efficiently.

- Trusted by more than 300 OEMs worldwide
- A strong history of innovation with more than 1,000 patents
- First to launch an electric hybrid solution for both articulated and non-articulated buses
- Over seven million fully automatic transmissions delivered

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SA8754EN (2020/10)

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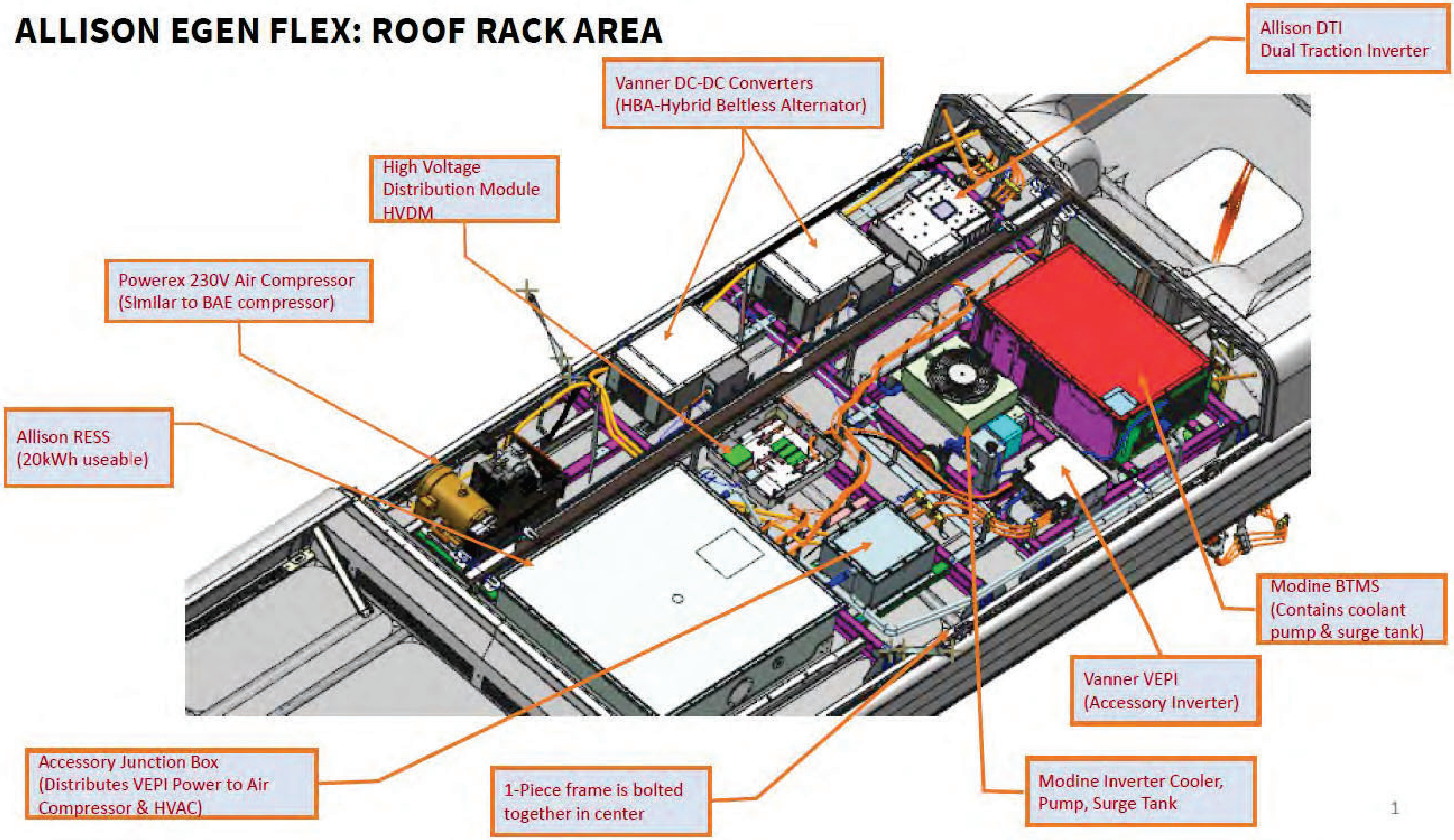
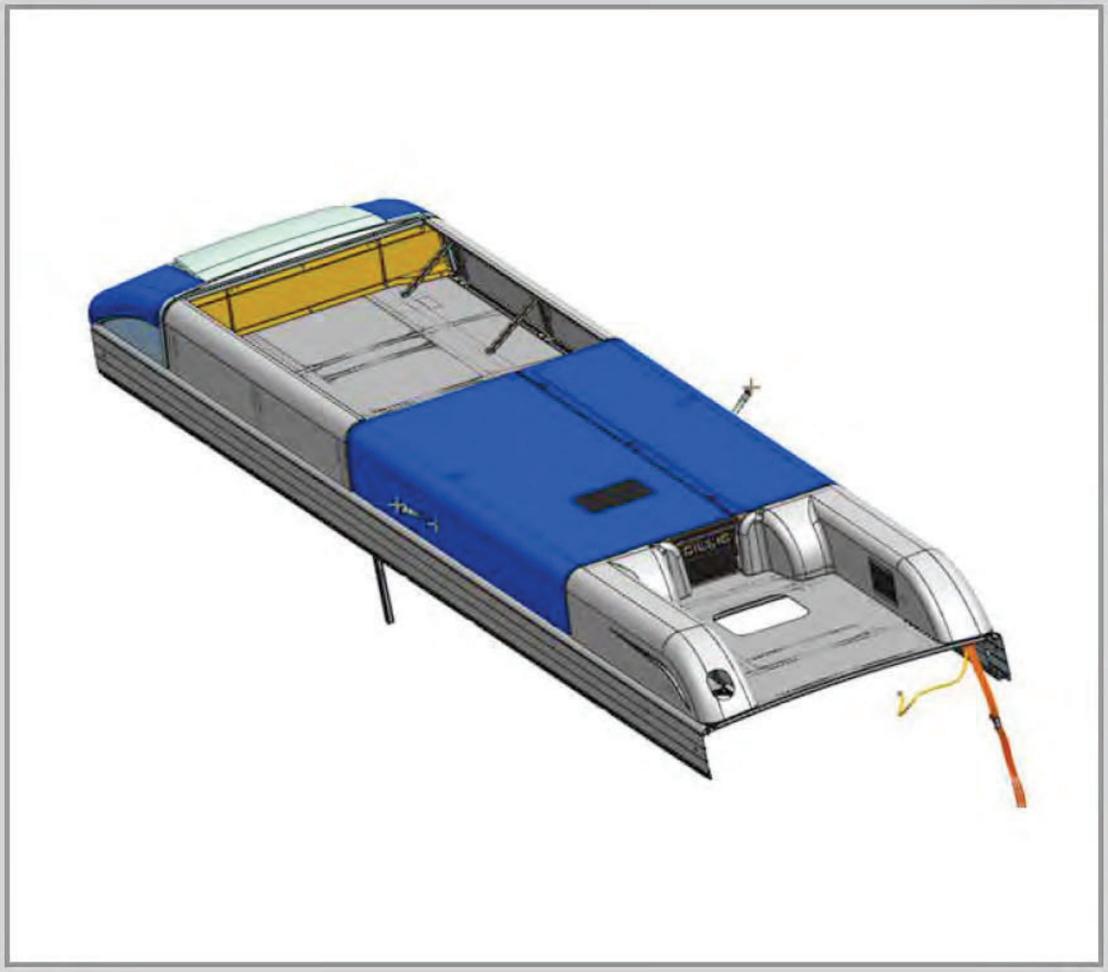
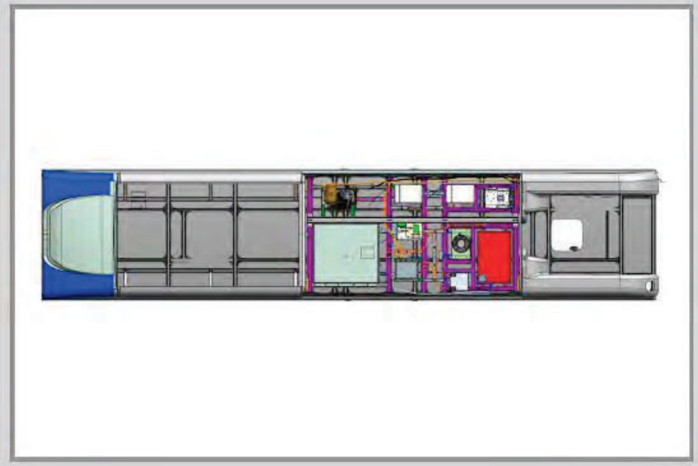
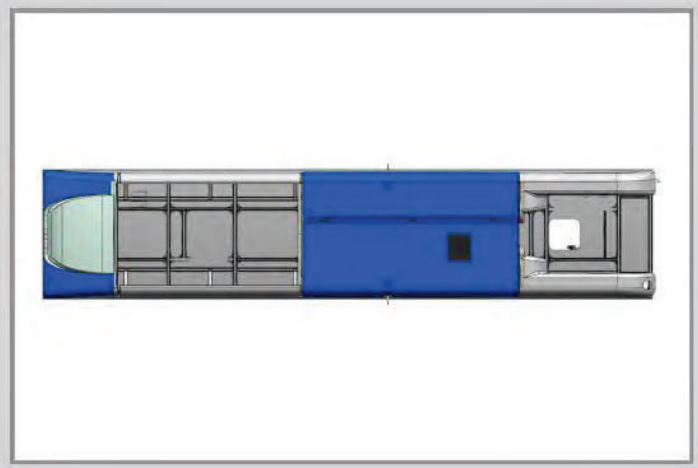
ALLISON EGEN FLEX: ROOF RACK AREA









BAE HYBRID-ELECTRIC

1. IDENTIFICATION OF THE SPECIFIC ENGINE AND HYBRID DRIVE SYSTEM TO BE USED ON THE VEHICLE.

• MODEL	LOW FLOOR 40 FOOT BAE HYBRID-ELECTRIC
• ENGINE	CUMMINS B6.7 280 HP
• HYBRID DRIVE	BAE MODEL HDS200

Attached is the Cummins B6.7 engine specification sheet specification sheet.

HYBRID ENGINE

GILLIG proposes the **Cummins B6.7 280 HP engine** in the Low Floor buses with the **Hybrid** drive system. The performance characteristics of the B6.7 is similar to, and in some case superior to that of a ISL diesel powered bus. Additionally, the B6.7 is significantly quieter, achieves better fuel economy, is more economical to maintain and operate then the same system with an ISL.

The straightforward design and greater degree of accessibility of the GILLIG bus allows for the B6.7 engine and the BAE hybrid drive to be **installed and removed as a single unit or the engine be can easily be removed without removing the hybrid drive unit.**

Cummins B6.7 for Hybrid Application

CUMMINS B6.7 ENGINE

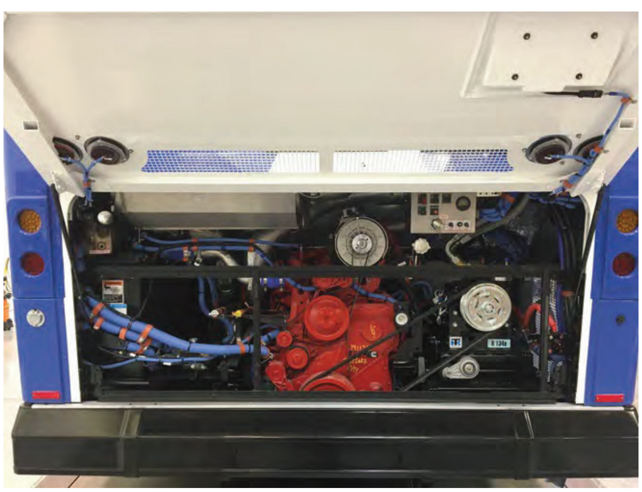
GILLIG utilizes the Cummins B6.7 diesel engine in the 35' and 40' Hybrid Low Floor buses. The engine utilizes a single, high-capacity Electronic Control Module (ECM) which provides fully integrated control over the engine and aftertreatment system, for optimized performance and improved engine lamp strategy.

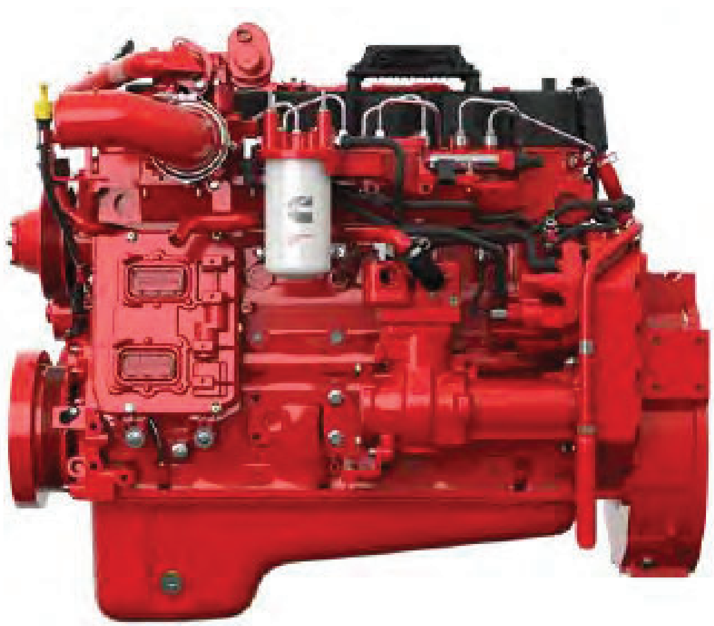
The proposed engine meets all applicable Federal EPA requirements currently in effect and Cummins has committed to meeting future requirements during the contract period.

The U.S. Environmental Protection Agency (EPA) regulations call for the addition of On-Board Diagnostics (OBD) for on-highway diesel engines. The OBD system continuously monitors the engine and aftertreatment system, recognizing the potential for an out-of-range event and thus providing a real-time alert of the entire emissions control system.

GILLIG works extensively with the engine manufacturers and vibration control system suppliers to develop "best practices" for engine isolation and mounting. Every engineering design is specifically tailored to address each individual engine installation. GILLIG engineers, using testing data collected by our engine suppliers, evaluate isolation mounts based on both velocity and accelerations of the drive train on a frequency analysis. We carefully look at both transmissibility and resultant vibration in the coach at the driver's floor, middle floor and rear floor. Based on the analysis, GILLIG has selected to use Metalastic mountings at the flywheel housing and at the pad mount under the accessory drive.

The straightforward design of the Low Floor bus allows for easy removal of the engine and transmission by 1 or 2 maintenance people. The removal of either the engine and/or transmission should only be required for major overhaul. Due to the accessibility provided in the Low Floor, all other repair work can be accomplished with the components in the bus.





Technical specifications

B6.7™

Advertised Horsepower	280 hp
Peak Torque	660 lb-ft
Governed Speed	2600 rpm
Clutch Engagement Torque	400 lb-ft
Number of Cylinders	6
Bore and Stroke	107 mm x 124 mm
Engine (Dry)	1150 lb

Source: Cummins

Smart Support™

To provide unparalleled service and support for transit authorities, Cummins now offers the SmartSupport™ program, by which Cummins will proactively replace critical engine components to reduce unscheduled downtime for end customers. The proactive replacement will utilize Cummins Connected Diagnostics™ to keep transit fleets operating with maximum reliability and minimum downtime. SmartSupport is currently available on L9-powered transit applications, but will be cascaded through the lineup in the near future. Contact your local Cummins representative for updates.

Connected Diagnostics™

The Lifeline For Your Engine.

Cummins Connected Diagnostics wirelessly connects your Cummins-powered transit and shuttle buses to product experts at Cummins. Available on 2007 and newer diesel and natural gas engines, Connected Diagnostics instantly transmits key data surrounding the event through your vehicle's existing telematics system to Cummins for immediate analysis.

A notification based on the most probable cause is sent instantly to you via email or the free Connected Diagnostics mobile app, so you know exactly what action to take. That reduces guesswork and allows operators to safely proceed on their trip with the knowledge of the probable cause and information on when service can wait or if it needs to be performed immediately.

Key service event information that can be accessed using the Connected Diagnostics app includes the following:

- Derate notice banner
- Active and inactive faults
- Suggested root cause
- Derate notice details
- Possible performance impact
- Equipment information
- Cummins Service Locator
- Cummins contact information
- Current status of service events

Connected Diagnostics is designed to maintain complete service histories attached to each engine. Information about your transit or shuttle bus fleet is available on the Connected Diagnostics web portal anywhere you have Internet access. Learn more at cumminsengines.com/connected-diagnostics.

Source: Cummins

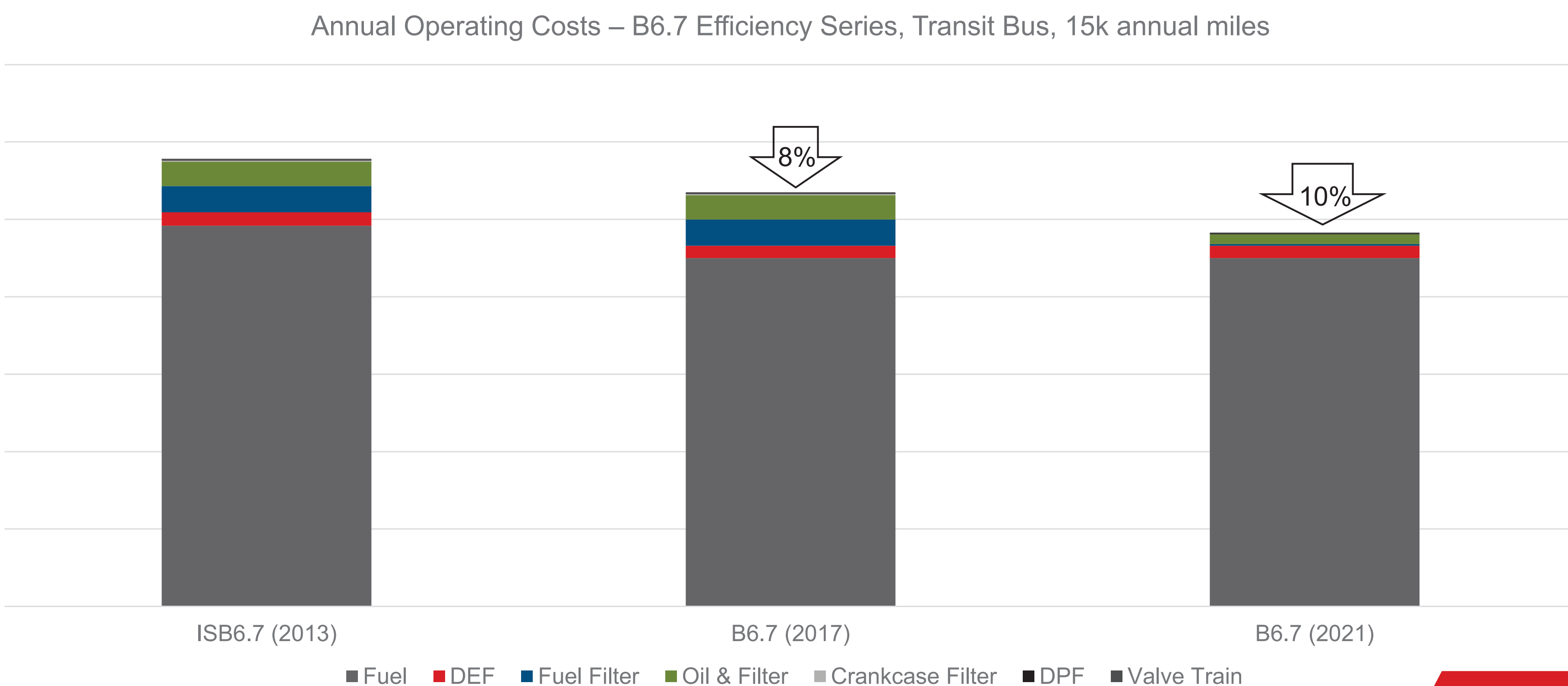
B6.7 | 2021 Maintenance Changes

Maintenance Event	EPA 2017 B6.7	EPA 2021 B6.7
Oil and Filter Change	Up to 20K miles / 550 hours / 12 months (duty cycle dependent)	Up to 30K miles / 1000 hours / 18 months (duty cycle dependent)
Fuel Filter Change	15K miles / 500 hours / 12 months	60K miles / 2000 hours / 18 months
Crankcase Ventilation Filter ("Breather") Change	75K miles / 2500 hours	MAINTENANCE FREE
Valve Lash Adjust	150K miles / 5000 hours	150K miles / 5000 hours
DPF Clean	200K miles / 6500 hours	200K miles / 6500 hours
DEF Filter Change	200K miles / 6500 hours	200K miles / 6500 hours

See Owner's Manual for full recommended maintenance schedules

B6.7 Bus Operating Cost Reduction

The 2021 B6.7 continues to deliver reductions in operating costs. Compared to the 2017 product, the 2021 B6.7 provides an additional ~10% reduction in TCO for transit bus through improvements in maintenance.



2021 B6.7 Engine Profile Summary

Differences between the EPA 2017 B6.7 and EPA 2021 B6.7 engine profiles.

	EPA 2017	EPA 2021
RATINGS (BY FAMILY)	280 hp/600 lb.-ft.	280 hp/600 lb.-ft.
ENGINE WEIGHT (DRY)	1150 lbs.	Same as 2017
FUEL EFFICIENCY	Base	Similar to 2017
DEF (% OF FUEL USAGE)	3.7%	Similar to 2017
WIRING	Base	Same vehicle Input/Output
DIMENSIONS	Base	Similar to 2017
SOFTWARE	Base	New to meet 2021 requirements
WATER PUMP	Fixed ratio	Same as 2017
CONTROL MODULE	CM2350	CM2450 (Same Input/Output)
WARRANTY	2 years/unlimited mileage	Same as 2017
MAINTENANCE (DUTY CYCLE DEPENDENT)	Up to 20,000 miles/550 hours oil drain interval and fuel filter	Up to 30,000 miles/1000 hours oil drain interval and fuel filter; Maintenance-free crankcase filter
AFTERTREATMENT	Single Module with UL2.0	Performance improvements with same packaging/interfaces

Medium Duty Base Warranty - Transit

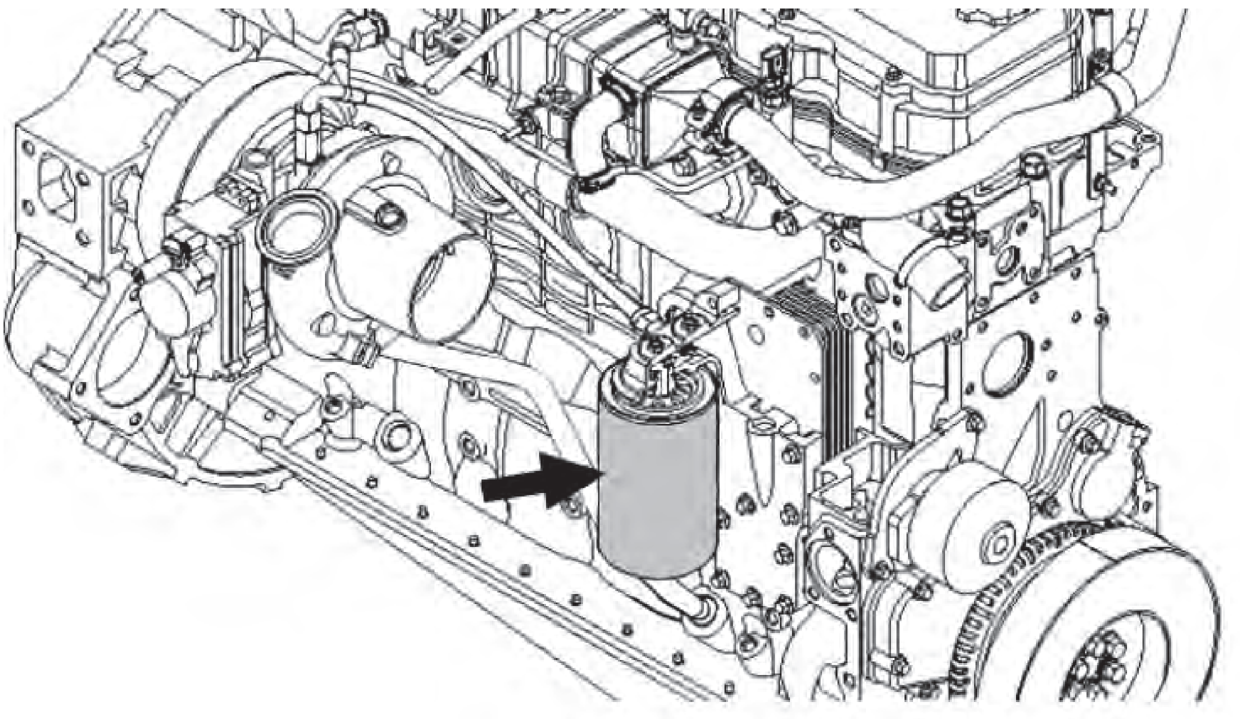
2021 B6.7 & L9 Transit base warranty maintained at 2 years / unlimited miles

- **2 Year / Unlimited Warranty**
- Confidence in ultra-reliable product
- Further peace of mind, beyond proven dependability
- 100% Coverage for:
  - Parts and labor on warrantable failures
  - Aftertreatment
  - Consumables used in the repair
- Travel / Towing is covered
- All with no deductible

2 years /
Unlimited miles

Oil Filter

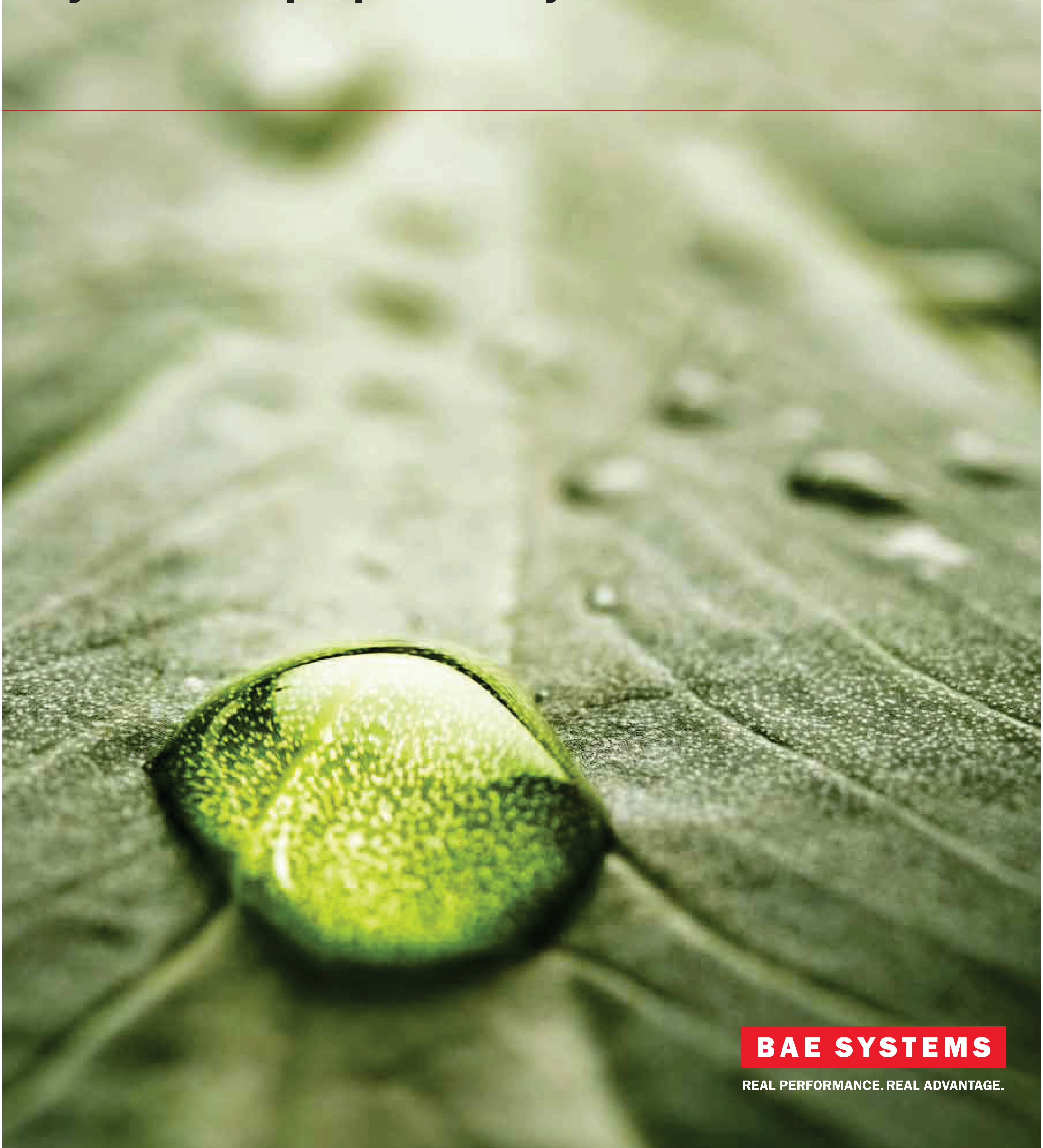
All B6.7 engines are furnished by Cummins with a full flow engine oil filter mounted under the filter head, just below the oil cooler on the street side of the bus. These full flow filters include a higher filtration bypass section. This spin on filter is made by Fleetguard, a division of Cummins and contains an internal venture that provides filter bypass oil flow through a stacked disc section of the filter. The oil, supplied to the engine by the oil pump, passes through the full flow filter before reaching the various moving parts of the engine.



Oil Sampling

The optional Probalyzer™ brass mini-gauge sampling valve allows for easy engine oil sampling without shutting down the unit. Sampling with the Probalyzer plug requires the compatible Probalyzer I cap, which screws onto standard 4-ounce sample bottles, or the Probalyzer II Bottle, which is a self-contained sampling bottle.

HybriDrive® propulsion system



BAE SYSTEMS

REAL PERFORMANCE. REAL ADVANTAGE.

Series-E: Hybrid Electric

Series-E is a hybrid electric propulsion system capable of powering all bus accessories on electric power, allowing operators to take advantage of stop/start technology. With Series-E, the engine can shut off at stops and electric accessories (A/C, power steering, air compressors, etc.) will continue to operate. Our hybrid systems have two energy storage units options to choose from, the ESS-3G-32K and the ESS-3G-1K. The ESS-3G-32K provides more engine-off operations whereas the ESS-3G-1K does not require a mid-life refresh.

How it works:

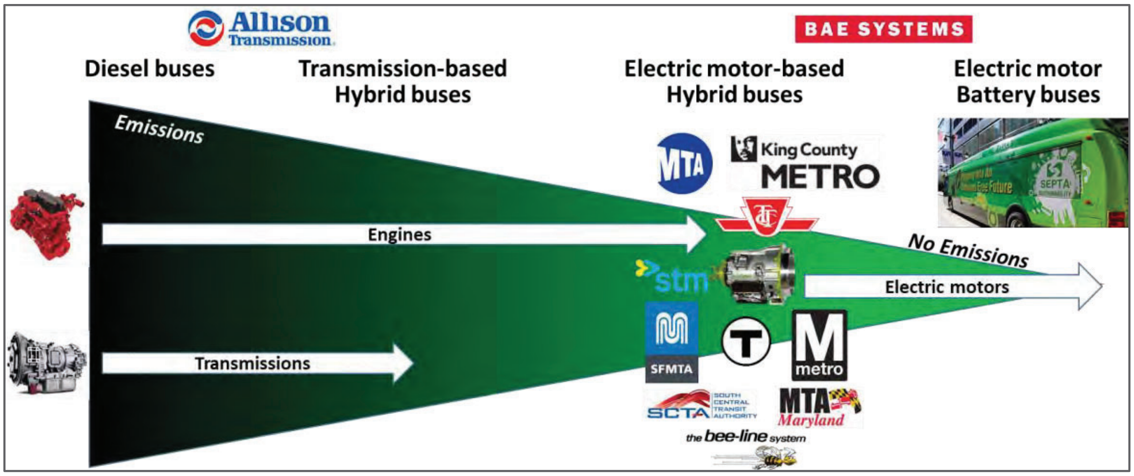
With Series-E, the integrated starter generator (ISG) is the prime energy source. Once the generator is turned by the engine, the generator provides power to the energy storage system (batteries) which in turn powers the electric drive motor. A secondary source of energy is realized from vehicle braking. As the driver engages the brake, energy is reclaimed and stored for use in the energy storage system to drive the wheels.

Benefits:

- up to 15% engine-off operation
- stop/start technology (engine-off at bus stops)
- no charging infrastructure required

BAE Systems' Series-ER (Electric Range) Power & Propulsion System for

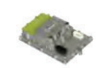
BAE Systems' Series-ER power & propulsion system is a complete, electric motor-based solution designed for transit agencies progressing towards zero emissions fleet operations.



BAE Systems is the transit industry's market leader for electric-hybrid power & propulsion systems. Since 2016, BAE Systems has outpaced Allison Transmission, in fielded electric-hybrid power & propulsion systems, at a rate of 6-to-1. Transit agencies are continuing to choose BAE Systems on their path to zero emissions. New York City's Metropolitan Transportation Authority (MTA) is aiming to be a 100% zero emission fleet by 2040. This year, the MTA is introducing 435 electric-hybrid, BAE Systems-powered transit buses in to their fleet. Boston's Massachusetts Bay Transportation Authority (MBTA) switched from Allison Transmission to BAE Systems in 2014 and now has over 500 Series-ER systems in service. Toronto Transit Commission (TTC) is baselining their battery electric pilot bus program against their Series-ER electric-hybrid fleet which is running at a 78,000 Mean Distance (km) Between Failures (MDBF) rate. At their April 2021 Board meeting, San Francisco Municipal Transportation Agency (SFMTA) highlighted their "significant experience with BAE propulsion systems" as part of their rationale to expand their battery electric bus pilot program.

Series-ER: Zero-emission travel where and when you need it

BAE Systems' Series-ER (Electric Range) Power & Propulsion System

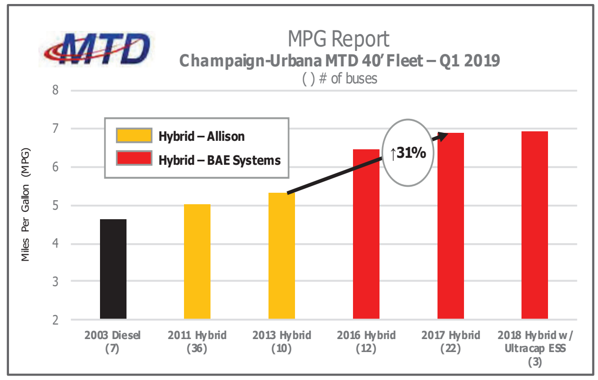
HDS200 Motor/Generator	Propulsion Control System (PCS)	32K energy storage system (ESS)	Accessory Power System (APS2/APS3)	System Control Unit (SCU)
				

Full electric modes w/ Series-ER – ***all proven in revenue service***

Stop/Start: Anti-idle; all electric accessory power
EV driving: limited engine off travel; geofencing
Arrive & Go: emissions-free bus stops
Depot Mode: zero emissions operation in & out of your depots

BAE Systems' Series power & propulsion systems have several technical advantages over transmission-based parallel architectures.

1. **Fuel and energy efficiency**. Electric motors are inherently more efficient than mechanical, gear-based transmissions. This difference is amplified in a transit bus duty cycle (ex. 12mph average speed, 5-10 stops per mile, 20-50% idle time). A transit bus is rarely at a sustained steady state operation; always changing speed, accelerating or decelerating. These constant changes allow BAE Systems' direct-drive electric motor and independent bearingless generator to capitalize on their superior energy efficiencies resulting in higher fuel and emissions savings.



2. **Mechanical complexity**. The Allison Transmission hybrid transmission drive unit, essentially an automatic transmission (wo/converter) plus 2 electric motors & clutch, is much more mechanically complex than the BAE Systems Series HDS200 motor/generator. All of the gears, bearings and clutches of the parallel transmission generate substantial pumping, lubrication, windage & friction losses. These losses are a small fraction or not present in the Series system. Parts count is also a good first order approximation of reliability; fewer parts, fewer things to go wrong. For example, BAE Systems' generator has a MDBUR of over 6M miles.
3. **Power electronics.** Designing and fielding high-integrity power electronics is a core competency at BAE Systems (eg. commercial/military aircraft engine controls). Allison Transmission's new eGen Flex system's WTI-260 propulsion inverter is manufactured by Curtiss-Wright, the same manufacturer of the often-plagued DPIM product line. The WTI-260 represents Allison Transmission's first attempt to field IGBT (Insulated gate bipolar transistor) technology. Since 2013, BAE Systems' PCS uses IGBTs and can be found on over 8,000 buses.
   Accessory power. BAE Systems has always provided organic accessory power systems (APS); from the 28V DC/DC converter to APS2 and APS3, and future Gen3 Modular APS (MAPS) featuring state-of-the-art SiC switching technology. Accessory power from BAE Systems has always been integrated with the propulsion system for maximum efficiency and reliability. Allison Transmission offers the iAPS Vanner accessory power system. iAPS has more junction connections, cabling and higher cooling requirements than BAE Systems' APS solutions, leading to increased maintenance and lower reliability.

BAE Systems		Allison Transmission
14,000	**Fielded systems**	**9,000**
✔	**Integrated system from one OEM**	✘
Series-ER (Electric Range)		**eGen Flex EV**
5,000	**Fielded systems**	0
500,000	**Revenue service EV mode miles**	0
MTA, MBTA, SFMTA, King County, TTC, London, Paris	**Deployed at peer agencies**	None
✔	**Proven integration with ITS providers**	✘

Get to zero

Getting transit operators to zero emissions, no matter where they are today.

Series-ER Spotlight
June 2020

BAE SYSTEMS

The Challenge: Get to Zero

Cities across North America are tasked with meeting national and/or local air quality targets – and are pushing forward targets to hit net zero emissions.
Low and No emission transport is the key to achieving this goal.

As government and business begin recovery from the impacts of COVID-19, sustainability and green growth will continue to be important.

- Cities may have to alter plans and timescales to reflect new challenges
- BAE Systems can help your city get to zero no matter where you are today
- We offer a range of electrification levels from near zero to full zero emissions, from no infrastructure to full infrastructure, from simple to more complex
- We need to maintain progress without backsliding for future generations

Introducing BAE Systems Hybrid and Electric Drive

- Our systems are in use on **over 12,000 electric** drive equipped buses across four continents, saving 300,000 tons of CO_2 emissions every year, equivalent to taking 47,000 cars off the road

- Our largest fleets are Paris, London, New York, Boston, Montreal, Toronto, Seattle and San Francisco – we help small fleets too

- We are a trusted partner to fleets and vehicle manufacturers across Europe and North America to ensure vehicle design and performance is optimal for the local environment

- We provide industry-leading support

BAE SYSTEMS

Choices of near and full zero: Series-ER spotlight

Near zero

REAL
Electric accessories

- First step towards zero emissions
- Proven hardware
- Significant maintenance savings

Series-E
Electric Hybrid

- Optimized thru-life costs
- Significant fuel savings and emissions reductions
- Engine Stop-Start capability

Series-ER
Electric Range Hybrid

- Significant zero emission capability
- Geofencing-enabled operation
- On-board charger
- Plug-in option available

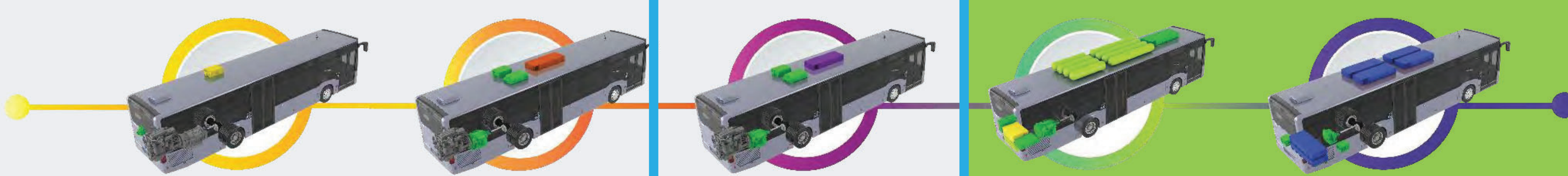
Full zero

Series-H
Fuel Cell Electric

- Full zero emission
- Hydrogen fueled
- Produces only pure water as exhaust
- 300+ mile range

Series-EV
Battery Electric

- Full zero emission
- Proven with 300 systems in service & 5 million zero emission miles
- Opportunity and depot charging



Series-ER introduction

Series Electric Range hybrid buses present a low cost ‘stepping stone’ in your transition to the long term goal of full electric.

- No charging infrastructure required
- Full ZE zone capability combined with no range restrictions
- Proven, quick and easy to scale
- Ideal for residential neighborhoods, schools, hospitals, city centers etc.
- Potential for future EV conversions

BAE SYSTEMS

How the ER technology works

- Buses using BAE Systems Series-ER technology automatically switch to full electric operation when entering zero emission (green) zones around residences, schools, hospitals, city centers, bus transit centers, etc

- Expands on basic engine anti idling (stop/start) capability to support EV operation
- Entering and exiting a stop (arrive and go)
- Inside of green zones using geo-fencing (electric range)

BAE SYSTEMS

Series-ER Engine off Options

Stop / Start

- **Anti idle - not EV driving**
- Uses internal logic to shut down engine based on vehicle speed
- Proven in more than one thousand buses worldwide with good results
- Works with 1 kWh Ultracap (40' Only) & 32 kWh Lithium Battery

Depot Drive (*ex PSTA, Nashville, Quebec*)

- **EV engine off driving – garages only**
- Uses either dash switch or third party GPS signal to trigger EV driving
- Short range EV operation (<=0.5 mi) per event
- 32 kWh Lithium Battery Required

Arrive & Go (*ex Boston, UK, EU*)

- **Limited EV driving**
- Expands on stop/start. Allows vehicle to pull in and out of stops in electric drive
- Proven in more than one thousand buses worldwide with good results
- Works with 1 kWh Ultracap (40' Only) & 32 kWh Lithium Battery

Green Zone (*ex San Francisco*)

- **EV engine off driving - anywhere**
- Uses third party GPS signal & preselected zones to trigger EV driving
    - Viriciti
    - NF CONNECT
- Up to 3 miles of EV driving per event
- Piloted in six cities with good results
- 32 kWh Lithium Battery Required

Arrive and Go Mode

- Theory of operation
  - Expands on engine stop/start (anti-idle) capability
  - Allows bus to pull into and out of stop in full electric drive
  - All accessories continue operation during engine off event

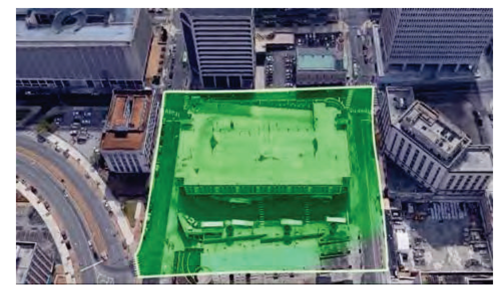
- Proven in revenue service
  - 1,000+ buses in UK, Europe and US
  - Boston Arrive & Go example
    - 254 buses delivered & on order
    - ~25% engine off time daily/bus
    - ~222,500 EV fleet miles per year

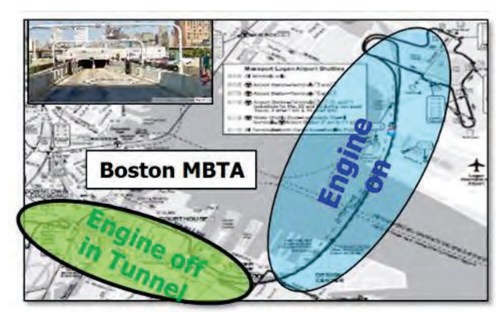
BAE SYSTEMS

Electric Range Mode

- Theory of operation
  - 1, 2, or 3 mile EV event setting options
  - Daily EV mileage varies by EV event selections
  - Recommend recovery zone of 1.5x the selected EV event range following each EV event
  - EV events managed by the hybrid system controller
  - Customer must furnish GPS via ITS provider or equivalent system

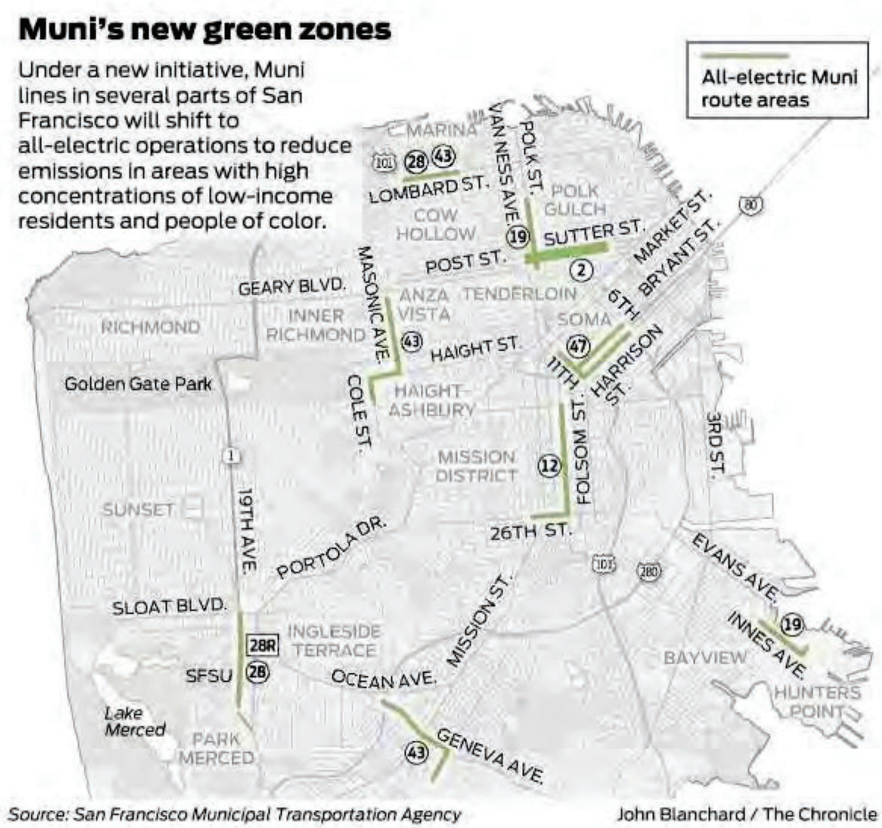
- Proven in revenue service
  - Used in more than 100 buses in North America and Europe and growing
  - Operational in San Francisco, Boston, Nashville, St Petersburg, Brighton, Dublin and more to come





BAE SYSTEMS

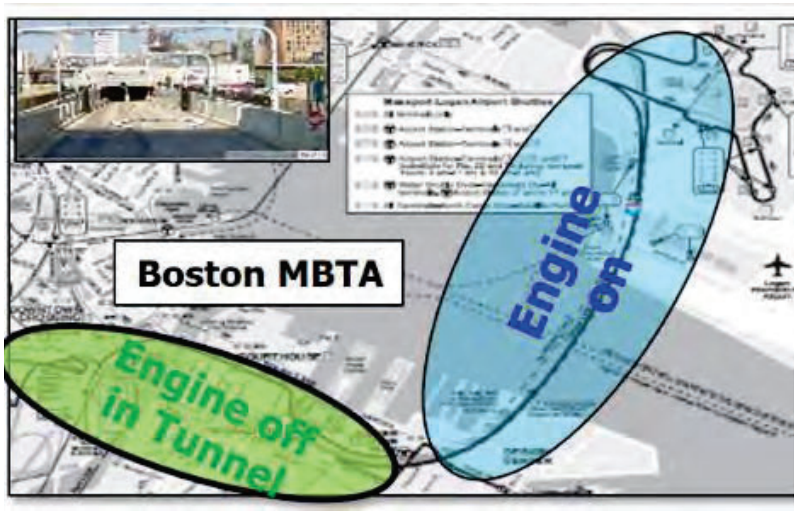
Case study: San Francisco



https://www.sfchronicle.com/bayarea/article/Muni-tries-to-tackle-environmental-justice-with-14484446.php

- Environmental justice initiative
- Reduce emissions in 9 low income neighbourhoods with measured emission hot spots
- 68 Series-ER equipped buses operate as part-time EV buses
  - Engine-off inside Green Zone
  - Triggered using geo-fencing
  - On board computer monitors battery life
  - ~131,000 EV miles per year
- Fleet and zone expansion planned for 2021

Case study: Boston



- MBTA using Series-ER on a 60′ bus for trial test in 2.4 mile Silver Line transit tunnel and on surface roads
- Services 3 different routes that all run through the same tunnel
- Alternate battery accommodates demand for high number of EV cycles per day (24+ times through the tunnel on Silver Line Route 2) for ~50% daily engine off operation
- ~48 EV miles per bus day and over 14,000 EV miles per bus year average over 12 month operation
- No grid charging required

BAE SYSTEMS

Case Study: Brighton (UK)

- In December 2019, over 30 Enviro400ERs were delivered into Brighton & Hove
- First buses in the UK that automatically switch to zero-emissions mode whenever they travel through controlled Ultra Low Emission (ULEZ) and Zero Emission Zones
- Proven benefits: **equivalent to 133,100 emissions-free miles inside zones each year**

Case Study: Dublin (IRE)

- In January 2020, NTA and Dublin Bus Ireland announced commitment to roll out **up to 600 Series-ER enabled vehicles over the next 5 years**
- Marking a key step to full electrification for the city
- These buses have **plug in capability**
- Intelligent charging that meets the European Clean Vehicle Directive

Proven Results

Locations (Delivered/On Order)	Series ER Buses (#)	EV Zones (#)	Estimated Daily EV Miles/Bus (mi)	Estimated Annual EV Miles/Fleet
Boston, MA (Arrive & Go)	254	n/a	3	222,504
Brighton, UK	30	24	15	132,276
San Francisco, CA	68	9	7	131,050
Nashville, TN	13	5	6	20,878
Quebec, CAN (depot mode)	92	1	0.6	16,118
Boston, MA (ER pilot)	1	1	48	14,016
Reading/Lancaster, PA	7	4	3	6,541
Binghamton, NY	3	3	6	5,344
St. Petersburg, FL (pilot)	1	5	8	2,336
Dublin, IRE	100	tba	tba	tba
Total	**569**	**52**		**551,062**

- ✓ Integrated on four OEM platforms and with multiple GPS providers
- ✓ Operational and/or pilot test in 10 cities on a variety of duty cycles
- ✓ Scaled to over 550 buses worldwide and growing
- ✓ Delivering over ½ million EV miles annually fleet wide

Lessons Learned

- The technology works & benefits are proven
  - Over 5 years experience & 4 OEMs
  - 10+ cities and 370+ buses worldwide
  - Various applications: tunnels, environmental justice, tourist districts, transit centers, other political considerations
  - Integrated with various GPS system providers
  - ½ million EV miles fleetwide today and growing
  - No external charging required
- Typical EV segments are short
  - Most customers running 1-2 mile EV zones
  - Allows more EV occurrences in multiple zones
  - Easier to distribute EV zones across entire city/area
  - Minimizes battery recovery time following EV and prevents engine from running harder/louder or longer to charge battery

BAE SYSTEMS

Lessons Learned

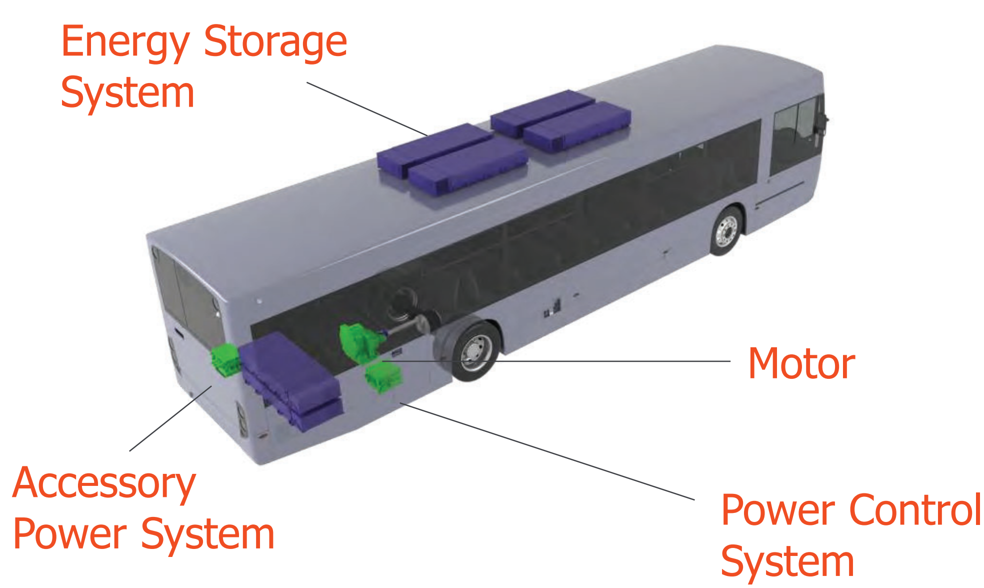
- Cold weather operation
  - Short EV segments minimize cabin temperature issues
  - Uses battery for EV driving rather than heating
  - Special considerations may be required to maintain driver comfort
- Scalability
  - Demonstrated ability to rapidly deploy capability across large number of buses easily
  - Compounding many short EV trips throughout day and across many buses leads to significant amount of annual EV operation
- Flexibility
  - Quantity and location of EV zones may adapt to suit changing operational, traffic/construction, and political needs
  - Fleet operators require ability to readily add, delete & alter EV zones

BAE SYSTEMS

We provide a full menu of low emission options

BAE Systems provides full electric systems

- Over 300 orders received to date from cities in France (e.g. Paris), Germany, Netherlands, Norway, and sales soon to be announced in North America
- Very positive energy consumption figures seen from buses in La Rochelle - significantly less than 1.0kWh/km
- EV Range increasing with new battery technologies



BAE Systems also has hydrogen fuel cell capability

Get to zero

Getting transit operators to zero emissions, no matter where they are today.

BAE SYSTEMS

MAJOR HYBRID SYSTEM COMPONENTS

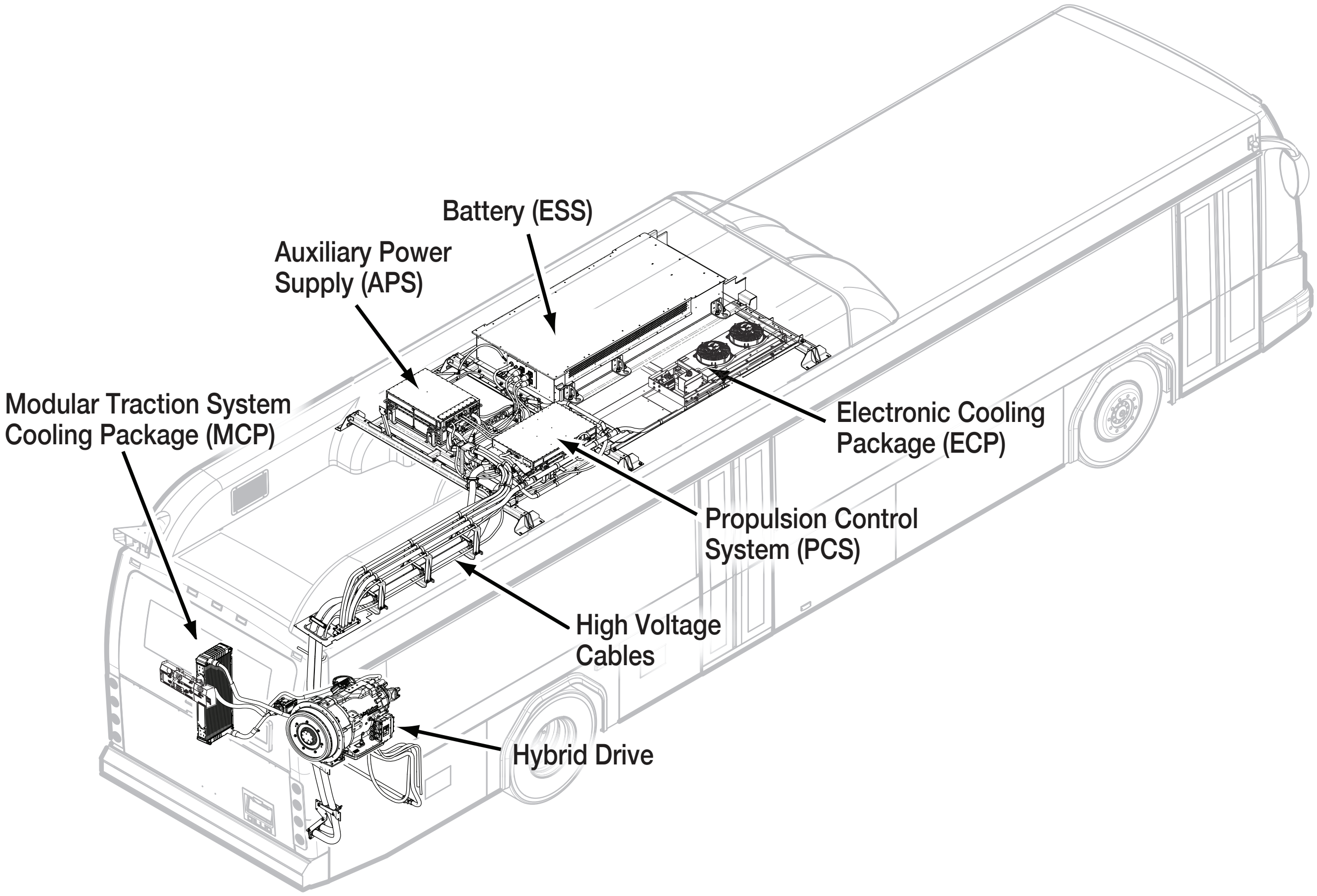


Figure 4-11, Hybrid Drive Components

Energy Storage System (ESS)

The energy storage system, located on the roof of the bus under aerodynamic covers, uses self-contained lithium-ion nano-phosphate battery modules. No periodic conditioning or maintenance is required. The central energy storage management system continually monitors state-of-charge, temperature, voltage, and other parameters of all individual modules to provide optimum service life. When the brake pedal is depressed, the SCU instructs the PCS to extract power from the motor, which slows the vehicle down and, in the process, captures a significant amount of the vehicle's kinetic energy, which is directed to the ESS. This process of capturing the vehicle's kinetic energy during braking is called regenerative braking.

Auxiliary Power Supply (APS)

The auxiliary power supply, located on the roof of the bus, is a 17 KW-600 VDC-to-28 VDC converter, commonly referred to as a DC/DC converter. During regenerative braking, the APS converts high voltage DC electricity generated by the hybrid drive to low voltage DC and 3-phase AC electricity and stores it in the ESS. This unit also provides 28 VDC output power to replace the belt driven alternator for use by vehicle accessory systems.

Modular Traction System Cooling Package (MCP)

The MCP provides cooling for the MTS. It is located on the chassis, integrated into the engine cooling module (see Figure 4-11).

Electronic Cooling Package (ECP)

The ECP is mounted on the roof (see Figure 4-12) and provides cooling for PCS and APS.

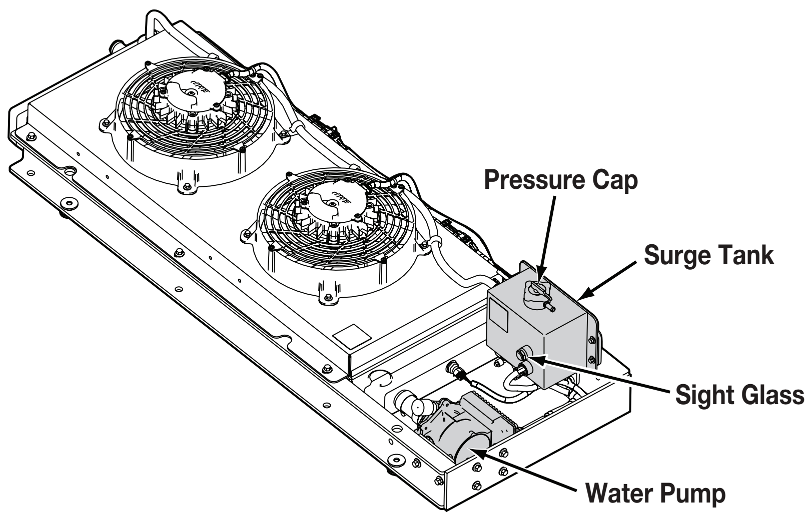


Figure 4-12, Electronic Cooling Package (ECP)

Propulsion Control System (PCS)

The PCS is the power processing and power management center for the entire hybrid drive propulsion system. The PCS accepts torque, speed, and directional commands from the SCU over dedicated 1-Mbit CAN bus as well as discrete sensor inputs from the traction motor and generator. It uses this information to provide optimal power to and from the traction motor and generator, regulate the high-voltage DC-Link and maintain the ESS state of charge. The PCS has the capability to monitor the system, customize performance, and provide diagnostic information. The hybrid drive system has a stand-alone electrically powered water/glycol cooling system for thermal management and control.

System Control Unit (SCU)

The SCU is located inside the bus in the curbside A/C duct and provides a system and driver interface to the entire vehicle (accelerator pedal, brake pedal, warning lights, etc.) and determines the amount of torque to apply to the rear axle and the amount of regenerative braking to apply. The SCU also monitors the system for failure conditions and can shut down the system.

WARNING

In the event of a fire: Wear full protective clothing and a self-contained breathing apparatus (SCBA) on positive pressure, and extinguish fires with an appropriate Class ABC type extinguisher on fires when ESS cells are intact. If cells are ruptured, use a fire extinguisher indicated under Facility - ESS, Li-Ion. Class C fire Extinguishers should be used to extinguish electrical fires.

WARNING

If contents of an opened lithium-ion battery are inhaled, move any victim to fresh air. Obtain medical advice.

- **Eye Contact: Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for at least 30 minutes while holding the eyelids open. Quickly transport victim to an emergency care facility.**
- **Skin Contact: Immediately flush with lukewarm, gently flowing water for at least 30 minutes.**
- **Inhalation: Have victim rinse mouth thoroughly with water. DO NOT INDUCE VOMITING. Have victim rinse mouth with water again. Quickly transport victim to an emergency care facility.**

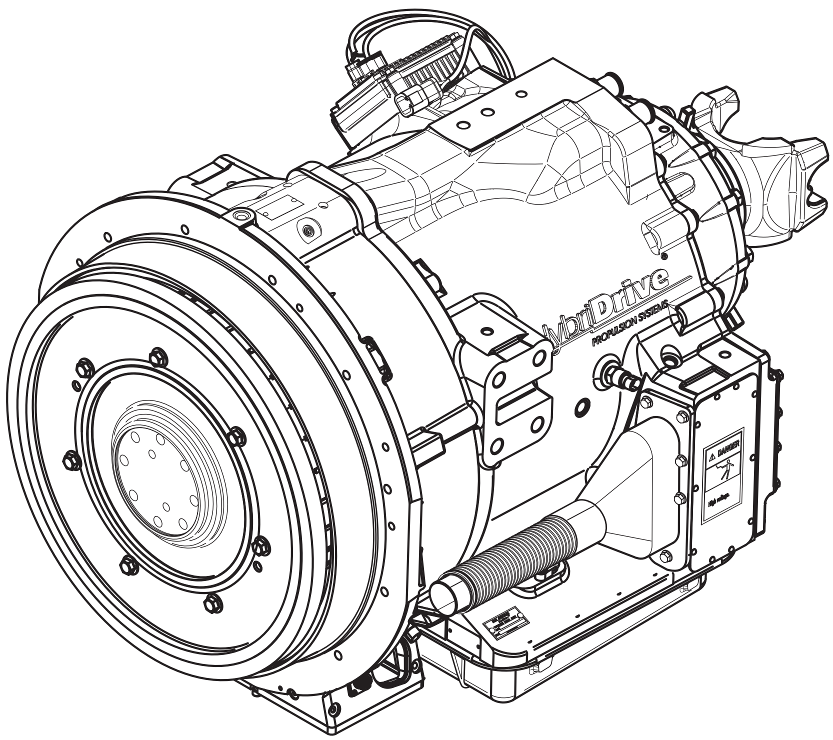


Figure 4-13, BAE Hybrid Drive

Hybrid Drive

The hybrid drive consists of the ISG and the ACTM. The ACTM provides forward and reverse output using an AC induction motor with a fixed-ratio speed reduction gear box. The ACTM also acts as a generator during regenerative braking. The ISG is the only component that is connected to the engine crankshaft. The engine spins the ISG stator to generate electricity, but is not used during regenerative braking. The ISG also acts as the engine starter. In colder climates (below –13°F), the engine can also be fitted with a 24V starter at the engine flywheel housing. The hybrid battery pack may not provide enough power in extreme cold, in which case the 24V starter and bus batteries are used. The hybrid control system determines which starter to use when the start button is pressed. The hybrid control system also periodically starts the engine using the 24V starter to keep that starter in working order.

When the ISG and ACTM are mated, they look like a traditional transmission. See Figure 4-13.

DESCRIPTION OF REGENERATIVE BRAKING SYSTEM

The regenerative braking function in the BAE Systems HybriDrive® propulsion system is provided by the traction motor (ACTM). Energy is taken from the ACTM and flowed back into the energy storage system (ESS) until it approaches an upper operating state of charge. Upon reaching the upper state of charge, the remaining energy is blended into the generator (ISG) on the engine and, in some cases, an engine brake that accepts the additional regenerative energy into the engine. The hybrid regenerative braking performs similarly to a hydraulic retarder in a conventional vehicle. The regenerative braking level is determined by both the throttle in the fully lifted position (coasting regen) and the brake pedal (braking regen). There is a standard set of regenerative braking control settings that allow for different levels of regenerative braking torque. It should be noted that the foundation air brake system installed on the vehicle is unmodified by the addition of the hybrid propulsion system.

Regenerative Braking and Savings

When decelerating or stopping, the system converts the vehicle's kinetic energy to stored electric energy. In effect, the motor becomes a generator. Regenerative braking saves on brake maintenance costs.

The GILLIG Low Floor utilizes the Meritor FH-946 deep drop front-non-drive steer axle as our standard front axle. The axle includes suspension rod attachment points which are integral to the I-beam for simplified bracket design and greater bracket flexibility with Easy Steer king pin bushings and tapered roller thrust which permit easier steering.

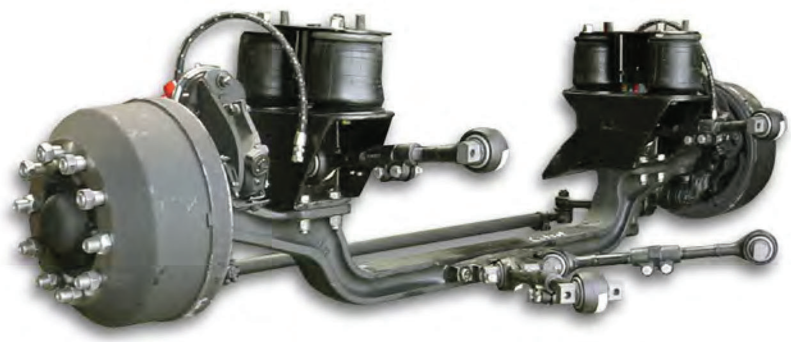


Figure 1: Meritor FH-946 Deep Drop Front Axle w/Drum Brakes

GILLIG Low Floor buses utilize a hydraulically assisted power steering system consisting of the steering wheel, steering column and shaft assembly, power steering gear, pitman arm, drag link, and tie rod. A gear type hydraulic pump, reservoir, and interconnecting system lines and hoses are also used in the system.

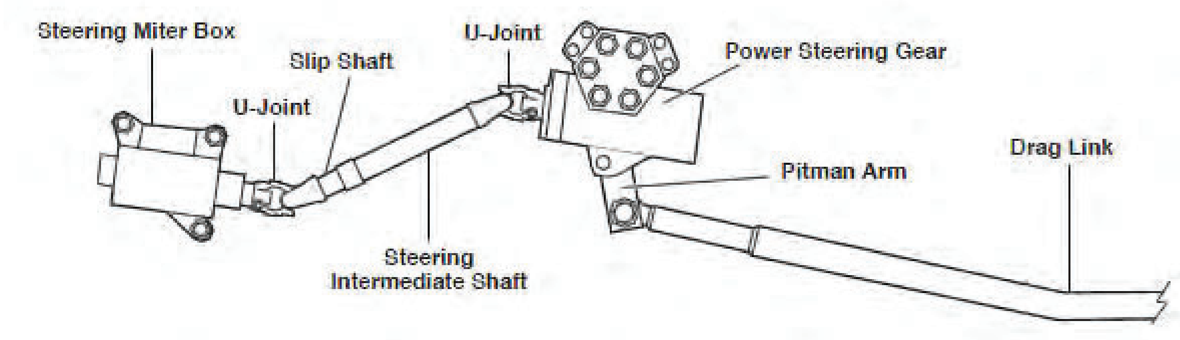


Figure 2: Steering Box Components

The steering column extends through the floor and, using a universal joint, attaches directly to the input shaft of the steering gear. The upper end of the steering shaft has an adjustable (Tilt /Telescopic) steering column and steering wheel attached.

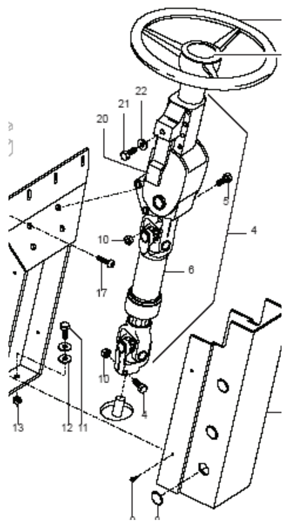


Figure 3: Tilt/Telescopic Steering Column and Wheel

The hydraulically assisted steering gear assembly is mounted on a bracket attached between the forward two outriggers on the street side of the chassis, directly beneath the driver's platform.

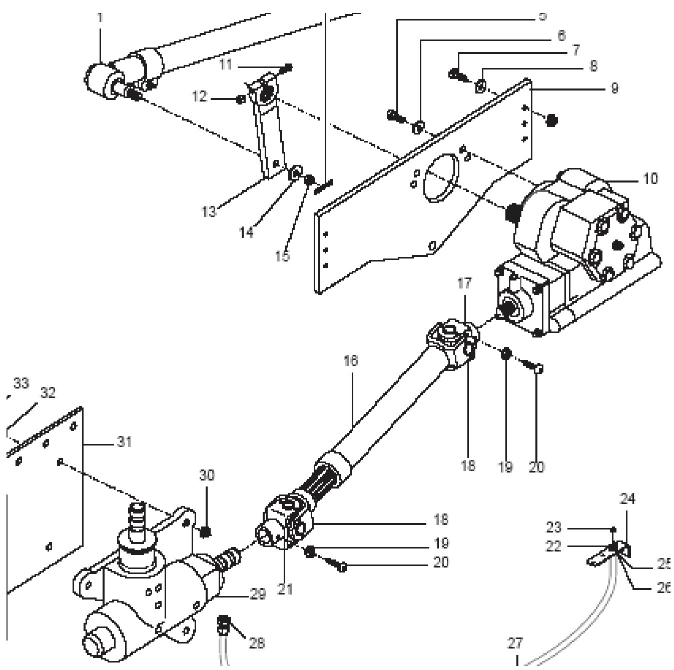


Figure 4: Miterbox/Steering Shaft/Steering Gear Box

The steering gear assembly is connects to the pitman arm, drag link, tie rods and steering knuckles on each end of the axle that turns the wheels.

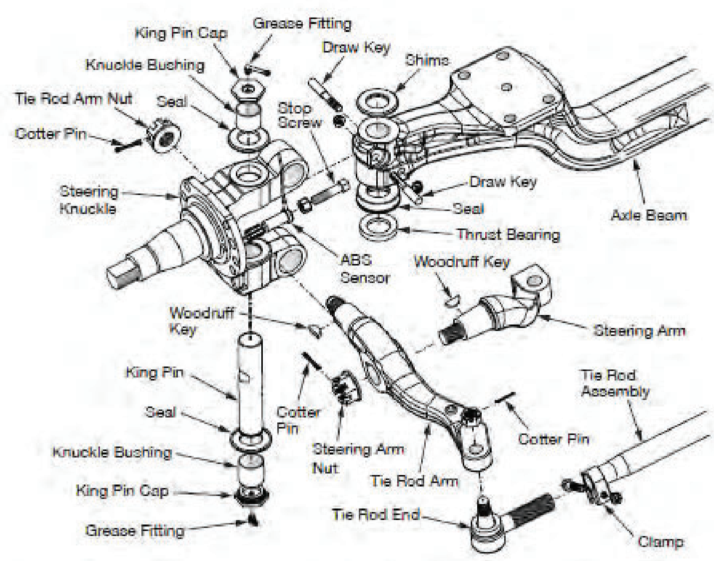


Figure 5: Steering Knuckle Assembly

GILLIG utilizes the TRW Model TAS65 power steering box. The frame-mounted steering gear is a recirculating ball type and contains an integral power cylinder and control valves. A hydraulic supply line connects the steering gear to the hydraulic pump and return line routes fluid form the steering gear back to the reservoir. The steering gear hydraulic system is equipped with two poppet valves, on at each end of the rack piston, to allow pressure relief when the steered wheel approaches the axle stop. The tripped valve reduces pressure in the gearbox and thus helps to reduce heat generated by the pump and prolongs the service life of the gear and pump.

REAR AXLE

GILLIG utilizes the Meritor 71000 series single reduction axle. The differential assembly, drive pinion gear, and pinion cage assembly are mounted in the differential carrier. By removing the axle shafts, the carrier can be removed for inspection, adjustment or replacement without having to remove the axle housing from the vehicle.

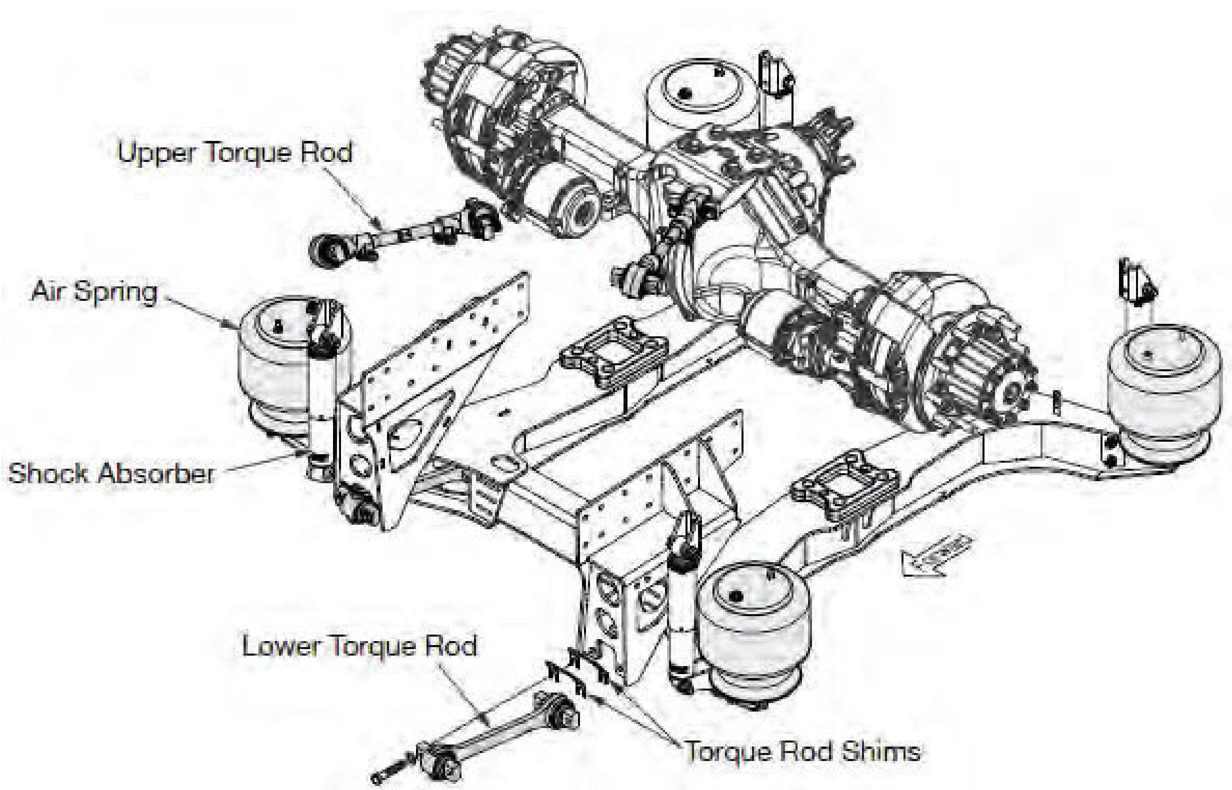
The differential is a conventional four-pinion type carried in a two-piece case mounted in tapered roller bearings. The drive (ring) gear is bolted to the flanged half of the differential case. The ring and pinion gears are manufactured in matched, lapped sets and should always be installed as such to assure satisfactory operation. Thrust washers are used between the side gears and differential case and also between the differential pinion gears and case. The case halves are secured by cap screws and hardened washers.

The differential is supported in tapered roller bearings which accept both thrust and radial loads. The bearings are mounted in supports in the carrier, while thrust loads are born by the adjusting rings threaded into the carrier supports and bearing caps.

The axle housing is a one-piece design with the differential bowl centered. The housing has outer end tubes which are threaded to accept wheel bearing adjusting nuts. The axle shafts are the same for left or right sides. The flange at the outer end is attached to the hub by studs, tapered dowels, and nuts. The inner end is splined to the differential side gears.

REAR SUSPENSION

The Hendrickson 4-bag rear suspension has an H-frame construction, which supports four air springs. The H-frame is a multi-piece welded assembly which supports the axle via mounting pads on each side. The air springs rest on mounting plates at each corner of the H-frame. The suspension is connected to the chassis frame by four torque rods. The air springs and shock absorbers form the other connecting points of the suspension and frame. Two height control valves automatically maintain correct ride height by controlling air pressure in the air springs. Two upper and two lower torque rods are used to position the axle. Each of these rods has rubber bushings. Four telescoping-type shock absorbers are installed.



Hendrickson Rear Suspension

GILLIG utilizes Firestone air springs. Air springs provide passengers with a smooth and comfortable ride. The opening at the bottom of the air spring is smaller than that at the top. Each end of the flexible member (the air bag) has a reinforced bead which forms an air-tight seal when the spring is inflated. When in operation, the air bag folds over the piston at the bottom of the suspension so that the characteristic lobe shape is produced. There are rubber stops inside the air spring assembly to support the bus if there is an air spring failure and to prevent damage to the bus understructure from large suspension deflections.

LEVELING VALVES

The air suspension height control valves (also known as "leveling valves") automatically control the air pressure in the air springs to maintain the proper ride height. GILLIG utilizes Barksdale valves. As the vehicle is loaded, the air springs will compress slightly. The height control valve actuating arm will be moved up from the neutral position to the fill position. This will allow air from the air tanks to flow into the air springs, increasing the pressure in the springs, bringing the air spring back to the proper height. When the vehicle is unloaded, the air springs will slightly increase in length and the height control valve actuating arm will be moved from the neutral position to the exhaust position. This will exhaust some of the air in the air spring until enough air has been exhausted to bring the air spring back to the proper height. The height control valves do not "level" the bus. They only control the air spring height. The front suspension has one height control valve and the rear has two. The two rear suspension height control valves keep the bus level to the road (controls leaning) while the single front valve only maintains the proper air spring height at the front suspension air springs.

The LOW FLOOR twenty-nine foot vehicle has completed testing at Altoona with the suspension system installed as described below.

Front Suspension

The front suspension system incorporates four (4) air springs controlled by a single automatic leveling valve. Two (2) Koni shocks are provided.

The front suspension includes four (4) adjustable radius rods arranged so they locate the front axle in both X and Y planes. The rods also provide the means for setting caster angle.

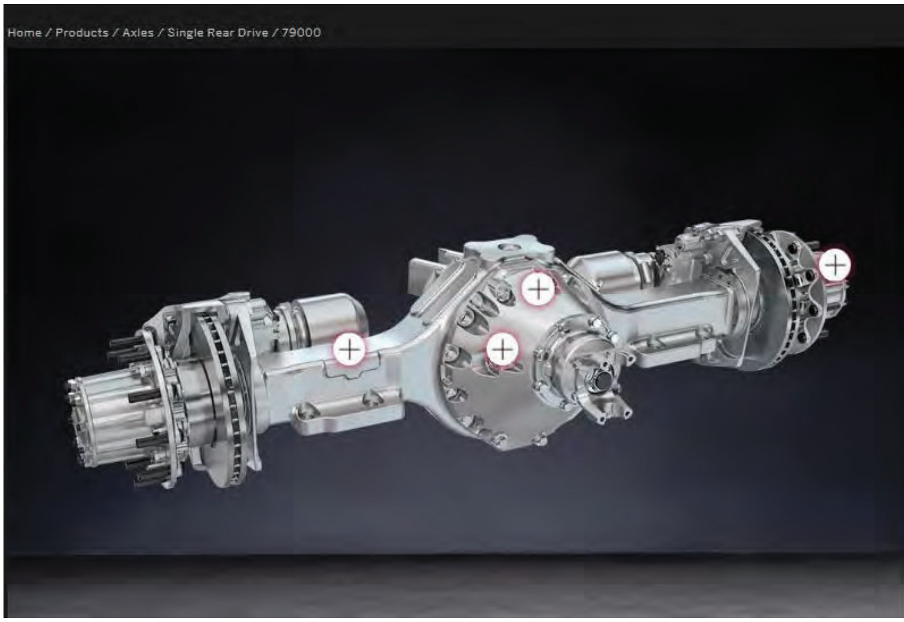
The front suspension bellows have a composite base and an external bump stop. The bump stop is easily replaceable.

Rear Suspension

The rear suspension is manufactured by Hendrickson, a rear trailing arm type air suspension system. The two air springs are located aft of the axle centerline and are located directly under the main frame rails. Two Koni shock absorbers are required.

The rear suspension is located in the X and Y planes by means of two radius rods with longitudinal and lateral orientations. The rod ends have rubber bushings.

Two automatic leveling valves, one on each side of the rear suspension, are provided for the air springs. The valve is located so that it will preclude "flipping over" or reversal of valve action. Adjustment of the valve is accomplished by positioning a vertical link in a slotted bracket.



79,000™ SERIES SINGLE REAR DRIVE AXLES

OVERVIEW SPECIFICATIONS

79,000™ Series
Single Rear Drive Axles

The 79,000™ series axle is the next generation single reduction drive axle for 35-60ft. transit bus applications and motorcoach vehicles. Performance engineered, it's the perfect choice for high stop-and-start duty cycles, demanding regenerative loads and periodic axle-overload applications.

FEATURES & BENEFITS

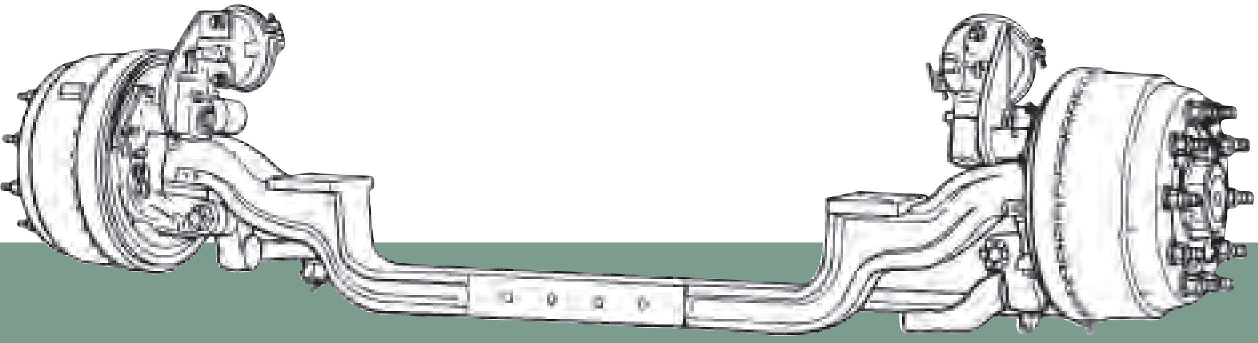
- 28,660 pound gross axle weight rating offers increased capacity for demanding transit bus and motor coach applications
- More economical, efficient and a lower weight than double reduction axles
- One-piece cast iron housing with integral suspension bracket pads and "bolt-on" torque rod brackets for extra strength and durability
- Uses the innovative and futuristic MS-197™ carrier featuring the most power dense gearing and robust bearings for handling the demanding duty cycle loads of transit/coach operations
- Bolted differential case and ring gear for easier and more efficient assembly and service
- Quiet Ride gearing delivers a more relaxing ride experience
- Industry-leading Cast Plus™ 16.5" x 8.625" S-cam™ brakes or EX+ H™ air disc brakes come standard, with optional 14.5" x 10" "W" Series cam
- 5-Year/Unlimited-Mile warranty based on application approval
- Robustness of the gearing and the carrier itself makes this product ideal for not just the drivetrains of today - diesel, CNG and hybrid-electric - but also the drivetrains of the future as more emphasis is placed on all-electric vehicles

SPECIFICATIONS

GAWR Ratings	Ratios	Brakes & Sizes Inches (mm)	Hubs & Drums Bolt Circle Diameter Inches (mm)
28,660 (13)	4.10, 4.30, 4.89, 5.13, 5.38, 5.63, 6.14	16.5 x 8.625 (419 x 219) Cast Plus (Std.) 14.5 x 10 "W" Series (368 x 254) (Opt.) EX+H Air Disc	10-Stud 11.25 B.C. (286) "W" 14.5 x 10 (368 x 254) Brake (Hub & Stud Pilot) 10-Stud 11.25 B.C. (286) Cast Plus 16.5 x 8.625 (419 x 219) Brake (Hub & Stud Pilot) 10-Stud 13.19 B.C. (335) Cast Plus 16.5 x 8.625 (419 x 219) Brake (Hub Pilot Only)

Deep Drop Front Non-Drive Steer Axle

FH-946



Product Summary

Meritor's Easy Steer™ FH-946 front axle responds to the transit bus industry trend toward low-floor bus designs by allowing the bus floor to drop up to 20" (508mm) below conventional bus designs.

With conventional "high-floor" transit buses, the floor height must exceed 30" (762mm) in order to accommodate the necessary undercarriage components. With this design, a three-step entry into the front of the bus is required.

The deep beam drop of the FH-946 front axle allows for the floor to drop closer to the ground, therefore eliminating the need for steps and providing for easier passenger accessibility. The axle also incorporates wide centers between the air bag pads to maximize aisle width.

When the FH-946 is used in conjunction with Meritor's RC-26-720 inverted portal drive axle, a virtually flat low bus floor can be achieved.

The FH-946 has many of the design features that have been proven in Meritor axles for high floor buses for many years. Optional wheel end ABS preparation with tone ring and sensor is also available.

Meritor Cast Plus™ brakes offer the added durability and reliability that coaches demand. The brake consists of a single, heavy-duty casting rather than multiple stampings welded together. In addition, the Cast Plus shoe table is compatible with Meritor's Q Plus™ extended life brake linings. (Refer to TP-96106 for more information).

Features | Benefits

Features	Benefits
King pin seals	Seal out contaminants; provide an improved lubrication system
Double draw keys	Hold front axle king pins firmly in place; two keys provide more durable service and longer life
Large diameter king pin	Provides greater durability and longer life
Deep drop beam/wide spring centers	Permits floor heights as low as 14 - 15" (356-381mm); maximizes aisle width for easier access
I-Beam construction	Proven durability in coach application; maintenance practices same as current axles
Suspension bracket flexibility	Suspension rod attachment points integral to beam to simplify bracket design; custom design brackets available
Easy Steer™ king pin bushings Tapered roller thrust bearing	Permit easier steering
Up to 51 degree turn angle	Improves maneuverability
Cast Plus™ Brakes: Cast shoes	Excellent dimensional integrity in service; reusable
Camshafts hardened and chrome plated	Superior resistance to damage from contamination and moisture
Chrome plated anchor pins with lubrication fittings	Improve wear resistance and resist moisture damage
Bronze camshaft bushings	Better resistance to contamination
3X drums	Extra material to permit turning up to three times before discarding drum
Uses Meritor Q Plus linings	27% thicker for extended mileage between relines; added durability

Specifications: FH-946

GAWR RATING* POUNDS (kg)	TRACK INCHES (mm)	OVERALL INCHES (mm)	BRAKES & SIZES INCHES (mm)	HUBS & DRUMS BOLT CIRCLE DIAMETER INCHES (mm)	PAD CENTER INCHES (mm)	AXLE BEAM DROP INCHES (mm)	TURN ANGLE
16,000 (7264)	85.96 (2184)	102 (2591)	16.5 x 6 Cast Plus (419 x 152)	10 Stud-11.25 (286) 10 Stud-13.19 (335) Hub Pilot	49.82 (1265)	8.0 (203)	51 Degree

***Permitted use of axles and components, including capacity ratings where stated, vary with application and service. Applications should be approved by Meritor Specialty Products and Brake Engineering Departments. Approved ratings may be higher or lower than indicated above, dependent upon engineering review.**

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We work for you.

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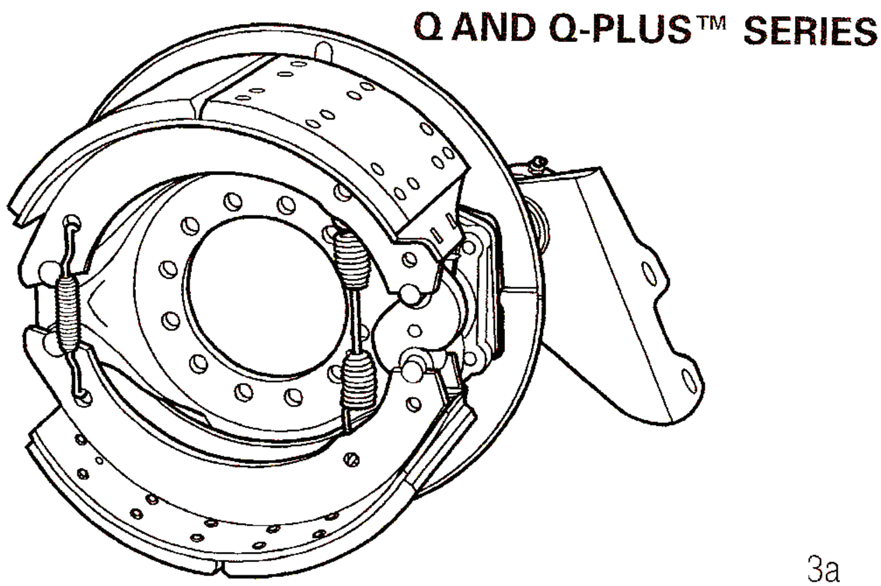
Revised 12-99
TP-96113 (47865/11900)

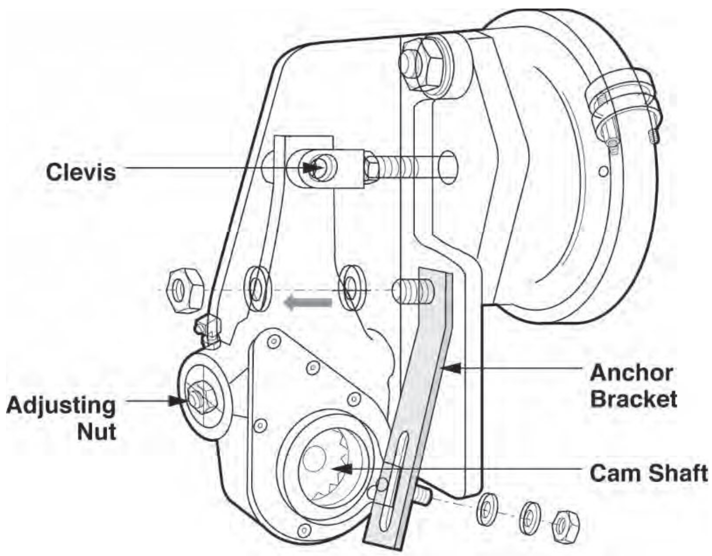
GILLIG uses an industry standard air brake system consisting of the Wabco air compressor, SKF High Capacity Turbo-2000 air dryer, dedicated air brake circuits, and **Meritor S-cam brakes** with Bendix front brake chambers and **Haldex automatic slack adjusters**. **The system and components are certified to FMVSS 121 standards.** All plumbing and hoses comply with industry, APTA standard procurement guidelines, and FMVSS standards for sizes, fittings, color code, etc.

The front brakes on the 35’ and 40’ bus are 6" wide x 16.5" in diameter and the rear brakes are 10" wide x 14.5" in diameter. The front brakes on the 29’ bus are 6" wide x 15" in diameter and the rear brakes are 7" wide x 16.5" in diameter The Rockwell certified non-asbestos lining blocks are bolted or riveted to the shoe tables. Actuation is by S-cam operated internally expanding shoes.



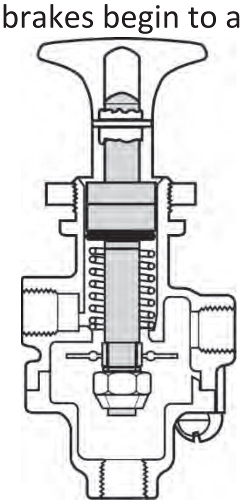
GILLIG buses are equipped with safety actuators, or spring brake chambers, capable of bringing the fully loaded coach to a stop from a speed of twenty miles per hour (20mph) at a deceleration rate equivalent to a stop within sixty feet (60’).

Brake air system timing is balanced to provide controlled stopping within FMVSS 121 requirements.

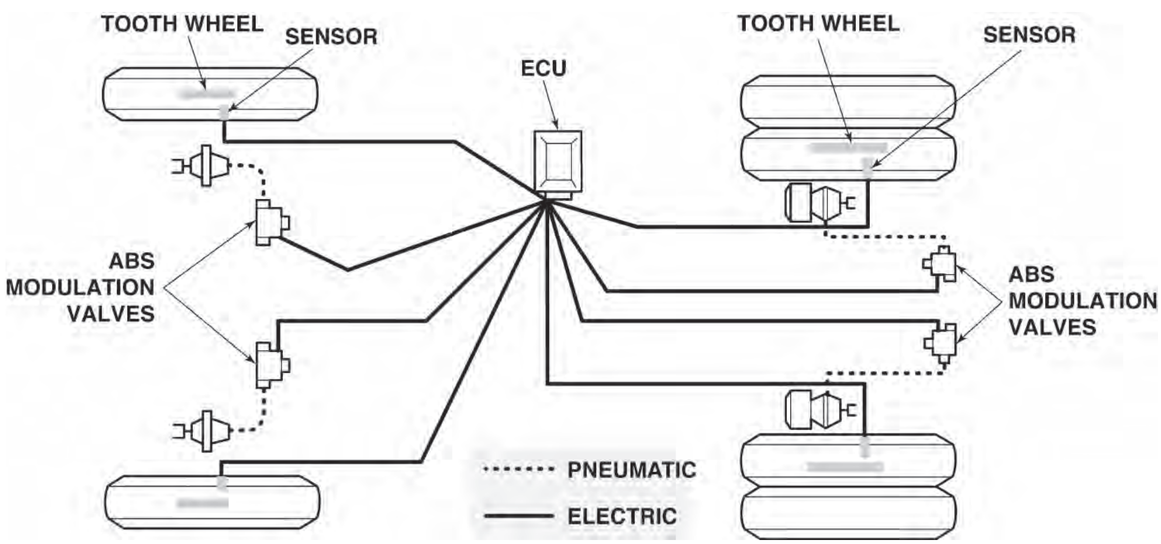


Automatic Slack Adjuster

The parking/emergency brake is located to the left of the driver and is operated by pulling up on the knob to set the brake. This action activates a pressure switch that illuminates a lamp on the driver’s indicator lamp to notify the driver that the parking brake has been set. Activation of the parking/emergency brake activates the rear spring brakes. If air is lost to the brake system the spring brakes begin to apply at 70 psi.



GILLIG provides an anti-lock braking system (ABS) provided by Wabco. The ABS system monitors and controls wheel speed during braking. If a wheel starts to lock up during braking, the ABS will reduce air pressure to that wheel's brake to keep all wheels turning at the same speed. When the wheel speed enters the stable region again, the air pressure automatically increases.



Anti-Lock Braking System

AUTOMATIC TRACTION CONTROL

Optional Automatic Traction Control (ATC) is available on all GILLIG Low Floor models. ATC helps improve traction in low traction road conditions and reduces the potential of control loss caused by excessive wheel spin during acceleration or in curves.

ATC works automatically in two different ways:

1. When one drive wheel is spinning at a different speed than the other, ATC momentarily applies the brake until traction is regained
2. When both drive wheels are spinning on a port-traction surface, ATC automatically reduces engine power to attain optimum tire-to-road traction.

ATC automatically turns on and off; driver input is not required to turn this feature on.

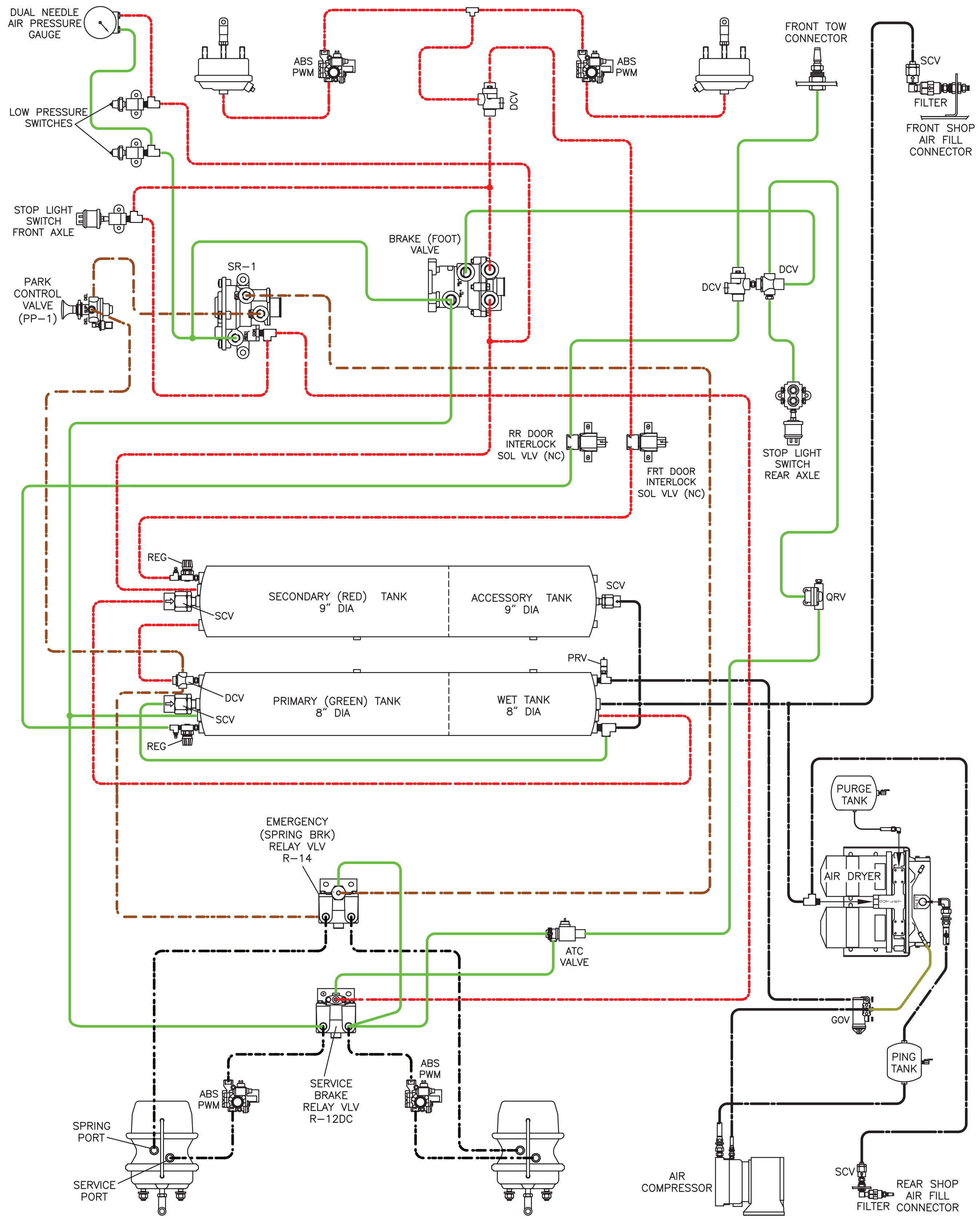


Figure 6-1, Air Supply and Brake System

A driver-actuated kneeling device lowers the bus during the loading or unloading of passengers to a floor height of twelve inches (12”) measured at the longitudinal centerline of the front door. Brake and throttle interlock will prevent movement when the bus is kneeled. The bus is capable of kneeling in a minimum of 1.5 seconds and a maximum of 2.5 seconds from the time the control is actuated. After kneeling the bus will rise within two (2) seconds to a height permitting the bus to resume service and will rise to the correct operating height within five (5) seconds. During the lowering and raising operation the maximum acceleration will not exceed 0.2g and the jerk will not exceed 0.3g per second, measured on the front door step tread. An indicator mounted on the instrument panel will be illuminated during the kneeling operation and will remain illuminated until the bus is raised to a height adequate for safe street travel.

The front suspension kneeling system allows the driver, when the bus is stopped, to override the air suspension height control system and kneel (or lower) the front air suspension. Kneeling the bus reduces the front step height and reduces the wheelchair ramp angle. Reducing the step height or ramp angle makes access into the bus easier for passengers in wheelchairs. The kneeling system allows lowering the front suspension and holding it at the lowered height in any position from normal ride height to fully lowered. To raise the bus back to normal ride height quickly, the kneeling system includes a fast fill feature. This will raise the front suspension back from fully lowered to normal ride height in 3-5 seconds. If required to facilitate the wheelchair ramp deployment, the kneeling system can also be used to over raise the front suspension to provide a front suspension height above the normal ride height.

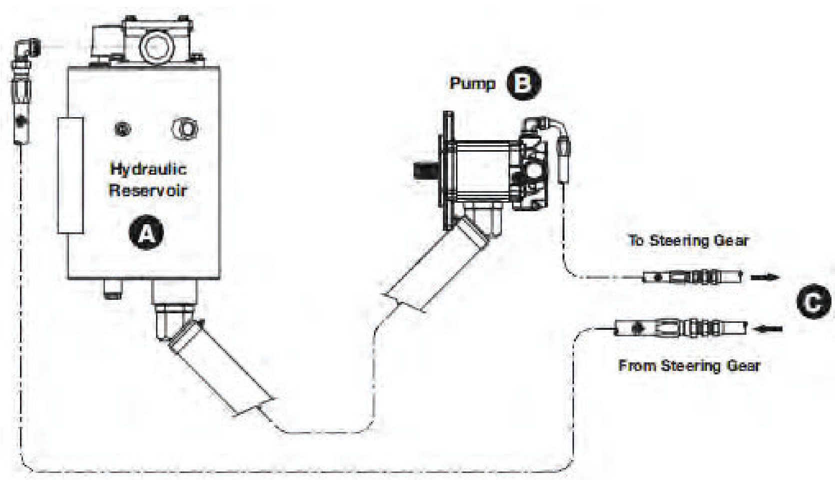
The KNEEL switch on the dash or driver’s console is a three position, self centering toggle switch. When the driver holds the switch in the KNEEL position, the kneeling system will block the air flow from the suspension height control valve and exhaust the air in the front suspension air bags. The kneeling system will continue to exhaust the air pressure as long as the KNEEL switch is held in the KNEEL position. When the driver stops holding the toggle switch in the KNEEL position, the switch is spring loaded to return to the center (OFF) position. When the switch returns to the center position, the kneeling system will stop exhausting air from the air bags, but the hold function will remain engaged to prevent the air bags from refilling with air. This holds the bus in the kneeled or lowered position.

The Low Floor front suspension kneeling system consists of a kneeling valve assembly which contains five air solenoid valves:

- Hold/HCV solenoid valve. When energized, the hold solenoid blocks airflow from the height control valve (HCV). This is necessary when kneeled to prevent the height control valve from refilling the suspension air bags.
- Kneel or exhaust solenoid. This solenoid, when energized, exhausts the air pressure in the suspension air bags, which lowers the front suspension.
- Raise or fast fill solenoid. This solenoid, when energized, will take air directly from the accessory air tank and deliver air pressure to the air bags. The raise solenoid is supplied by a large (1/2" diameter) air line and is a high-flow-rate valve to quickly raise the suspension back to normal ride height. A single check valve is placed in the raise solenoid air line to prevent airflow back from the air bags into the air tank if the raise feature is engaged with low air tank air pressure.
- Bag S (Streetside) and Bag C (Curbside) solenoids. The streetside and curbside air bag circuits are connected by small diameter orifices in the kneeling valve assembly. This restricted air flow keeps more pressure in the bags during cornering, which reduces body sway. Normally, air would move to or from the air bags through these orifices when the kneel or raise function is used. However, the bus would kneel or raise very slowly due to the restricted air flow. Instead, both Bag S (Streetside) and Bag C (Curbside) solenoids are activated when the kneel or raise feature is used. These solenoids open larger diameter paths to the air supply and allow the air bags to inflate or deflate quickly.

The hydraulic system furnishes hydraulic pressure to the steering gear to steer the front wheels. The system consists of a fluid reservoir, pump, steering gear and associated hoses and pipes. The hydraulic pump is electrically driven

Hydraulic fluid is stored in the reservoir and provides constant flow to the steering gear at variable pressure. Fluid leaving the steering gear is returned directly to the reservoir.



The hydraulic pump provides hydraulic pressure to the power steering gear. The hydraulic pump mounts on, and is driven from, the rear of the air compressor.

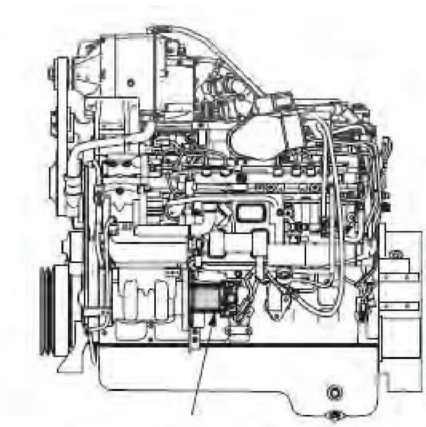


Figure 8-2. Hydraulic Pump Location

The reservoir is mounted in the right rear corner of the bus, in the engine compartment. The drop-in filter element keeps foreign matter and dirt from entering the pump and the steering gear. The fluid in the hydraulic system is selected to accomplish all of the various demands placed on it by the system performance parameters.

GILLIG Low Floor buses utilize a hydraulically assisted power steering system consisting of the steering wheel, steering column and shaft assembly, steering gear, pitman arm, drag link, and tie rod. An electric hydraulic pump, reservoir, and interconnecting hydraulic lines and hoses are also used in the system.

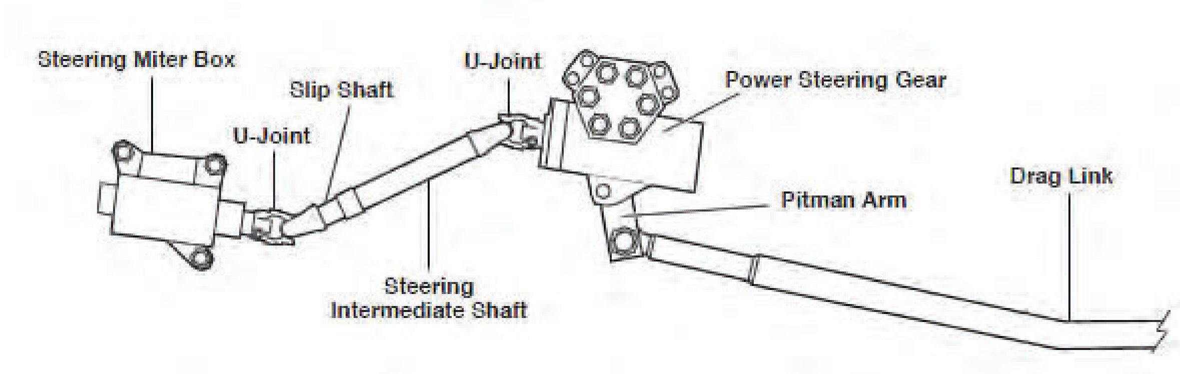


Figure 1: Steering Box Components

Steering turning action is transferred by the upper and lower steering shafts, enclosed within the steering column, to a miter box below the floor of the driver's area. The steering column is adjustable in two directions – up and down and fore and aft. The steering wheel is a three-spoke type, constructed of plastic resin over a steel framework. The horn button is mounted in the center of the wheel. An intermediate steering shaft connects the miter box to the steering gear.

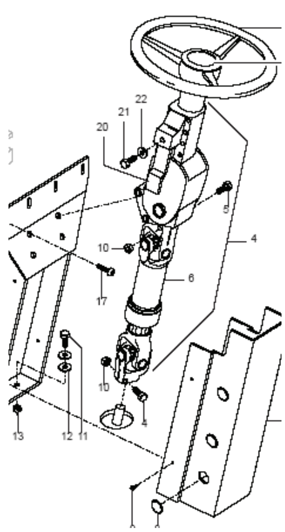


Figure 2: Tilt/Telescopic Steering Column and Wheel

The hydraulically assisted steering gear assembly is mounted on a bracket attached between the forward two outriggers on the street side of the chassis, directly beneath the driver's platform.

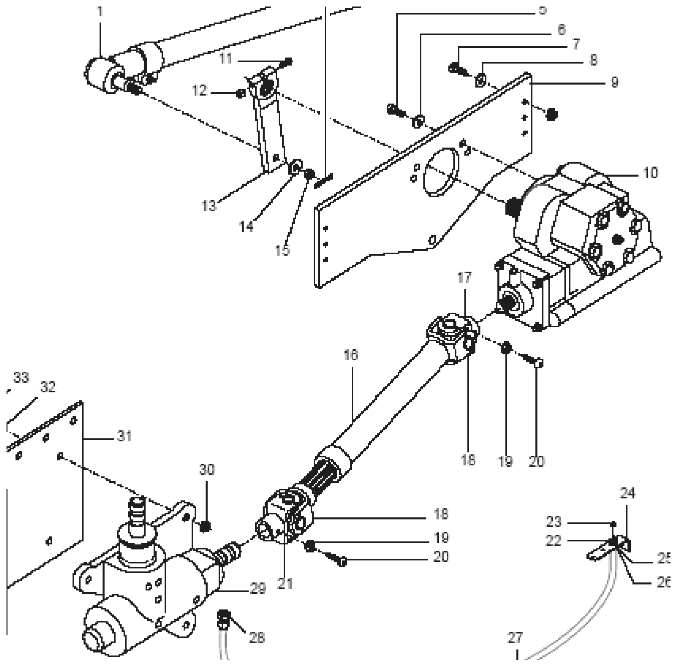


Figure 3: Miterbox/Steering Shaft/Steering Gear Box

The left steering arm and the left and right tie rod arms are secured to the steering knuckles at one end and to a drag link or tie rod at the other. The arms are retained with a key in the steering knuckle in the fixed angular position necessary for proper steering.

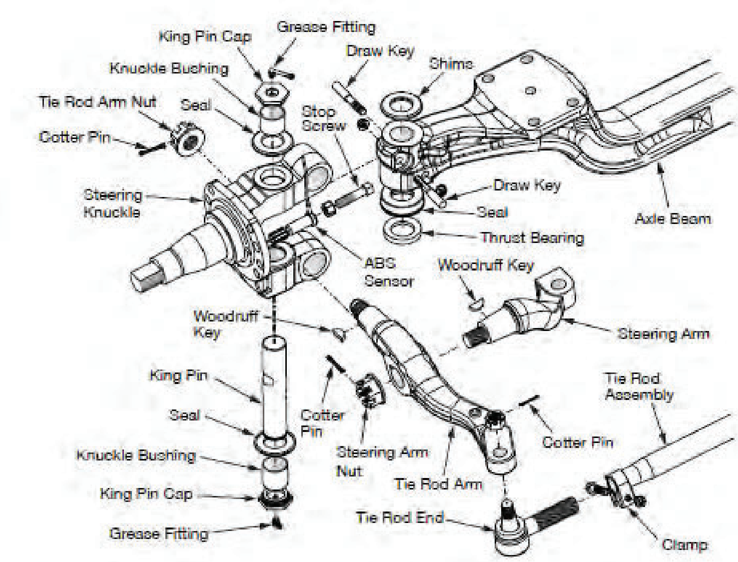


Figure 4: Steering Knuckle Assembly

GILLIG utilizes the TRW steering gear box. The frame-mounted steering gear is a recirculating ball type and contains an integral power cylinder and control valves. A hydraulic supply line connects the steering gear to the electrically-driven hydraulic pump which pulls from the reservoir and return line routes fluid form the steering gear back to the reservoir. The hydraulic steering gear system is equipped with two poppet valves, on at each end of the rack piston, to allow pressure relief when the steered wheel approaches the axle stop. When the poppet valves are tripped, pressure is reduced in the steering gear and, thus, helps to reduce heat generated by the pump and prolongs the service life of the pump.

AIR DRYERS

Dual Turbo-2000

Not just heavy duty ... double duty!

SKF dual air dryers are designed to perform where conventional, single canister air dryers cannot adequately meet air demands. And now with two dual air dryer options, SKF can meet the increased air demands of today's transit and fleet vehicles.

Complementing the success of the Dual Turbo-2000, the SKF High Capacity (H.C.) Dual Turbo-2000 air dryer is ideal for large compressor output applications and is available in 12V 75W (6.6 amps) and 24V 75W (3.2 amps) options. Additionally, it can withstand compressor air flow output of up to 80 scfm and up to 40 percent compressor duty cycle – the standard Dual Turbo-2000 withstands up to 40 scfm and 100 percent compressor duty cycle.

- **Proven effective by the country's largest and most severe-use municipal fleets.**
- **Keeps air system clean, keeps air capacity high – even in the most severe use situations.**
- **Integrated filtration system removes compressor blow-by before entering desiccant cartridge – protects downstream components.**
- **Easy to install and service; reduces fleet downtime.**

See the reverse side of this flyer to find out which Dual Turbo-2000 air dryer would be best for your application.

SKF

Providing a reliable source of dry air to severe use fleets

Vehicles that use large amounts of air, such as transit and refuse, depend heavily on the performance of the air dryer – sometimes requiring nearly 100 percent compressor charge time. But some of today's vehicles are requiring even higher output compressor levels, such as 2010 transit bus applications.

Both the H.C. Dual Turbo-2000 and the standard Dual Turbo-2000 can meet the increased demands of tomorrow's applications. The H.C. Dual Turbo-2000 can withstand compressor air flow output of up to 80 scfm and up to 40 percent compressor duty cycle. The unit requires 600 cu. ft. in purge volume and is D2 Governor controlled.

The standard Dual Turbo-2000 offers a compressor air flow output of up to 40 scfm and up to 100 percent compressor duty cycle. The unit requires no purge tank and has an internal timer to control cycles.

To learn more about which Dual Turbo-2000 unit is more appropriate for your application, please reference the chart below.

Turbo-2000

The broad line of Brakemaster Turbo–2000 air dryers allow you to match air dryer performance to your application requirements and maintenance goals. For more information about which one is right for your application, contact your SKF representative.

Operating parameters		H.C. Dual Turbo-2000	Dual Turbo-2000
Maximum compressor duty cycle		40%	100%
Maximum compressor size		80 scfm	40 scfm
Purge tank requirement		600 cu ft. required	None
		2 #221 purge tank can be used	
D2 Governer controlled		Yes	No – internal timer
Turbo-boost compatible		Yes	Yes
Discharge Line Unload compatible		Yes	Yes
Inlet/Outlet ports		3/4" npt	3/4" npt
Filtration package		7 internal filters	7 internal filters
12 V 75 Watt	Without purge tanks	#620982	#620910
	With purge tanks	#620980	
24 V 75 Watt	Without purge tanks	#620984	#620920
	With purge tanks	#620986	

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HVAC SYSTEM

The GILLIG Low Floor utilizes the latest technology in rear mount HVAC systems featuring the Thermo King T14 with the Intelligaire III. This installation has a proven performance record to maintain comfortable interior temperatures in all environments. Each system is engineered and installed in strict conformance to the suppliers requirements and is tested thoroughly to document cooling system performance.

THERMO KING T14 PACKAGED WITH ENGINE INSTALLATION

THERMO KING

T Series

The most reliable HVAC system for transit is now better than ever.

Ingersoll Rand

High performance and reliability for more than 30 years

T-Series: The HVAC design that changed an industry.

Low life cycle costs

Performance proven components provide long service life and minimum maintenance for low life cycle costs.

Lightweight

Lightweight all aluminum frame, blowers, coil headers and compressor reduce bus stress and fuel consumption.

Easy to service

Convenient service access to all major components. Simplified electrical troubleshooting with microprocessor controls. Removable access panels and a convenient rear window location provide easy access to unit components for repairs or maintenance.

Same major components and options across platform.

T Series units have many of the same internal components in the electrical and refrigeration systems, assuring a readily available supply of parts and parts interchangeability to lower costs and minimize downtime.

Easy to install

T Series units are easy to install and service because of the compact, one-piece design.

Proven dependability

You know you're getting a dependable, reliable bus air conditioning and heating system that can lower your operating and maintenance costs and keep your bus riders cool.

Best Value, Best Performance.

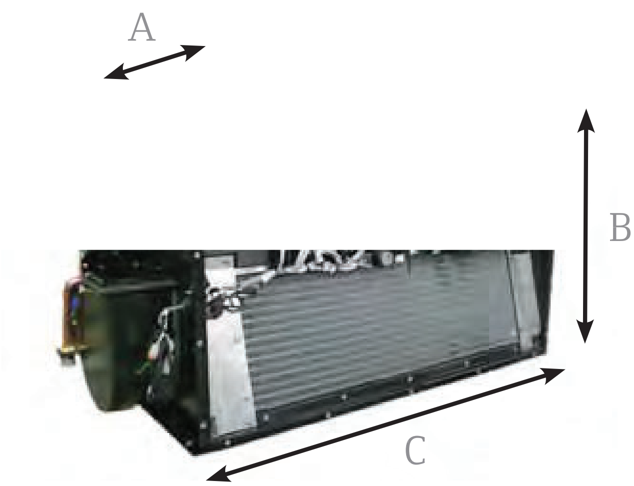
Thermo King offers system diversity to fit your
individual requirements.

Unmatched versatility to meet customer specifications

2 Refrigerant Options
- R134a
- R407C

3 Motor Options
- Brushless
- Wound Field
- Permanent Magnet

3 Compressor Options
- X426/X430
- S391 Screw
- S616 Screw



Unit	A (Depth)	B (Height)	C (Width)	Weight
T 14	683 mm (26.9″)	902 mm (35.5″)	1636 mm (64.4″)	168 KG (370 lbs)
T 15	658 mm (25.9″)	963 mm (37.9″)	1618 mm (64.4″)	173 KG (380 lbs)

The Best Solution Available for CNG Rear Mount Applications!

T-Series Standard Features

Why pay for more than you want. Thermo King provides standard features designed to meet your needs.

Thermo King's IntelligAIRE III Control System Delivers Industry-Leading Capability with Unmatched Ease-of-Use

- ✓ Multiple zones can be controlled using identical expansion modules via CAN network and interconnected software
- ✓ Expanded CAN communication capability to plug directly into the vehicle's J1939 network
- ✓ Operator-friendly display and pressure modules for improved control and diagnostics

Four simple modules remove complexity for operators and technicians

Display Module

Pressure Display Module

Main Module

IO Module

High Performance R-407C

- Environmentally safe alternative that provides more BTUs of cooling per HP used

R-134a Refrigerant

- Environmentally-friendly solution

The Thermo King X430 Compressor

- Engineered exclusively for transport applications
- Built for extended service life
- Field repairable

Additional Standard Features

Evaporator fan motor

- Heavy-duty, double shafted industrial permanent magnetic motor with replaceable bearings and brushes
- 27V, 1.15 hp, 1700 rpm (high speed)
- Drives two large, high airflow, forward curved, centrifugal blowers

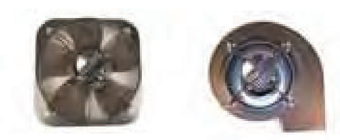
Condenser fan motors

- Two, heavy-duty, industrial permanent magnet motors with replaceable bearings and brushes
- 27V, .75 hp, 1900 rpm (high speed)
- Each motor drives a 457 mm (18 in.) diameter axial flow fan

T-Series Optional Features

Take control of your operating costs with these cost-saving options available only from Thermo King.

Thermo King Brushless Motors



114-LB. WEIGHT REDUCTION FOR IMPROVED FUEL ECONOMY!

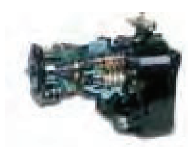
Designed Specifically for Mobile Air Conditioning

Lower Your Operating Costs

- Eliminates High Brush Maintenance Costs
- Fewer Parts to Maintain and Replace - Electronic Package is Integral to Motors, Eliminating External Controllers, Harnesses, Terminals and Studs for Lower Costs
- Advanced Diagnostics Provide Failure Mode Indication

IntelligAIRE III™ Electronic Pressure Display Module

- Touchpad displays four different pressure readings
- Simplifies problem diagnosis and pre-trip inspections



S391/S616 Screw Compressors

- Exclusive oil management system for increased reliability
- Fewer moving parts than reciprocating compressors
- Lower noise levels and vibration than reciprocating compressors
- Programmable capacity control for fuel savings

Electronic Energy Management System

- Provides fuel savings with X426, X430 and X640 reciprocating compressors
- Programmable electronic capacity control reduces the parasitic load on the engine

High Performance Clutch

- Long-life sealed bearing
- More torque for heavy-duty applications
- Extended maintenance intervals

Additional Optional Features

- Wound field condenser & evaporator fan motors
- Modulating water valve
- 125 amp, 27V dc batteryless alternator (independently powers fan motors and controls)

T Series Specifications

Evaporator Airflow* *

0 mm (0 in.) water column
external static pressure
High speed fan
-3814 m³/hr (2250 cfm)
Low speed fan
-2366 m³/hr (1400 cfm)

* *Consult factory for optional airflow on high speed or low speed fan operation.

Performance Data

System net cooling capacity with 35°C (95°F) ambient, and 26.7°C (80°F) db, 19.5°C (67°F) wb evaporator return air (50% RH):

Refrigerant HFC R-407c*

CompressorNet System Capacity

RPM	Btu/hr	KCal/hr	HP
1000	66,700	16,808	7
1800	88,400	22,277	15
2400	97,300	24,520	21
2800	101,000	25,452	24

Refrigerant HFC-134a*

CompressorNet System Capacity

RPM	Btu/hr	KCal/hr	HP
1000	45,700	11,516	6
1800	73,600	18,547	12
2400	83,900	21,143	15
2800	86,000	21,672	18

* Nominal cooling system capacities shown above may vary depending upon the specific T Series unit model (frame size) selected. Consult factory for more specific performance data for your application.

System Heating Capacity

24,696 KCal/hr (98,000 Btu/hr)
@ 8 GPM & 160°F water

Electric Power Requirements

AT 27V dc
High speed fan: 106 amps (high speed evaporator and condenser fans)
Power source: Bus alternator or Thermo King batteryless alternator (options below)

Unit Operation W/Driver Mode Switch

Reheat:Compressor clutch continuously engaged, boost pump and water control valve cycling is controlled by thermostat.

Cool: Compressor clutch cycles On/Off on demand of thermostat.

Vent: Evaporator fan operation only.

Heat:Boost pump and water control valve cycle on demand of thermostat.

Compressor clutch off.

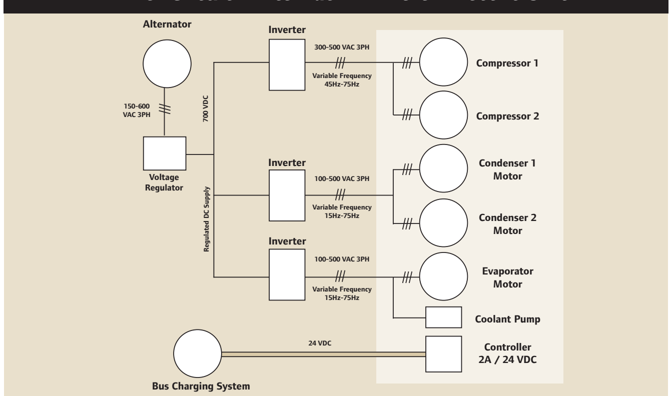
Add Thermo King's T-Series HVAC System to Your Specification Today!

T-Series All-Electric HVAC Options

Help Drive Energy Efficiency and Sustainability in Your Organization!

TEA Series

Power Circuit - Alternator Powered Electric Unit

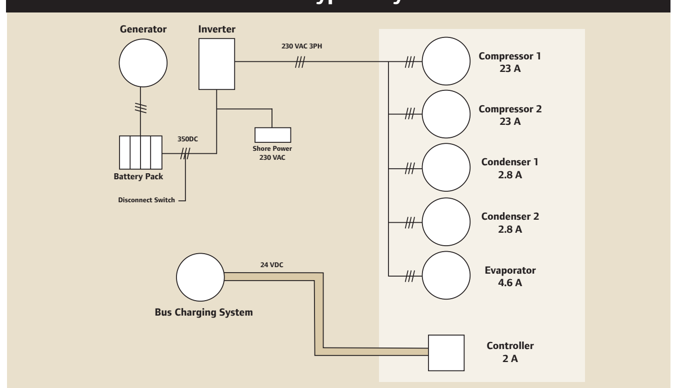


For use on standard diesel engine-driven buses.

Engine driven
600 VAC Alternator

TE Series

Power Circuit - Typical Hybrid Electric



For use on hybrid electric and all-electric buses.

For complete All-Electric specifications, see your local Thermo King dealer or call 952-887-2241

Ingersoll Rand's Climate Solutions sector delivers energy-efficient HVACR solutions for customers globally. Its world class brands include Hussmann, a manufacturer of refrigeration and food merchandising solutions, Thermo King, the leader in transport temperature control and Trane, a provider of energy efficient heating, ventilating and air conditioning systems, building and contracting services, parts support and advanced controls for commercial buildings and homes.

Distributed by:

TK 30274-3-PL (9-11)

THERMO KING

IntelligAIRE® III

Third generation advanced microprocessor control and communications technology.

Ingersoll Rand

Thermo King's IntelligAIRE: Since 1994

The name you know and trust brings you the next generation of bus microprocessing technology.

Coach and Transit Bus Climate Control has Never Been This Easy!

✓ **Improved diagnostic and troubleshooting that reduces downtime.** Technicians can override any function to create a specific condition to help identify a problem. All alarm and shutdown codes are stored with a real time date stamp to assist maintenance when diagnosing or troubleshooting a problem.

✓ **Complete and advanced communication capabilities with the CAN based HVAC control system** allows customers to plug directly into the vehicle's J1939 network, makes more information available and eliminates the gateway module required between the bus controller and the unit controller.

✓ **Reduced setup time for installing and changing program files** with a flashload option for custom configuration. Users can now load a single file, which can be saved and applied to all buses in the fleet without having to configure each bus individually.

IntelligAIRE III gives you MORE:

- Available I/O to monitor and control components
- Multi-zone temperature control flexibility
- Programming simplicity and configurability with the PC interface
- Communications capability
- Weight reduction with elimination of harness

Energy Efficiency and Sustainability:

IntelligAIRE III can help you get there!

Second Generation Brushless Motors

Fuel-Saving Screw Compressor

Power Electronics for All-Electric HVAC

Energy Management System for
Reciprocating Compressors

Electric Scroll
Compressor

Let IntelligAIRE III Provide Optimum Control of These Energy-Saving Components

---

Unmatched versatility with IntelligAIRE III -
One controller for all of our products!

Athenia Roof Mount

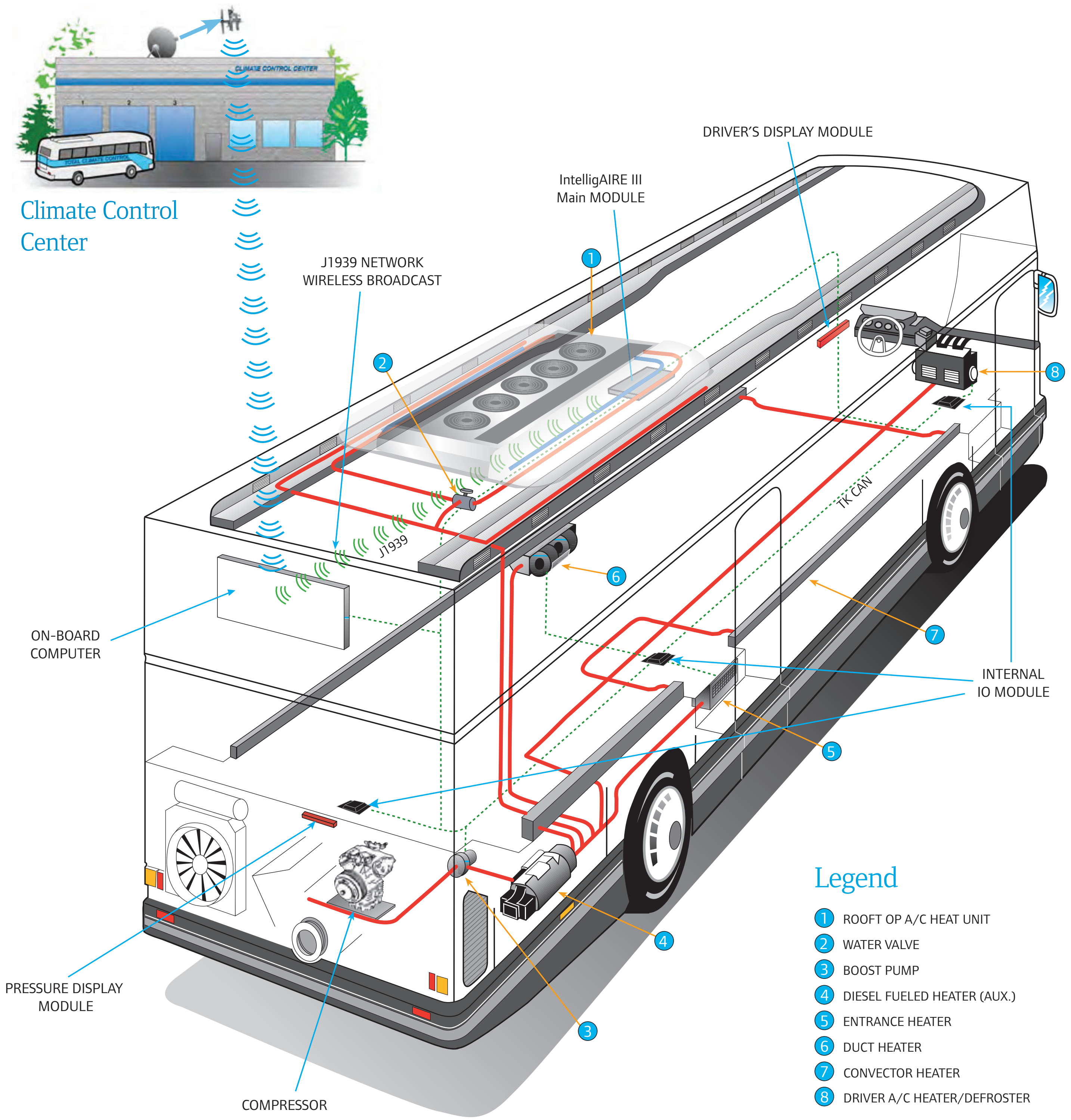
T-Series Rear Mount

Rear Mount
All-Electric

RLF Integrated
Rooftop

Athenia Roof Mount
All-Electric

IntelligAIRE III: More information at your fingertips than ever before!

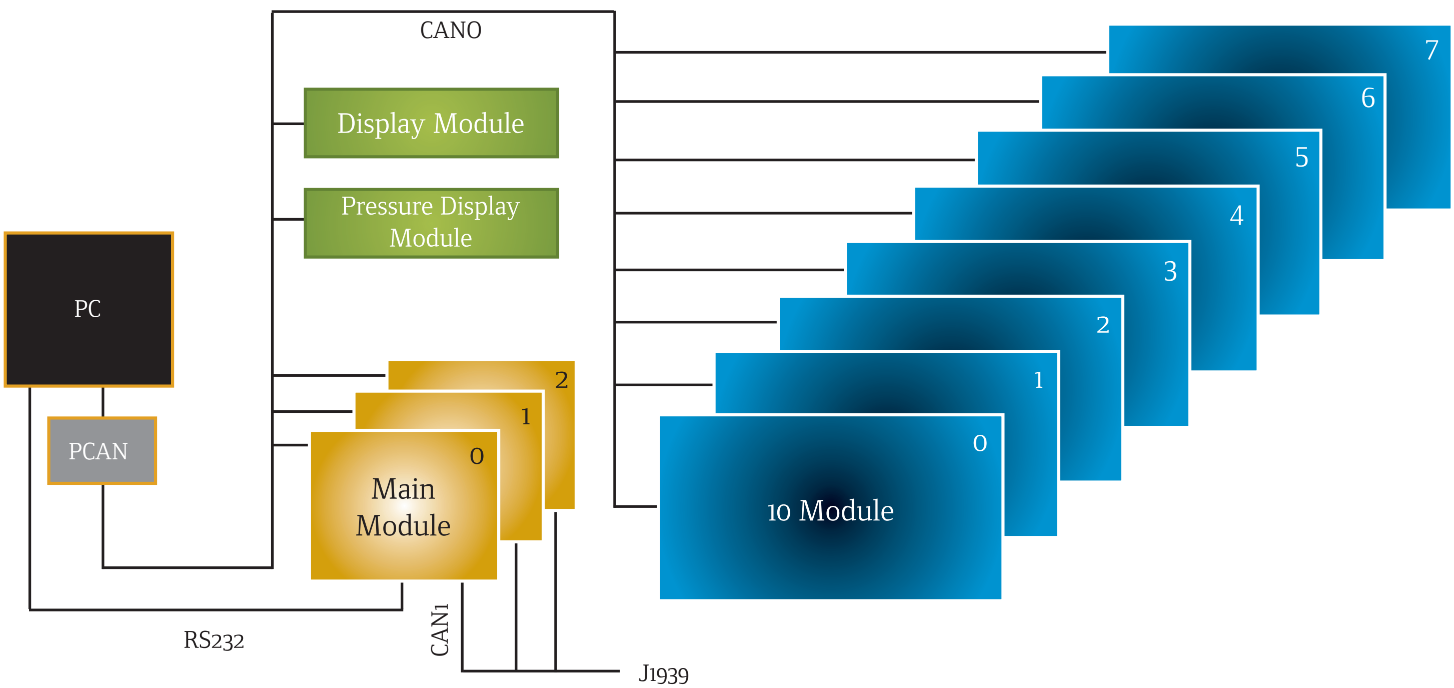


Choose to monitor any of over 100 functions — unique alarm codes alert you to any problems.

Let the Power of IntelligAIRE III Work for You!

System level block diagram

The IntelligAIRE III is a component-based system that allows system expansion as necessary to incorporate additional features or multiple temperature control zones in applications such as articulated buses.



Toolkit of the future from Thermo King

Four simple modules remove complexity for operators and technicians

Display Module

Pressure Display Module

Main Module

IO Module

Display Module

(Optional)

The display module provides an optional user interface for controlling the HVAC on/off, set point adjustment and readout of passenger zone temperatures and outside ambient temperature. The display features touch sensitive operator keys, LED indicators and a 3-digit LED display.

Pressure Display Module

(Optional)

The pressure readout module provides an optional digital readout of suction and discharge pressures. The module features touch sensitive operator keys, LED indicators and a 3-digit LED display.

Main Modules

(up to 3 as required by the application)

The microprocessor in the main module(s) provides the primary "intelligence" and acts as the main controller(s) of the system. The main modules, IO modules, display module and pressure module communicate via CAN bus. A second CAN port is included on each main module to provide an optional SAE J1939 interface to the vehicle network.

IO Modules

(Up to 8 as required by application)

The IO modules support additional floor heat zones as required by the application. The conditions of all sensors and other inputs are transmitted to the main module. The main module then determines what system actions are required and transmits the appropriate output commands back to the IO modules.

IntelligAIRE III Delivers Industry-Leading Capability with Unmatched Ease-of-Use

- ✓ Multiple zones can be controlled using identical expansion modules via CAN network and interconnected software
- ✓ Expanded CAN communication capability to plug directly into the vehicle's J1939 network
- ✓ Operator-friendly display and pressure modules for improved control and diagnostics

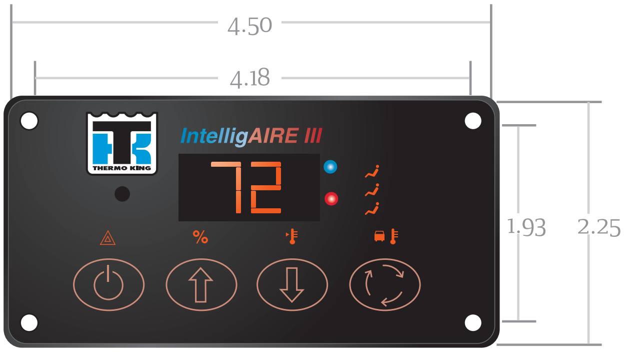
Add Thermo King's IntelligAIRE III to your HVAC specification today

The Thermo King IntelligAIRE III is a 3rd generation advanced microprocessor-based controller for bus climate control systems that can be programmed for either manual or automatic operation. A unique feature of the IntelligAIRE III system is its modular configuration, connected via a CAN 2.0B communications network.

The modular configuration provides the user greater flexibility for customization, reduces the number of electrical connections and significantly reduces weight with the elimination of long multi-wire harnesses.

The IntelligAIRE III system consists of up to (3) Main Modules, Display Module and up to (8) IO Modules. The operator can cool/heat/ventilate up to three zones on the vehicle. The set point, fan speed and fresh air damper can be controlled independently for each zone. These functions can also be controlled independently on the driver's evaporator/heater unit. All components associated with the cooling, heating and ventilating of the passenger compartment(s) are controlled by a single control system.

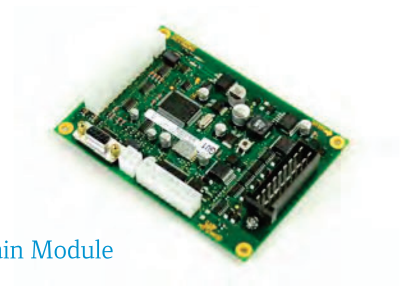
The Thermo King IntelligAIRE III comes fully equipped to handle all of your communications needs. The package includes an RS232 port for flash-loading firmware updates, a J1939 port for interface with the vehicle's CAN BUS network and a CAN port for diagnostics and customized configurations. The CAN Diagnostic program provides more diagnostic features and troubleshooting information than any other controller available for bus HVAC systems.



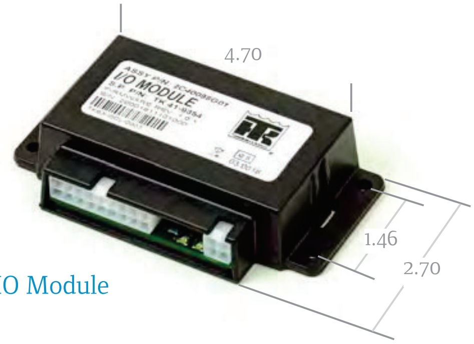
Display Module

(Dimensions same as Display Module)

Pressure Module



Main Module



IO Module

Worldwide Service Organization

Thermo King backs its equipment and customers with a highly-trained, worldwide service organization. This assures you the support of factory authorized service facilities and a stock of factory parts and factory trained mechanics.

Warranty Summary

Terms of the Thermo King Warranty are available on request from your local Thermo King dealer. Please reference document TK50049 for the Thermo King Bus Unit Warranty.

Ingersoll Rand

Ingersoll Rand's Climate Solutions sector delivers energy-efficient HVACR solutions for customers globally. Its world class brands include Hussmann, a manufacturer of refrigeration and food merchandising solutions, Thermo King, the leader in transport temperature control and Trane, a provider of energy efficient heating, ventilating and air conditioning systems, building and contracting services, parts support and advanced controls for commercial buildings and homes.

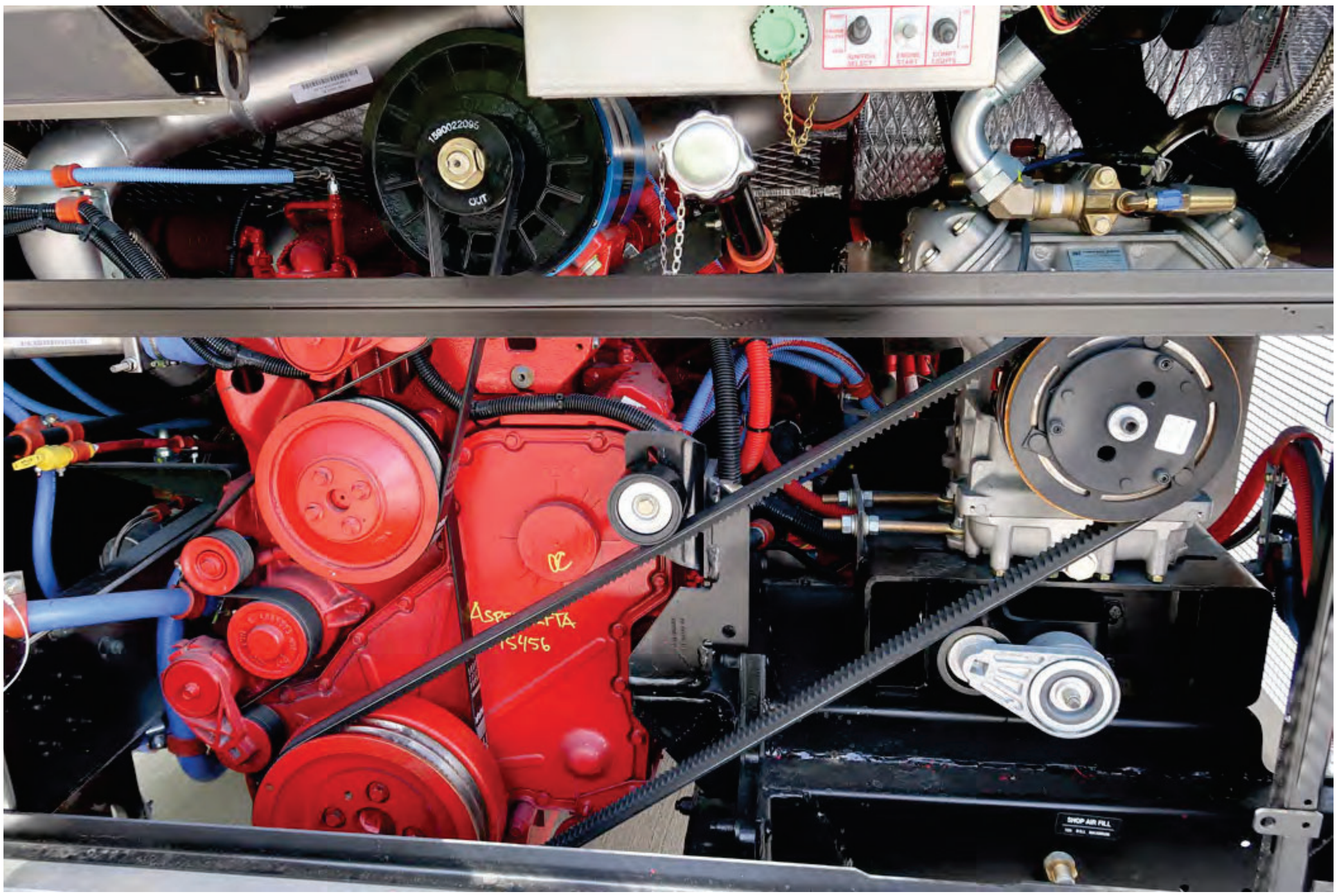
Distributed by:

TK 55196-3-PL (7-11)

HVAC COMPRESSOR

The belt driven HVAC Refrigerant compressor is mounted to the top of the rear curbside chassis outrigger immediately inside the engine door. There are two piston driven models available from Thermo King: the standard X426 that provides 25.9 cu. in. of displacement or the upgraded X430 that provides 30 cu. in. of displacement.

We are providing the X430 with this proposal. A tensioner pulley is provided under the lower length of the belt to reduce slap and increase belt life.



THERMO KING

X426 and X430 Compressor and Clutch

Air conditioning compressors and clutches for bus applications.

Ingersoll Rand
Climate Control Technologies

Lower your **operating costs.**

Today, in the bus transportation business, "operating costs" are critically important. Finding ways to reduce operating costs will have a positive influence on profitability. Thermo King understands that, which is why you should know all the ways Thermo King compressors work to keep your operating costs down. Here's how:

Designed Exclusively for Bus Transportation Applications

- Fast and easy to service
- Extended service life
- More efficient operation
- Reduces fuel consumption
- Environmentally friendly HFC refrigerants

Engineered exclusively for transport applications

Built for continuous duty, reliable operation, and long life in an environment that features extreme fluctuations in operating temperatures, constant shock and vibration, dirt, dust, and other potential contaminants. Reliability translates directly to less downtime and lower operating costs.

Built for extended service life

Thermo King compressors have been designed and built for extended service life. And fewer repairs mean lower parts and labor costs.

Reduces fuel consumption

The Thermo King unique clutch system allows cycling at any engine speed. This allows the compressor to disengage when cooling isn't needed, reducing the load on the bus engine and conserving fuel. The compressor is sized to provide capacity, but not oversized to where it increases fuel consumption and operating costs.

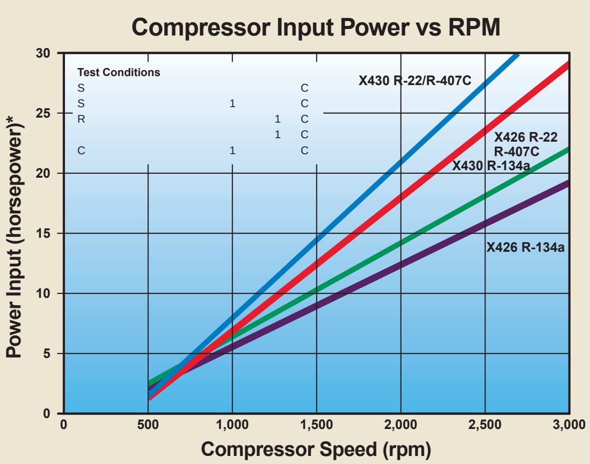
Less wear and tear on bus transmission and engine

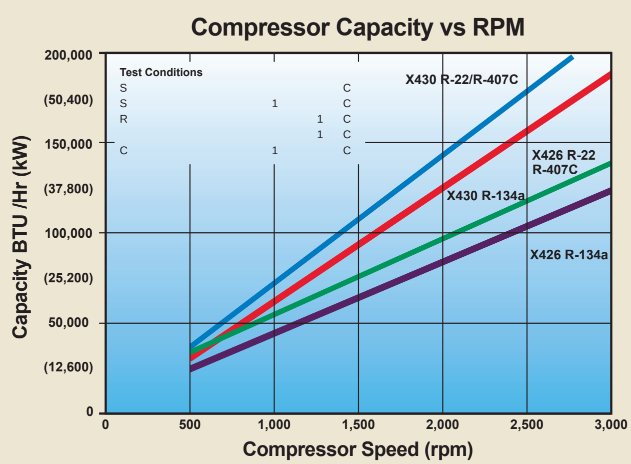
The in-line, V-type, four-cylinder reciprocating design of Thermo King compressors, coupled with top center positioning of pistons every 90 degrees relative to the crankshaft, results in smooth even torque load on the bus transmission and engine crankshaft for longer life, fewer repairs, fewer replacement parts, and fewer man hours in repair.

Fast and easy to service

A Thermo King compressor can be completely overhauled by one mechanic (using common shop tools) in less than four (4) hours, without the need for complicated and costly machining.

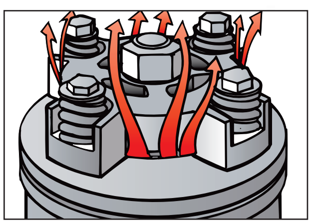
How environmentally friendly refrigerants perform.



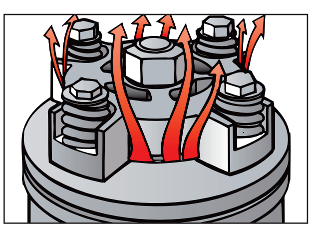


How Thermo King compressors **help lower operating costs.**

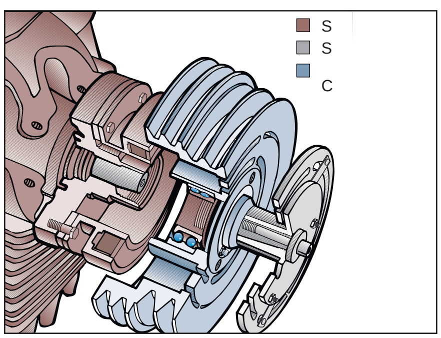
- ✓ Body mounted clutch reduces wear on compressor parts.
- ✓ Magnetic clutch design saves fuel.
- ✓ Epoxy sealed clutch coil for lower maintenance.
- ✓ Mounting of clutch bearing ensures even wear, protects against premature wear.
- ✓ Double row ball bearings add strength, longer life.
- ✓ Teflon grease seals increase bearing life.
- ✓ Ease of lubrication reduces maintenance time.
- ✓ Friction plate air gap easily adjusted.
- ✓ Pulley face is easily reconditioned.
- ✓ Stainless steel bellows seal for improved reliability.
- ✓ Multiple sight glass assures vision will not be blocked when checking oil.
- ✓ Deep oil sump results in fewer breakdowns, longer compressor life.
- ✓ Suction strainer and refrigerant oil filter prevent recirculation of harmful particulates, extends compressor life.
- ✓ Check valves limit oil escape, increases lubrication during startup, extends compressor life.
- ✓ Spring-loaded discharge valve cage relieves pressure if hydraulic pressure develops in cylinder.
- ✓ Free-floating suction and discharge valve reeds allow greater gas flow.
- ✓ Replaceable cylinder sleeves allow overhauling without reboring, lowers cost of repairs.
- ✓ Vanasil alloy ringless pistons for long life performance and high pumping efficiency.
- ✓ Gas cooling lowers piston operating temperature, extends compressor life.
- ✓ Gerotor oil pump extends compressor operating life.
- ✓ Drilled oil passages through crankshaft deliver positive lubrication to bearing surfaces extending bearing life.
- ✓ Forged steel crankshaft and connecting rods add strength, increase compressor life.
- ✓ Field-replaceable crankshaft ball bearings, rather than bushings, results in less expensive overhauls.
- ✓ Lightweight aluminum body transfers heat rapidly for cooler, more efficient operation.



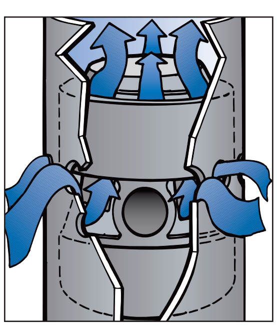
During normal operation, the discharge valve lifts to allow compressed gas to exit the cylinder.



Under abnormal conditions, when extreme pressure is created by liquid refrigerant or oil entering the cylinder, the entire discharge valve cage lifts to vent the excessive pressure. This 2-stage pressure relief system helps extend overall compressor life.



Weight of the clutch and belt side load is supported directly by the rigid compressor body. Only the friction plate and retaining bolt are mounted on the shaft, reducing the amount of stress on the crankshaft, increasing overall life of other compressor components.

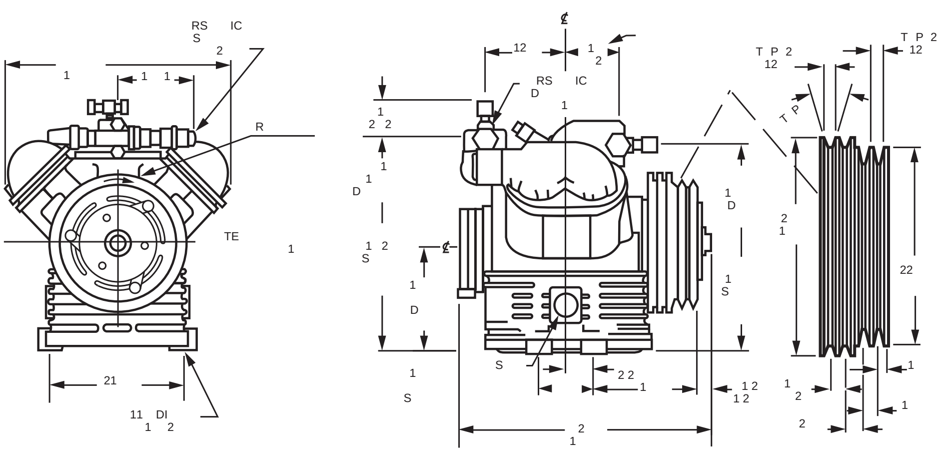


Cool refrigerant gas enters the chamber around and through the piston, reducing the operating temperature and resulting in a cooler, more efficient running compressor.

Bus Air Conditioning Compressor and Clutch Specifications

Compressor	Model X426	Model X430
Displacement	426 cu. cm (25.9 cu. in.)	492 cu. cm (30 cu. in.)
Number of cylinders	4	4
Maximum BHP	19 BHP (R-134a) 29 BHP (R-22/R-407C)	19 BHP (R-134a) 29 BHP (R-22/R-407C)
Maximum speed	3,000 rpm (R-134a) 3,000 rpm (R-22/R-407C)	3,000 rpm (R-134a) 3,000 rpm (R-22/R-407C)
Refrigerant	R-134a R-22/R-407C	R-134a R-22/R-407C
Oil capacity	4.2 liter (8.9 pints)	4.2 liter (8.9 pints)
Oil pump	Gerotor type	Gerotor type
Oil type	TK Part No. 67-404 (R-22) Alkybenzene TK Part No. 203-513 (R-134a/R-407C) Polyolester	TK Part No. 67-404, (R-22) Alkybenzene TK Part No. 203-513 (R-134a/R-407C) Polyolester
Maximum tilt	10° any direction	10° any direction
Drive method	Belt or direct	Belt or direct
Max. belt side loading	136 kg (300 lbs.)	136 kg (300 lbs.)
Operating Conditions		
Max. discharge temp.	162.8°C (325°F)	162.8°C (325°F)
Max. saturated suction temp.	12.7°C (55°F)	12.7°C (55°F)
Max. saturated discharge temp.	68.3°C (155°F)	68.3°C (155°F)

Dimensions: millimeters (inches)



Clutch Assembly	
Type	Electro-magnetic
Voltage	12V dc/24V dc
Current draw	5.0 amps/2.5 amps
Engagement speed	0 to 3,000 rpm (X426/X430)
Drive pulley O.D.	229 mm (9.0 in.) 197 mm (7.75 in.)
Available belt types	B type, 2 groove 5V, 2 groove
Rotation	Clockwise or counter-clockwise (clutch end)
Peak torque	80 ft. lbs.

Weight: (approximate)

Model X426 52.2 kg (115 lbs.)
Model X430 52.2 kg (115 lbs.)
(Including oil, service valves and clutch)

Worldwide Service Organization

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Warranty Summary

Terms of the Thermo King Warranty are available on request from your local Thermo King dealer. Please reference document TK50049 for the Thermo King Bus Unit Warranty.

Ingersoll Rand
Climate Control Technologies

Providing equipment and services to manage controlled-temperature environments for food and other temperature-sensitive products, our Climate Control Technologies sector encompasses both transport and stationary refrigeration solutions. Our product brands include Thermo King®, a world leader in transport temperature control systems, and Hussmann®, a manufacturer of refrigeration and food merchandising equipment.

TK 30174-3-PL (9-08)

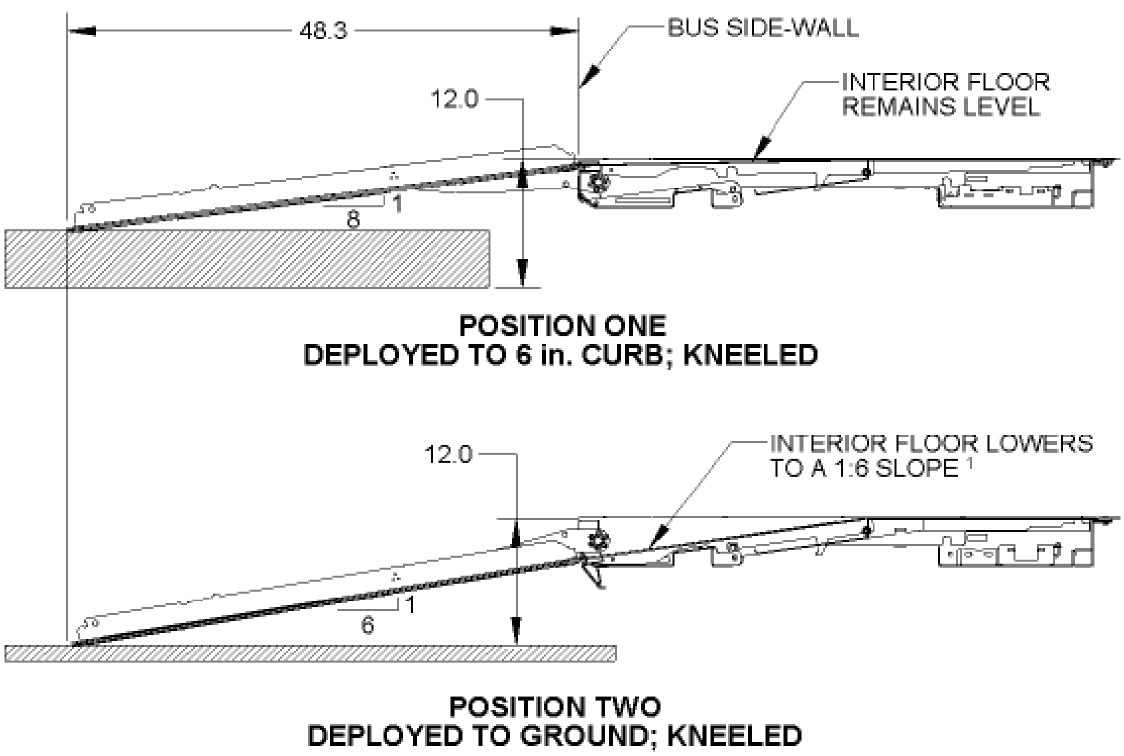
www.thermoking.com www.hussmann.com www.ingersollrand.com

WHEELCHAIR RAMP

The GILLIG Low Floor bus comes equipped with a powered fold-out passenger ramp which makes boarding the bus easy for physically disabled passengers. The LIFT-U LU18 “Dual Mode” fold-out ramp is a self-contained unit located in the entrance platform floor which is covered with the same rubberized flooring as used in the main aisle of the bus.

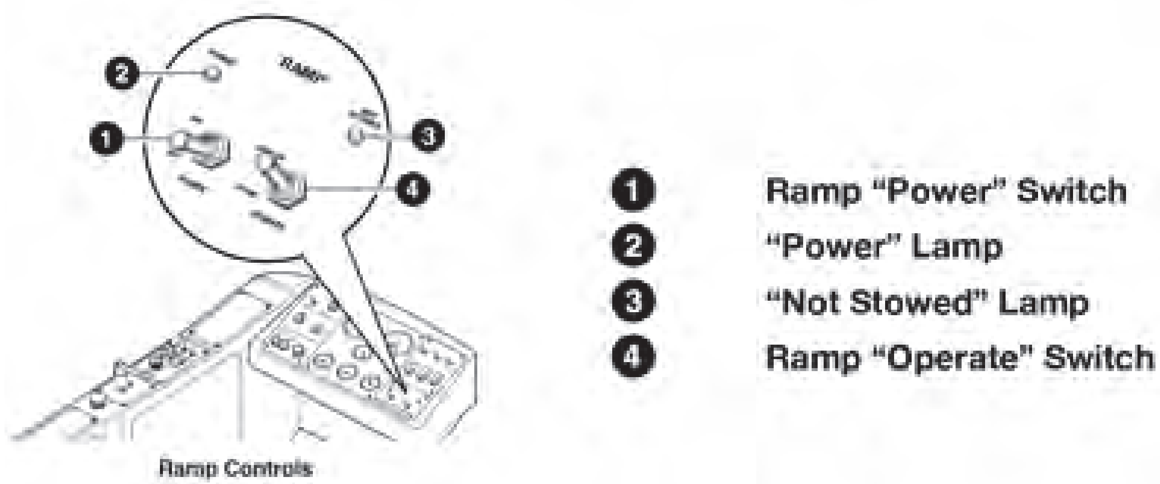
This ramp offers an industry leading 1:8 maximum slope when deployed to a 6” curb and 1:6 when deployed to street level. The platform area measures 30” x 49”, which provides excellent on/off maneuverability and is rated for up to 950 lbs. The ramp is manufactured from stainless steel for maximum corrosion protection and has a standard two year warranty.

The “two position” interior floor automatically lowers on an incline when the outer ramp reaches a pre-determined angle. Operator involvement is not required.

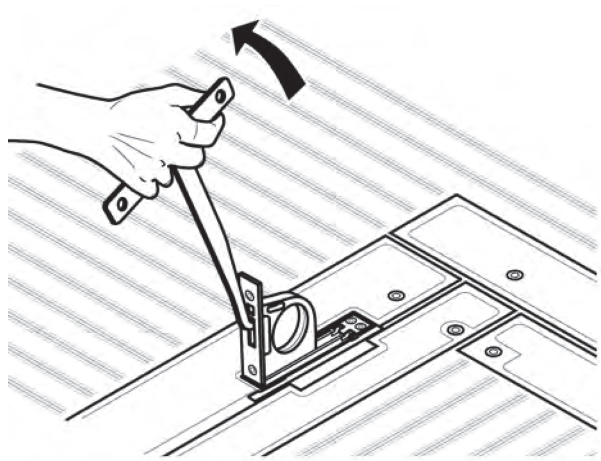


Operation

The ramp is entirely electrically operated and controlled by the dash-mounted controls (location of these controls can be discussed during the preproduction meeting).

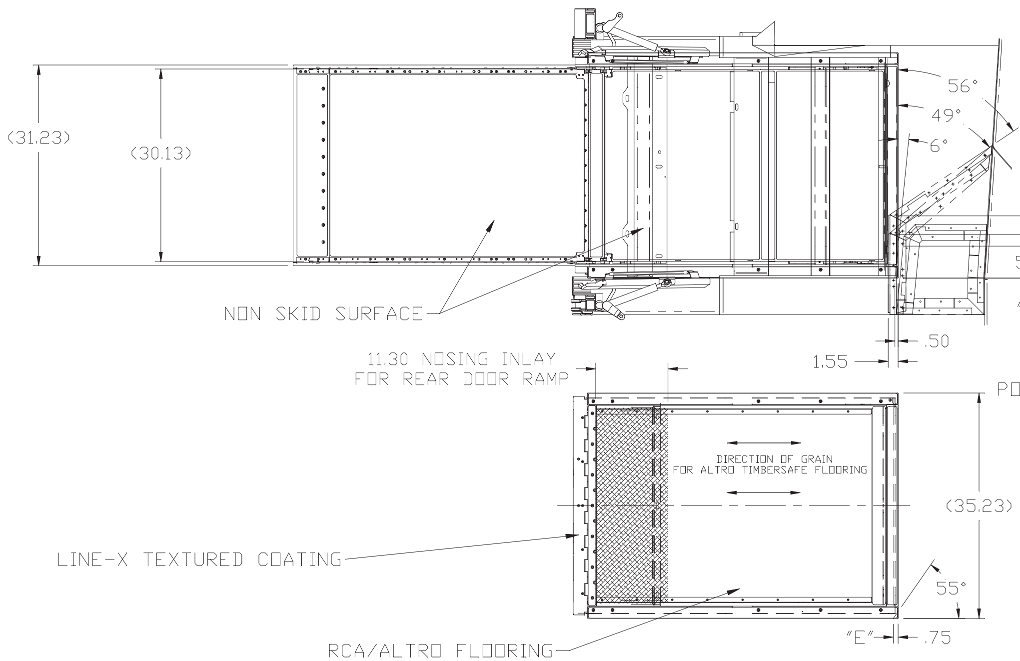


The fold-out mechanism is simple and includes provisions for manual deploy override which requires less than 20 lbs of force to articulate in either direction.

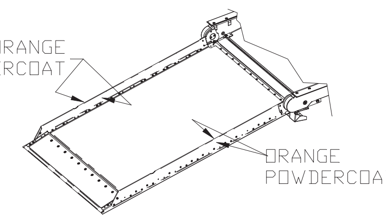


Wheelchair Ramp Beeper

The wheelchair ramp warning beeper is mounted in the right sidewall to the rear of the front wheel. It is an electronic buzzer type of beeper. It is energized by the multiplex system whenever the kneeling switch is activated or whenever the wheelchair ramp is in any phase of operation including "Stow." Each beeper has a closable cover that keeps water from directly entering its sound chamber during washing.



RAMP STOWED



17-71433CXXXXXXX7X
ORANGE POWDERCOAT RAMP PLATE SIDE RAILS

ADA RAMP SLOPE REQUIREMENTS FOR 12" STEP HEIGHT TO GROUND:

STEP HT ABOVE 6" CURB	MAXIMUM RAMP SLOPE		MINIMUM RAMP LENGTH
> 3" TO 6"	1:6	(9.462°)	36.497"
> 6" TO 9"	1:8	(7.125°)	48.373"
MAX SLOPE TO GROUND	1:4	(14.036°)	49.477"

REVISIONS

SYM	DWN	ZONE	DESCRIPTION	REL.	DATE
A	MAS		RELEASED FOR PRODUCTION	94443	01/30/13
B	ESF	A1	ADDED NOTE 7 FOR SPECIAL P/N FOR ALTRO TRANSFLOR CHROMA GREY.	REI 95449	05-28-2013
C	MAS		ADDED PAINT/STRIPE OPTIONS 5,7,9	97517	9/10/13

NOTES:

1) TOP OF RAMP IS SUPPLIED W/ FLOORING AND STEP NOSING. LIFT-U WILL SUPPLY CUSTOMER SPECIFIC PART NUMBER BASED ON FLOORING TYPE/COLOR AND STEP NOSING COLOR.

2) RAMP STD DEFAULT CONFIGURATION INCLUDES INTERNAL RAMP COUNTER & 4" YELLOW STRIPE GOING DOWN C/L, VISIBLE W/ RAMP DEPLOYED. (REF OPTION 4 BELOW)

3) PART NUMBER. 17-71433C XX XXXX X X 1-XXXXXX

- ADD BUS S/N TO END OF P/N FOR SPECIAL CUSTOMER REQUEST, REF MTG NOTES FOR DETAILS
- 1 = WITH RAMP CYCLE COUNTER (DEFAULT)
- 9= NO STRIPE DOWN RAMP C/L, W/WHITE P-COAT RAMP PLATE SIDE RAILS, TRIM, TREAD CLAMP BARS & WHITE NON-SKID AT DEPLOYED TRANSITION THRESHOLDS
  8= 4" WHITE STRIPE DOWN RAMP C/L, W/WHITE P-COAT RAMP PLATE SIDE RAILS, TRIM, TREAD CLAMP BARS & WHITE NON-SKID AT DEPLOYED TRANSITION THRESHOLD
  7= NO STRIPE DOWN RAMP C/L, W/ORANGE P-COAT RAMP PLATE SIDE RAILS W/YELLOW P-COAT TRIM & TREAD CLAMP BARS W/BLACK NON-SKID.
  6= 4" YELLOW STRIPE DOWN RAMP C/L, W/ORANGE P-COAT RAMP PLATE SIDE RAILS, W/YELLOW P-COAT TRIM & TREAD CLAMP BARS W/BLACK NON-SKID.
  5= NO STRIPE DOWN RAMP C/L, W/SSTL TRIM & TREAD CLAMP BARS W/O PAINT & W/O NON-SKID ON FORWARD, REAR & ROADSIDE PIECES.
  4= 4" YELLOW STRIPE DOWN RAMP C/L, W/YELLOW P-COAT RAMP PLATE SIDE RAILS, TRIM, & TREAD CLAMP BARS W/BLACK NON-SKID (STD DEFAULT)
  0= NO STRIPE DOWN RAMP C/L, W/YELLOW P-COAT RAMP PLATE SIDE RAILS, TRIM, & TREAD CLAMP BARS W/BLACK NON-SKID
- A = NOTCH LENGTH : 9.74 INCHES
  NOTCH ANGLE : 56 DEGREES
  (USE W/ 18-63308F000 OR 18-63308F001 FAREBOX PEDESTAL)

  B = NOTCH LENGTH : 6.85 INCHES
  NOTCH ANGLE : 49 DEGREES
  (USE W/ 18-63310F000 OR 18-63310F001 FAREBOX PEDESTAL)

  C = NO NOTCH

  D = NOTCH LENGTH : 5.0 INCHES
  NOTCH ANGLE : 6 DEGREES
  (USE W/ 18-58636-000 FAREBOX PEDESTAL)
  (USE W/ 18-65618F001 FAREBOX PEDESTAL)

  E = NOTCH LENGTH : 0.75 INCHES
  NOTCH ANGLE : 55 DEGREES
  (USE W/ 18-38719-000 DRIVER'S STEP)
- FLOORING MANUFACTURER COLOR CODE
  (ADD LEADING X'S IF COLOR CODE IS 2 OR 3 DIGITS LONG. W/ ALTRO TREADFLEX USE THE FOLLOWING FOR THE FIRST DIGIT: R=RIBBED
  S=SMOOTH
  D=DIAMOND
- NOSING COLOR: W=WHITE, NO HEATED MAT
  Y=YELLOW, NO HEATED MAT
  K=YELLOW, NO HEATED MAT, YELLOW NON SKID ON DEPLOYED SURFACES OF RAMP PLATE AND RISING FLOOR.
  L=YELLOW, 11.3" WIDE FOR REAR DOOR, NO HEATED MAT. RAMP TRIM W/O ADDITIONAL BEND AT CURBSIDE FOR FRONT DOOR FLOOR POCKETS.
- MANUFACTURER & TYPE: D= ALTRO TRANSFLOR
  I= ALTRO IMPRESSIONIST (IM)
  V= ALTRO TRANSFLOR VM20
  T= ALTRO TRANSFLOR TEMPO
  F= ALTRO TREADFLEX
  R= RCA
  N= NORAMENT
  M= ALTRO META
  C= ALTRO CHROMA
  W= ALTRO TIMBERSAFE

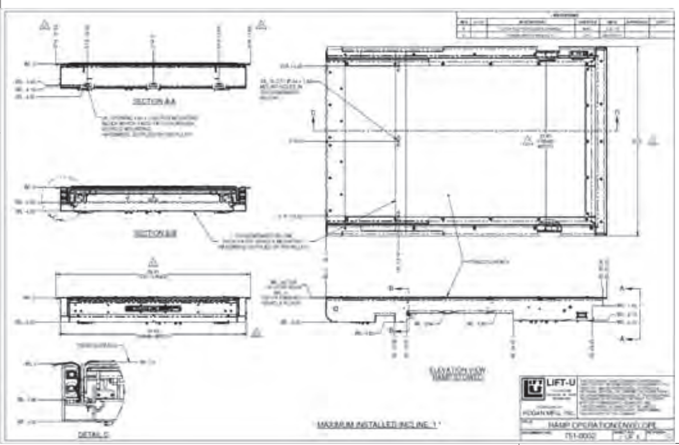
EXAMPLE: 17-71433CRYX602C41
RCA FLOORING, YELLOW STEP NOSING, NO HEATED MAT
RCA COLOR CODE 602
NO FARE BOX NOTCHOUT
W/ 4" YELLOW STRIPE
W/ RAMP CYCLE COUNTER

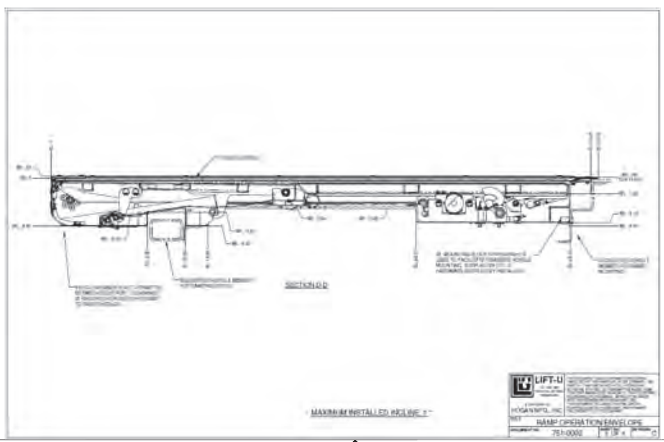
4) REMOTE MOUNTED RAMP COUNTER NOT INCLUDED W/ RAMP, REF P/N'S 17-66098-000 OR -001 FOR LOOSE CYCLE COUNTER GAUGES

5) L CODE STEP NOSING FOR REAR DOOR RAMP APPLICATIONS.

6) USE MOUNTING BLOCKS F/W LIFT ASM FOR STREETSIDE RAMP MTG. LIFT-U P/N 750-0691

B 7) PART NUMBER 17-71433CCYXMTSB41 IS FOR CUSTOM ALTRO TRANSFLOR CHROMA GREY COLOR TFCR27MTS AND IS SAME AS ALTRO P/N TFCR27001.





1	751-0002	LIFT-U LU18 DUAL MODE RAMP W/S-SIDE MTG BLOCK SLOTS	1
ITEM NO	DESCRIPTION		QTY

GILLIG LLC HAYWARD, CA	WELD PER GILLIG-10688 CLASS — MARK PART W/PN PER GIL DB #370.002
	CLEAN/PRIME PER GIL MFG STD NONE — LH SHWN, RH OPP, PN: NONE
PROPRIETARY THIS DRAWING AND THE INFORMATION CONTAINED THEREON SUBMITTED CONFIDENTIALLY AND IS THE PROPERTY OF GILLIG LLC USE, REPRODUCTION, OR DISCLOSURE OF THE CONTENT OF THIS DRAWING OR ANY PORTION THEREOF FOR ANY PURPOSE MUST BE APPROVED IN WRITING BY GILLIG LLC.	TITLE: RAMP-FOLD-OUT LIFT-U LU18 "DUAL MODE" RAMP
REMOVE ALL BURRS, BREAK SHARP EDGES	DWN: MAS — DATE: 01/30/13 — MATER'L SPEC:
DIMENSIONING AND TOLERANCING ARE PER ANSI Y14.5M-1982 UNLESS OTHERWISE SPECIFIED TOLERANCES ARE IN INCHES:	CHKR'S INIT: — DATE: — MFG STD:
DECIMALS .X ± .06 .XX± .03 .XXX± .010 — ANGULAR ± .5° — THIRD ANGLE	APPR'S INIT: — DATE: — FMVSS COMPL: STD NO 302
1ST S.O.:	ORIG REL #: 94443 — SIZE B — DOCUMENT NO. 17-71433C000
	CAD SCALE: 1/20 = 1.0

SHEET 1 OF 2

NOTES:

1. SEE SHEET 2 FOR THE FOLLOWING:

-APTA (WHITE BOOK) REGULATIONS
- -FOR FRONT DOOR CLEAR WIDTH
- -WHEEL CHAIR PASSENGER INTERIOR MANEUVERING ROOM.

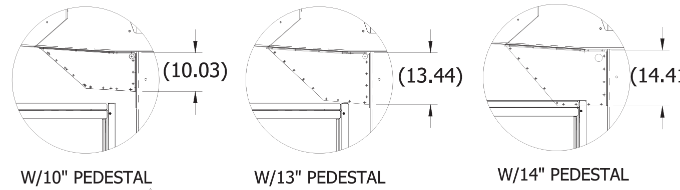
-PART 38 ADA
- -WHEELCHAIR RAMP CLEAR WIDTH.

B

2. APTA WHEEL CHAIR BLOCK ENTRANCE DIAGRAM SHOULD BE REVIEWED BY A CASE BY CASE BASIS DUE TO VARIOUS ITEMS MOUNTED IN THIS AREA WILL AFFECT BOX FIT. OPTIONS LISTED BELOW BUT NOT LIMITED TO:
- -LARGER FARE BOX PLATFORM (SEE DETAIL C)
- -FARE BOX
- -FARE BOX GUARD
- -DASH MOUNTED TRASH RECEPTACLE
- -DASH MOUNTED FIRE EXTINGUISHER
- -DASH MOUNTED GRAB RAIL
- -DASH MOUNTED CLIP BOARD HOLDER
- -DASH MOUNTED APC SENSOR
- -FLIP-UP STEPS FOR WHEEL WELL MOUNTED SEATS
- D -DRIVER'S SHIELD

3. DIM R = 38.0 FOR 10" PEDESTAL
= 36.6 FOR 13" PEDESTAL
= 35.0 FOR 14" PEDESTAL

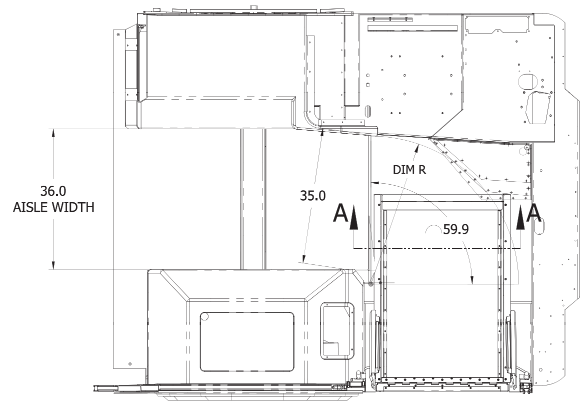
C2



C1 DETAIL "C": REF 10", 13", 14" FAREBOX PEDESTALS

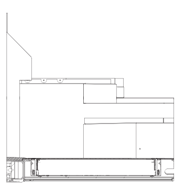
REVISIONS

SYM	DWN	ZONE	DESCRIPTION	REL	DATE
A	CNA		RELEASED FOR PRODUCTION	REI 74089	07/15/09
B	CNA		ADDED W/C BLOCK ENTRANCE DIAGRAM	REI 80159	08/11/10
C	GXC		1) ADDED 10",13",14" FAREBOX PEDESTAL VIEWS	REI 99428	12/4/13
	GXC		2) ADDED NOTES 3	REI 99428	12/4/13
D	JCG		ADDED DRIVER'S SHIELD TO NOTE 2	104759	10/6/14

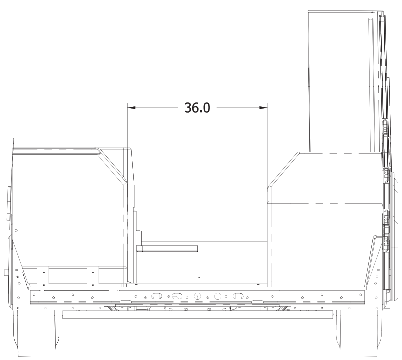


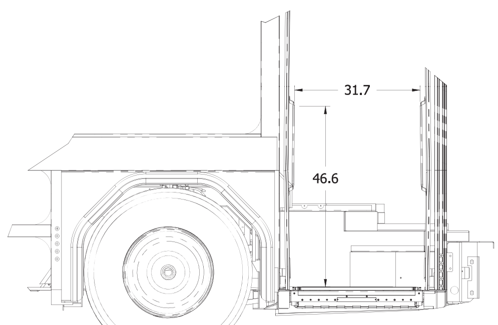
B DETAIL "B": W/C BLOCK ENTRANCE DIAGRAM

OBJECTS REMOVED FOR CLARITY 2



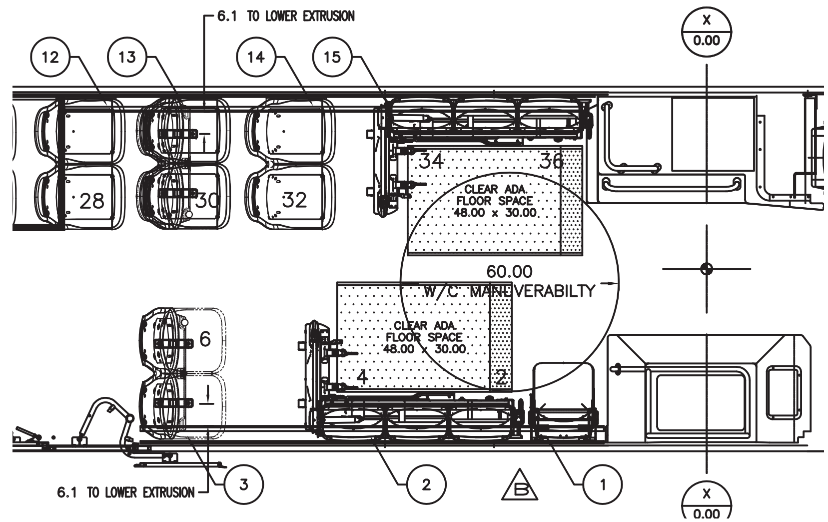
SECTION A-A





ITEM NO	DESCRIPTION			QTY
2 QAC	GILLIG — GILLIG LLC HAYWARD, CA		MARK PART W/PN PER GIL DB #370.002	
			LH SHWN, RH OPP, PN: NONE	
PROPRIETARY THIS DRAWING AND THE INFORMATION CONTAINED THEREON SUBMITTED CONFIDENTIALLY AND IS THE PROPERTY OF GILLIG LLC USE, REPRODUCTION, OR DISCLOSURE OF THE CONTENT OF THIS DRAWING OR ANY PORTION THEREOF FOR ANY PURPOSE MUST BE APPROVED IN WRITING BY THE GILLIG CORPORATION.		TITLE: DESIGN BULLETIN WHEELCHAIR ACCESS		
REMOVE ALL BURRS, BREAK SHARP EDGES		DWN: CHARLIE ABABSEH	DATE: 07/15/09	MATER'L SPEC:
DIMENSIONING AND TOLERANCING ARE PER ANSI Y14.5M-1982 UNLESS OTHERWISE SPECIFIED TOLERANCES ARE IN INCHES:		CHKR'S INIT:	DATE:	MFG STD:
DECIMALS .X ± .06 .XX± .03 .XXX± .010	ANGULAR ± .5° THIRD ANGLE	APPR'S INIT:	DATE:	FMVSS COMPL: STD NO 302
		ORIG REL #: REI 74089	SIZE B	DOCUMENT NO. DB-152-019
1ST S.O.: SSLF		CAD SCALE: 1/4 = 1.0		

SHEET 1 OF 1



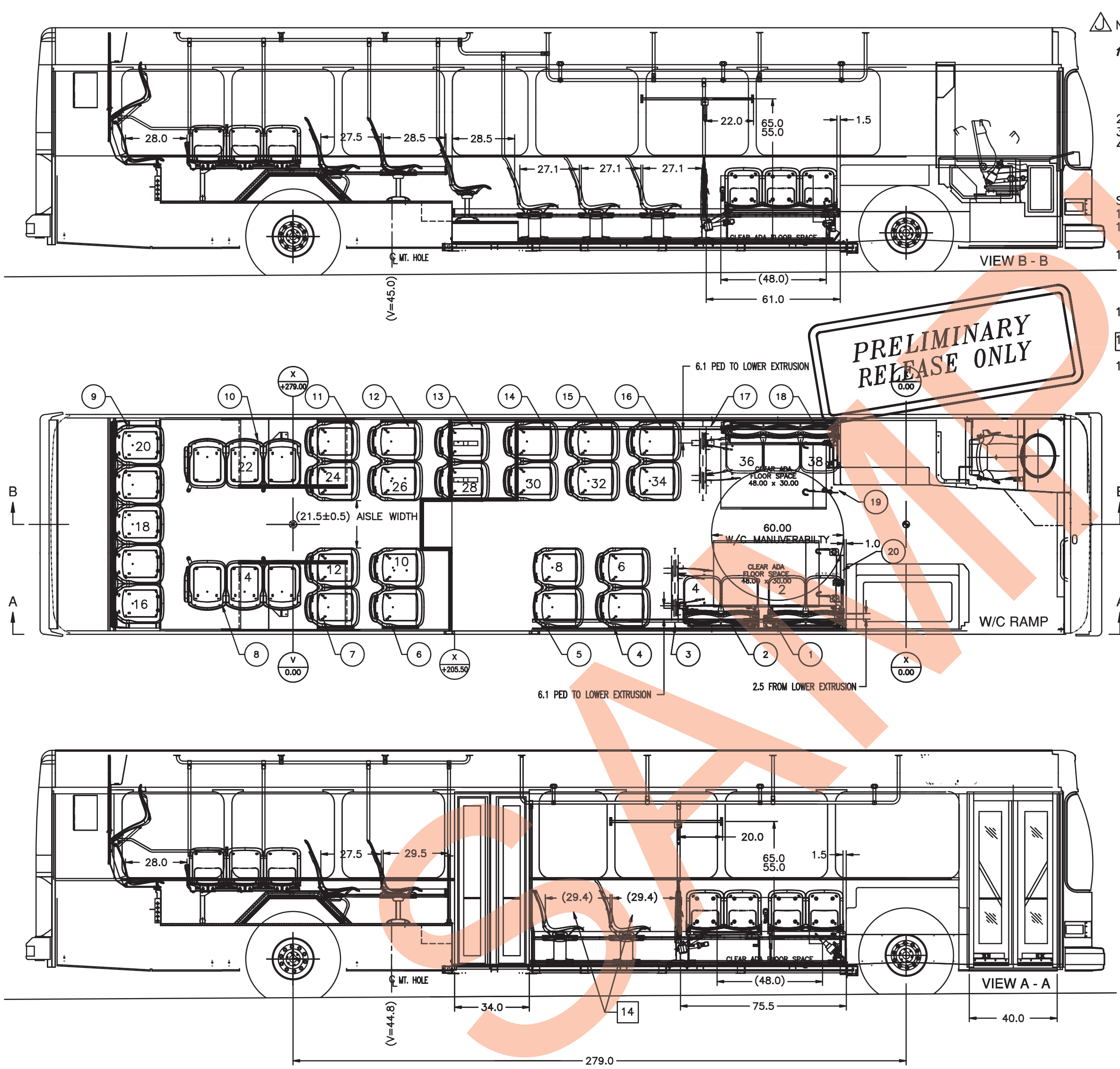
6.1 TO LOWER EXTRUSION
X
0.00
12
13
14
15
28
30
32
34
36
CLEAR ADA
FLOOR SPACE
48.00 x 30.00
60.00
W/C MANUVERABILTY
6
CLEAR ADA
FLOOR SPACE
48.00 x 30.00
4
2
1
6.1 TO LOWER EXTRUSION
3
2
B
1
X
0.00

GILLIG PARTS	QTY
STANCHION, REAR LONGITUDINAL	4
STANCHION, TRVS. @ 3RD STEP	2
STANCHION, TRVS. @ 2ND STEP	1
STANCHION, TRVS. @ 1ST STEP	1
STANCHION, W/C BARRIER	2

GILLIG PARTS	QTY
STANCHION, 1.0 SINGLE OFFSET FWD RD	1
STRAPS, O/H GRAB	–
BAR, WINDOW, 46.0	2
PANEL, MODESTY, 3RD STEP, C. SIDE	1

REVISIONS

SYM	DWN	ZONE	DESCRIPTION	REL.	DATE
A	NSH		RELEASED FOR PRODUCTION	100107	01/17/14
B	NSH		ADD CRASH PROTECTION NOTE	100823	02/25/14
C	NSH		REV #PASS FOR ITEM 17, MOVED ITEM 3 TO CLEAR CHASSIS STRUCTURE	100750	03/13/14
D	NSH		CORRECTED GRAPHICS ON ITEM 18, REV ITEM 8: WAS 28.5	102318	06/12/14
E	NSH		ADDED STANCHIONS TO ITEMS 8 & 10	102146	07/21/14
F	NSH		REV CS MODESTY PANEL GRAPHICS	103650	07/24/14
G	NSH		UPDATED NOTE 1 AND DB REVS	105893	01/26/15
H	NSH		REV ITEM 3 LOC: WAS 76.3, ITEM 1 & 2 TOUCH PAD LOC	119251	01/09/17
J	UKS		REPLACED ITEMS 4, 5, 14-16 WITH UPDATED CANTILEVER MODEL	143439	01/27/20
J	UKS		UPDATED 1ST STEP SPACING OF CANTILVER SEATS & UPDATED NOTES/ DB REV	143439	01/28/20



THIS SAMPLE LAYOUT IS PERTINENT TO DIESEL, BEB, CNG, EGENFLEX HYRBID AND BAE HYBRID BUSES.

NOTES:

1. *TO MAXIMIZE OCCUPANT CRASH PROTECTION AND REDUCE THE POTENTIAL FOR SIGNIFICANT INJURY TO PASSENGERS SEATED IN THE FIRST FORWARD FACING SEATS IMMEDIATELY REARWARD OF THE ADA AREA, GILLIG REQUIRES EITHER: 1.1 THE PLACEMENT OF A BARRIER FORWARD OF THESE SEATS. 1.2 USE OF A GRAB/STANCHION POLE FOR THE AISLE SEAT AND WALL MOUNTED GRAB HANDLE FOR THE OUTBOARD SEAT OR 1.3 SEAT BELTS ON BOTH THESE SEATS.*
2. ALL DIMENSIONS ARE IN INCHES.
3. FLOORING LAYOUT: SEE FL-67522R068.
4. THIS DRAWING IS TO BE USED FOR SEAT INSTALLATION. ALL OTHER GRAPHICS ARE SHOWN FOR REFERENCE ONLY. SEE BOM/ PAINT LAYOUT FOR EXTERIOR GRAPHICS AND GLAZING. FOR APPLICABLE O/H RAILS, TRANSMISSION HATCH AND STANCHIONS, RACKS AND HANDLES ON WHEEL WELL SEE BOM/MEETING NOTES.

SEAT AND RESTRAINT NOTES:

10. SEATS & RESTRAINT BELTS MUST MEET FMVSS 209 & 302 STANDARDS.
11. ALL SEATS WITH T-PEDESTALS SHALL HAVE AN OPEN CHANNEL DESIGN. ALL SEATS WITH DIMENSION E=6.12 SHALL HAVE 3.0 LONG MOUNTING SLOTS.
12. W/C BELTS AND RETRACTORS: SEE SPEC SHEET, ALSO AFFECTS REMOTE BELT RELEASE TYPE IF REQUIRED
    - A: Q' STRAINT = Q' STRAINT PULL HANDLE LEVER
    - B: SURE-LOK = SURE-LOK DUAL AUTO LOK (NOT AVAILABLE FOR OPTION P).
13. FOR EACH W/C LOCATIONS WITH FLOOR ANCHORAGE DISTANCES GREATER THAN 60 INCHES SHALL INCLUDE (2) WEBBING LOOPS. TOTAL QTY SHIPPED LOOSE: 2 (REQUIRED FOR CURBSIDE ADA AREA)
14. HIP TO KNEE DIMENSIONS SHOWN ARE NOMINAL. SEATS WILL BE EQUALLY SPACED.
15. REF: FOR OTHER SEAT DETAILS NOT SHOWN. SEE PURCHASING ORDER SPECIFICATION SHEET.

ITEM NUMBER	VENDOR PART NUMBER	(#) PASSENGER SEAT SIZE	(P) PEDESTAL (C) CANTILEVER	(G) GRAB HANDLE	(F) FLAT BACK PANEL	(QTY) STANCHION CUP	NOTES AND COMMENTS
20		–	–	–	–	–	OPTION H, RH
19		–	–	–	–	–	OPTION H, LH, WHEELWELL MOUNTED
18		3	C	–	–	–	W/C FLIP-UP, AFT ARMREST, STOP REQ.
17		–	P	G	–	1	W/C BARRIER, (2) PED, P1=10.00, P2=16.00, E=8.0, SEE NOTE 12
16		2	C	G	–	–	
15		2	C	G	–	–	
14		2	C	G	–	1	
13		2	P	G	–	1	(2) PED, P1=9.42, P2=16.55, E=6.12
12		2	P	G	–	1	(1) PED, Po = 26.25, E=6.12
11		2	P	G	–	–	MOUNTED TO WHEEL WELL, MIN TRAVEL ±1.5
10		3	P	–	–	2	AFT ARMREST, E=6.12
9		5	–	–	–	–	HINGED SETTEE, 1-3-1, GAS SPRINGS W/ SINGLE LOCKING PIN
8		3	P	–	–	2	AFT ARMREST, E=6.12
7		2	P	G	–	–	MOUNTED TO WHEEL WELL, MIN TRAVEL ±1.5
6		2	P	G	–	1	(1) PED, Po = 26.25, E=6.12
5		2	C	–	–	–	
4		2	C	G	–	–	
3		–	P	G	–	1	W/C BARRIER, (2) PED, P1=10.00, P2=16.00, E=8.0, SEE NOTE 12
2		2	C	–	–	–	W/C FLIP-UP, STOP REQ. @ SEAT POSITION 3
1		2	C	–	–	–	W/C FLIP-UP, AFT ARMREST, STOP REQ. @ SEAT POSITION 2

38 PASSENGERS

PASSENGER SEAT SUPPLIER: AMERICAN SEATING CO.
PASSENGER SEAT MODELS:
INSIGHT 18.0 WIDE FWD FACING
INSIGHT 17.0 WIDE AISLE FACING

FIRST CHASSIS: XXXXX

SIGNATURE ON THIS DRAWING INDICATES CUSTOMERS APPROVAL OF LAYOUT AND AGREEMENT THAT SAME IS IN COMPLIANCE WITH CUSTOMER'S SPECIFICATIONS. ONCE SIGNED THIS DRAWING BECOMES A PART OF

CONTRACT #________________

PURCHASE ORDER #:________________

SIGNED BY:________________
ACTING ON BEHALF OF AND WITH THE AUTHORITY OF

GILLIG DESIGN BULLETIN REQUIREMENTS: UNLESS OTHERWISE SPECIFIED

DESCRIPTION	DB NUMBER	REV
SETTEE:	DB 157.000	D
UPPER SECTION:	DB 157.001	C
CENTER SECTION:	DB 158.001	C
W/C RESTRAINT OPTION:	DB 152.014	AN
ADA CLEAR FLOOR SPACE:	DB 152.000	A
SEAT DIMENSIONAL SPEC.:	DB 152.001	D

DIMENSIONING AND TOLERANCING ARE PER ANSI Y14.5M-1982, UNLESS OTHERWISE SPECIFIED
HIP-TO-KNEE TOLERANCE: NON PADDED SEATS: ±0.25 PADDED SEATS: ±0.50
LINEAR: .X ±.3 .XX ±.12 .XXX ±.060 ANGULAR ±5°
THIRD ANGLE
CAD SCALE: 1:51
SIZE: B

STANDARD REVISION: J DATE: 01/28/20
DESIGNER: N. HOM DATE: 07/21/14

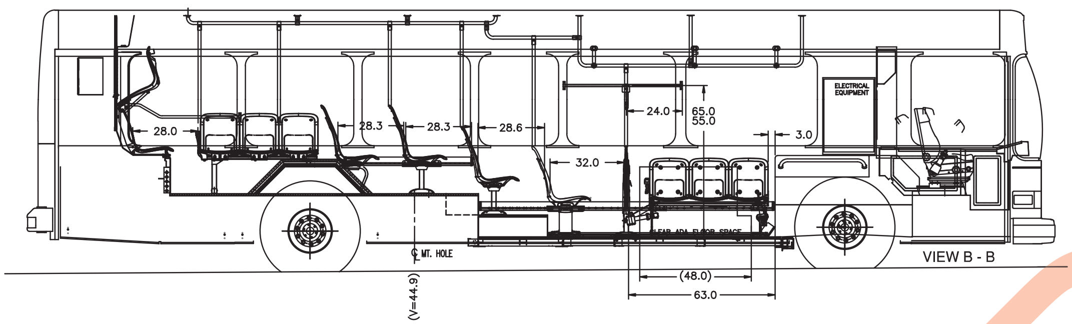
GILLIG
GILLIG LLC
LIVERMORE, CA

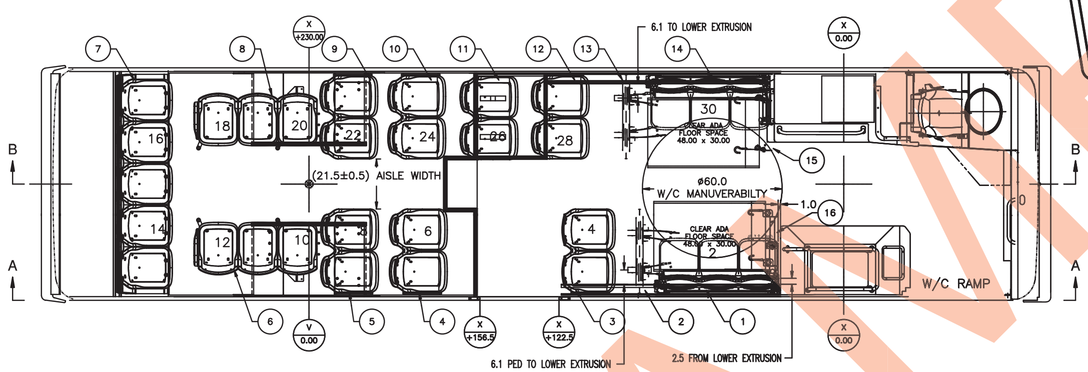
KIT & DIAGRAM, SEAT
LF2010 40' X 102"

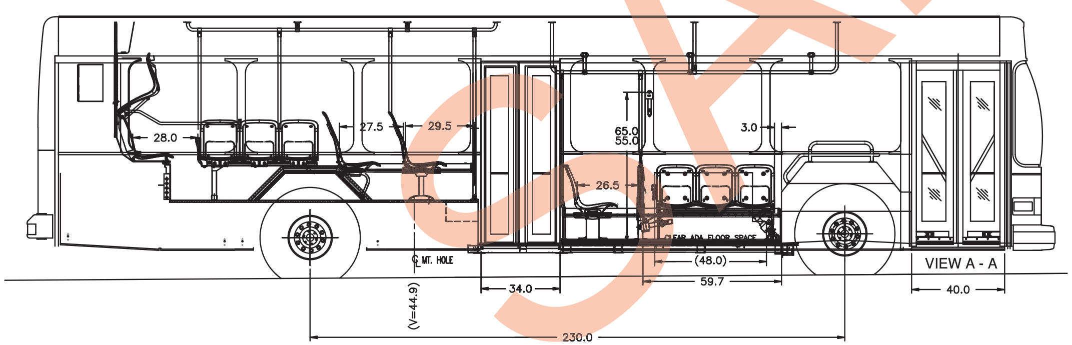
CUSTOMER NAME, STATE

PART NUMBER: SL-72715-XXXXX

GILLIG PARTS	QTY	GILLIG PARTS	QTY
STANCHION, REAR LONGITUDINAL	4	STRAPS, O/H GRAB	–
STANCHION, TRVS. @ 3RD STEP	2	BAR, WINDOW, 46.0	1
STANCHION, TRVS. @ 2ND STEP	1	STANCHION, 1.0 SINGLE OFFSET FWD RD	1
STANCHION, TRVS. @ 1ST STEP TO 9.0 O/H DROP	1	PANEL, MODESTY, 3RD STEP, C. SIDE	1
STANCHION, W/C BARRIER	2		







THIS SAMPLE LAYOUT IS PERTINENT TO DIESEL, BEB, CNG, EGENFLEX HYRBID AND BAE HYBRID BUSES.

NOTES:

1. *TO MAXIMIZE OCCUPANT CRASH PROTECTION AND REDUCE THE POTENTIAL FOR SIGNIFICANT INJURY TO PASSENGERS SEATED IN THE FIRST FORWARD FACING SEATS IMMEDIATELY REARWARD OF THE ADA AREA, GILLIG REQUIRES EITHER: 1.1 THE PLACEMENT OF A BARRIER FORWARD OF THESE SEATS. 1.2 USE OF A GRAB/STANCHION POLE FOR THE AISLE SEAT AND WALL MOUNTED GRAB HANDLE FOR THE OUTBOARD SEAT OR 1.3 SEAT BELTS ON BOTH THESE SEATS.*
2. ALL DIMENSIONS ARE IN INCHES.
3. FLOORING LAYOUT: SEE FL-67525R026 (NEED TO CONFIRM???).
4. THIS DRAWING IS TO BE USED FOR SEAT INSTALLATION. ALL OTHER GRAPHICS ARE SHOWN FOR REFERENCE ONLY AND THE FINAL DESIGN MAY VARY.

SEAT AND RESTRAINT NOTES:

10. SEATS & RESTRAINT BELTS MUST MEET FMVSS 209 & 302 STANDARDS.
11. GRAB HANDLE MATERIAL: ENERGY-ABSORBING OR STAINLESS STEEL??????????????????????
12. W/C BELTS AND RETRACTORS: Q-STRAINT??
13. SEAT INSERT: CLOTH COVERED VR50 OR CR50 WITH .50 PADDING
14. CANTILEVERED SEATS SHALL HAVE NO SHROUDS.??????????????????????????????
15. ALL SEATS WITH T-PEDESTALS SHALL HAVE AN OPEN CHANNEL DESIGN. ALL SEATS EXCEPT ADA SEATS SHALL HAVE 3.0 LONG MOUNTING SLOTS.
16. REF: FOR OTHER SEAT DETAILS NOT SHOWN. SEE PURCHASING ORDER SPECIFICATION SHEET.

PRELIMINARY RELEASE ONLY

P	APP	UPDATE CANTILEVER SEAT MODEL AND ITS DIMENSIONS	152312	02/02/21

REVISIONS

SYM	DWN	ZONE	DESCRIPTION	REL.	DATE
A	NSH		RELEASED FOR PRODUCTION	REI 77288	04/08/10
B	NSH		UPDATED DB & ADDED 2010 TO TITLE	REI [illegible]	08/27/10
C	NSH		UPDATED DB & ADDED STANCHION TO SEAT 12	REI [illegible]	01/12/11
D	NSH		[illegible] HIP TO KNEE [illegible] NOTE 3	REI 89713	05/18/12
E	NSH		UPDATE SETTEE W/ GAS SPRINGS DEL INSERT NOTE	REI [illegible]	[illegible]/12
F	NSH		UPDATE SETTEE , CS WW RACK GRAPHICS & DB	REI 96079	07/26/13
G	NSH		ADDED NOTE 1 & C SIDE MODESTY PANEL CALLOUT	101847	04/21/14
H	NSH		REV S.SIDE W/C BARRIER LOC : WAS 63.6	100862	05/27/14
J	NSH		REV O/H RAIL ADDED STANCHION TO ITEM 6 & 8	102350	07/14/14
J	NSH		UPDATED ITEM 6 & 8 TOP VIEW	103248	07/15/14
K	NSH		MOVED ITEM 1 & 14 AFT, UPDATED DB REV	104093	08/28/14
L	NSH		REV ITEM 3 HIP TO KNEE: WAS 27.3	105245	12/15/14
M	NSH		REV NOTE 1	105884	01/12/15
N	NSH		UPDATE GRAPHICS: S SIDE OH GRAB RAIL	111287	10/27/15

ITEM NUMBER	VENDOR PART NUMBER	(#) PASSENGER SEAT SIZE	(P) PEDESTAL (C) CANTILEVER	(G) GRAB HANDLE	(F) FLAT BACK PANEL	(QTY) STANCHION CUP	NOTES AND COMMENTS
16		–	–	–	–	–	OPTION H, RH
15		–	–	–	–	–	OPTION H, LH, WHEELWELL MOUNTED
14		3	C	–	–	–	W/C FLIP-UP, AFT ARMREST, TOUCH PAD
13		–	P	G	–	1	W/C BARRIER, (2) PED, P1=10.00, P2=16.00, E=8.0, REMOTE BELT REL
12		2	C	G	–	1	
11		2	P	G	–	1	(2) PED, P1=9.42, P2=16.55, E=6.12
10		2	P	G	–	1	(1) PED, Po = 26.25, E=6.12
9		2	P	G	–	–	MOUNTED TO WHEEL WELL, MIN TRAVEL ±1.5
8		3	P	–	–	2	AFT ARMREST, E=6.12
7		5	–	–	–	–	HINGED SETTEE, 1-3-1, GAS SPRINGS W/ SINGLE LOCKING PIN
6		3	P	–	–	2	AFT ARMREST, E=6.12
5		2	P	G	–	–	MOUNTED TO WHEEL WELL, MIN TRAVEL ±1.5
4		2	P	G	–	1	(1) PED, Po = 26.25, E=6.12
3		2	C	–	–	–	
2		–	P	G	–	1	W/C BARRIER, (2) PED, P1=10.00, P2=16.00, E=8.0, REMOTE BELT REL
1		3	C	–	–	–	W/C FLIP-UP, AFT ARMREST, TOUCH PAD

31

PASSENGERS

PASSENGER SEAT SUPPLIER:
AMERICAN SEATING CO.
PASSENGER SEAT MODELS:
INSIGHT 18.0 WIDE FWD FACING
INSIGHT 17.0 WIDE AISLE FACING

FIRST CHASSIS
000000 – 000000 (00) MM/DD/YY
000000 – 000000 (00) MM/DD/YY

SIGNATURE ON THIS DRAWING INDICATES CUSTOMERS APPROVAL OF LAYOUT AND AGREEMENT THAT SAME IS IN COMPLIANCE WITH CUSTOMER'S SPECIFICATIONS. ONCE SIGNED THIS DRAWING BECOMES A PART OF

CONTRACT #_______________

PURCHASE ORDER #:_______________

SIGNED BY:_______________
ACTING ON BEHALF OF AND WITH THE AUTHORITY OF
____

GILLIG DESIGN BULLETIN REQUIREMENTS: UNLESS OTHERWISE SPECIFIED

DESCRIPTION	DB NUMBER	REV
SETTEE:	DB 157.000	D
UPPER SECTION:	DB 157.001	C
CENTER SECTION:	DB 158.007	B
W/C RESTRAINT OPTION:	DB 152.014	AK
ADA CLEAR FLOOR SPACE:	DB 152.000	A
SEAT DIMENSIONAL SPEC.:	DB 152.001	D

DIMENSIONING AND TOLERANCING ARE PER ANSI Y14.5M-1982, UNLESS OTHERWISE SPECIFIED:
HIP-TO-KNEE TOLERANCE: NON PADDED SEATS : ±0.25 PADDED SEATS: ±0.50 | LINEAR: .X ±.3 .XX ±.12 .XXX ±.060 | ANGULAR ±5° | THIRD ANGLE | CAD SCALE: 1:51 | SIZE B

STANDARD REVISION: P | DATE 02/02/21
DESIGNER: N. HOM | DATE 04/08/10

GILLIG LLC
HAYWARD, CA

KIT & DIAGRAM, SEAT
LF2010 35' X 102"

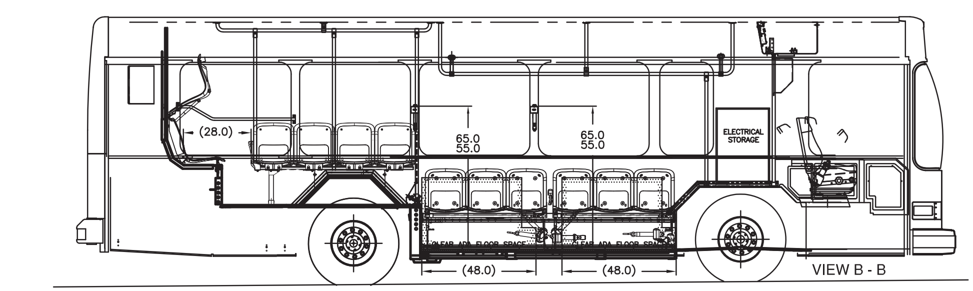
CUSTOMER NAME, STATE

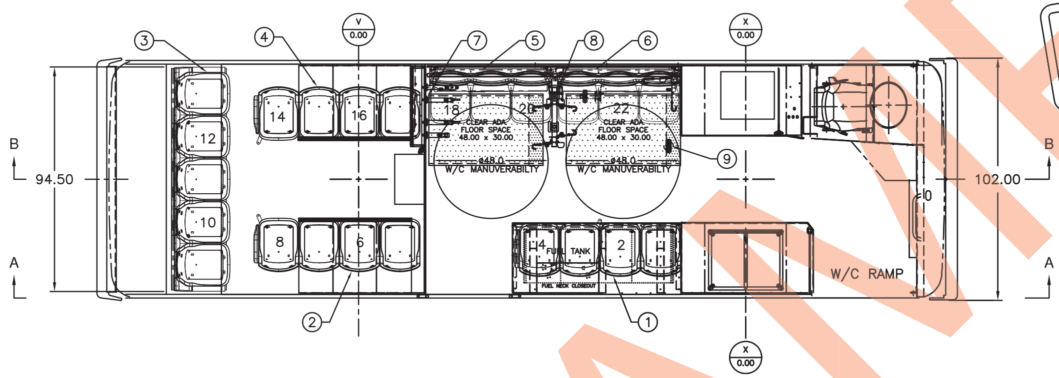
PART NUMBER: SL-66464-XXXXX

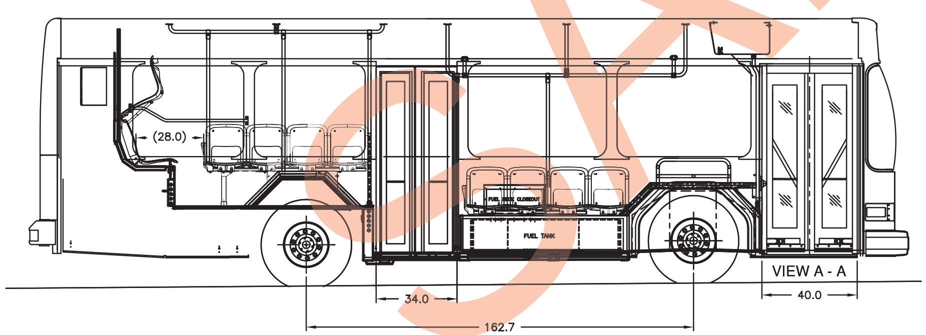
GILLIG PARTS	QTY
STRAPS, O/H GRAB	–
STANCHION, REAR LONGITUDINAL	4
STANCHION, FWD RD STRAIGHT	1
STANCHION, CS FUEL TANK	1
STANCHION, LONGITUDINAL @ S.SIDE FWD WW	1
PANEL, MODESTY, 3RD STEP, C. SIDE & S .SIDE W/ REMOTE BELT REL	1

REVISIONS

SYM	DWN	ZONE	DESCRIPTION	REL.	DATE
A	NSH		RELEASED FOR BID	107631	03/24/15
B	CNA		UPDATED DB REVISIONS	111243	12/28/15







NOTES:

1. ***TO MAXIMIZE OCCUPANT CRASH PROTECTION AND REDUCE THE POTENTIAL FOR SIGNIFICANT INJURY TO PASSENGERS SEATED IN THE FIRST FORWARD FACING SEATS IMMEDIATELY REARWARD OF THE ADA AREA, GILLIG REQUIRES EITHER: 1.1 THE PLACEMENT OF A BARRIER FORWARD OF THESE SEATS. 1.2 USE OF A GRAB/STANCHION POLE FOR THE AISLE SEAT AND WALL MOUNTED GRAB HANDLE FOR THE OUTBOARD SEAT OR 1.3 SEAT BELTS ON BOTH THESE SEATS.***
2. ALL DIMENSIONS ARE IN INCHES.
3. FLOORING LAYOUT: SEE FL–67617R000. (ALLISON CHECK CUSTOMER NOTES??)
4. THIS DRAWING IS TO BE USED FOR SEAT INSTALLATION. ALL OTHER GRAPHICS ARE SHOWN FOR REFERENCE ONLY AND THE FINAL DESIGN MAY VARY.

SEAT AND RESTRAINT NOTES:

10. SEATS & RESTRAINT BELTS MUST MEET FMVSS 209 & 302 STANDARDS.
11. GRAB HANDLE MATERIAL: ENERGY–ABSORBING OR STAINLESS STEEL????????????????????
12. W/C BELTS AND RETRACTORS: Q–STRAINT???
13. SEAT INSERT: CLOTH COVERED VR–50 OR CR50 WITH .50 PADDING OR CR50 WITH 1.25 BOTTOM AND .50 BACK PADDING. ??????????????
14. CANTILEVERED SEATS SHALL HAVE NO SHROUDS.?????????????????????????????
15. ALL SEATS WITH T–PEDESTALS SHALL HAVE AN OPEN CHANNEL DESIGN. ALL SEATS WITH DIMENSION E=6.12 SHALL HAVE 3.0 LONG MOUNTING SLOTS.
16. REF: FOR OTHER SEAT DETAILS NOT SHOWN. SEE PURCHASING ORDER SPECIFICATION SHEET.

PRELIMINARY RELEASE ONLY

THIS SAMPLE LAYOUT IS PERTINENT TO DIESEL AND CNG BUSES.

ITEM NUMBER	VENDOR PART NUMBER	(#) PASSENGER SEAT SIZE	(P) PEDESTAL (C) CANTILEVER	(G) GRAB HANDLE	(F) FLAT BACK PANEL	(QTY) STANCHION CUP	NOTES AND COMMENTS
9		–	–	–	–	–	OPT A2: FLOOR POCKET
8		–	–	–	–	–	OPT F: PIVOTING ARM W/ LOCK–DOWN PIN
7		–	–	–	–	–	OPT P: (4) D–RING MTD BELT ASSEMBLY, REMOTE BELT REL: 30.0 CABLE
6		3	C	–	–	–	W/C FLIP–UP, TOUCH PAD, AFT ARMREST, W/C RESTRAINTS ON FWD LEG
5		3	C	–	–	–	W/C FLIP–UP, TOUCH PAD
4		4	P	–	–	2	AFT ARMREST, E=6.12
3		5	–	–	–	–	HINGED SETTEE, 1–3–1, GAS SPRINGS W/ SINGLE LOCKING PIN
2		4	P	–	–	2	AFT ARMREST, E=6.12
1		4	–	–	–	1	AFT ARMREST, OVER FUEL TANK

23

PASSENGERS

PASSENGER SEAT SUPPLIER:
AMERICAN SEATING CO.
PASSENGER SEAT MODELS:
INSIGHT 18.0 WIDE FWD FACING
INSIGHT 17.0 WIDE AISLE FACING

FIRST CHASSIS
000000 – 000000 (00) MM/DD/YY
000000 – 000000 (00) MM/DD/YY

SIGNATURE ON THIS DRAWING INDICATES CUSTOMERS APPROVAL OF LAYOUT AND AGREEMENT THAT SAME IS IN COMPLIANCE WITH CUSTOMER'S SPECIFICATIONS. ONCE SIGNED THIS DRAWING BECOMES A PART OF

CONTRACT #________________

PURCHASE ORDER #:________________

SIGNED BY:________________
ACTING ON BEHALF OF AND WITH THE AUTHORITY OF

STANDARD REVISION – DATE –

DESIGNER N. HOM DATE 12/28/15

GILLIG

GILLIG LLC
HAYWARD, CA

GILLIG DESIGN BULLETIN REQUIREMENTS: UNLESS OTHERWISE SPECIFIED

DESCRIPTION	DB NUMBER	REV
SETTEE:	DB 157.000	D
UPPER SECTION:	DB 157.009	B
CENTER SECTION:	DB 153.025	C
W/C RESTRAINT OPTION:	DB 152.014	AK
ADA CLEAR FLOOR SPACE:	DB 152.000	A
SEAT DIMENSIONAL SPEC.:	DB 152.001	D

DIMENSIONING AND TOLERANCING ARE PER ANSI Y14.5M-1982, UNLESS OTHERWISE SPECIFIED:
HIP-TO-KNEE TOLERANCE NON PADDED SEATS: ±0.25 PADDED SEATS: ±0.50
LINEAR: .X ±.3 .XX ±.12 .XXX ±.060 ANGULAR ±5°
THIRD ANGLE
CAD SCALE: 1:51
SIZE B

KIT & DIAGRAM, SEAT
LF2010 29'-11" X 102"

CUSTOMER NAME, STATE

PART NUMBER SL-74030-XXXXX


INSIGHT®
AMERICAN SEATING

Your **INSIGHT**®
drives our innovation

The **INSIGHT** product offering combines lightweight design with superior strength, durability and comfort.

INSIGHT®
Cushion Onserts

INSIGHT-PRIME+®
Color Inserts

INSIGHT-PRIME®
Textured Module

INSIGHT-PRIME+

Color-coordinating inserts available in seven standard colors. No back panel required.

INSIGHT-PRIME

Seat module specifically engineered for cleanability.

INSIGHT's Construction

A large, sophisticated injection mold is able to produce a sleek, one-piece seat module made of a super-dense, composite resin with an integral grab handle. Each seat module hooks over the back side of the upper extrusion and is securely held in place by two front bolts. On two-pass transverse seats, one bolt secures the front V-filler to the back side of the upper extrusion. This five-bolt assembly simplifies any retrofit opportunities or rare cases of maintenance needs.

INSIGHT-PRIME and **INSIGHT-PRIME+** model types are built with a one-piece seat module, while **INSIGHT** adds a single back insert with a seat and a back cushion onserts that accept permanently bonded foam and/or upholstery. The back panel insert is held in place by six fasteners hidden by the cushion onserts. These onserts are secured to the perimeter of the seat with a quick-release system of hardware technology that does not require tools to efficiently remove and replace when required.

Options

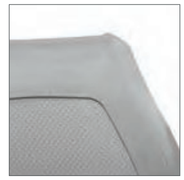

Cushion Onserts


Back Extension

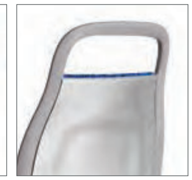

Textured Seat Module


Color Inserts


Grab Rail Cover


Without Grab Rail


Plastic Back Panel


Stainless-Steel Back Panel

	INSIGHT	PRIME	PRIME+
Cushion Onserts	•		
Back Extension	•		
Color-Coordinating Inserts			•
Drain Hole (Excludes Plush Pad)	•	•	•
Grab Rail	•	•	•
Grab Rail Cover	•	•	•
Without Grab Rail	•	•	•
Back Panel (18" only)	•		
Docket 90A	•	•	◉

(Standard Materials FMVSS 302 Compliant)

◉ *Prime+ Module: Docket 90A, Prime+ Inserts: Small components are exempt*

Cushion Onsert Selection

Standard 1/2" padded cushion with optional drain hole

Plush padded cushion (1-1/4" seat, 1/2" back)

VR-50® Vandal-resistant cushion with optional drain hole

CR-50® Cut-resistant cushion; available on standard and plush padded

Docket 90A foam and fabric available

Features

Contemporary Styling

Individual sculpted seat module with integral grab rail and back panel in complementary colors, with no unsightly welds or exposed fasteners.

Modular Design

Replacement of a single seat or major component if necessary is quicker and more economical. The one-piece molded seat module with minimal parts is unmatched in the industry.

Superior Comfort

Ergonomic seat design features the largest personal seating area, increased spaciousness in legroom and back height, and padded seat and back cushions for enhanced comfort.

Superior Vandal and Corrosion Resistance

Seat module constructed of advanced technology composite resin that is colored throughout and corrosion resistant materials. Mounting design incorporates anodized aluminum.

Module Color Selection

1471 Charcoal

980 Grey

989 Blue

Back Panel Selection

Thermoplastic

1471C Charcoal

980C Grey

989C Blue

Textured Stainless Steel

Insert Color Selection

Custom colors also available, minimum order quantities and additional costs may apply

2283 Red

2169 Dark Cool Grey

321C Teal

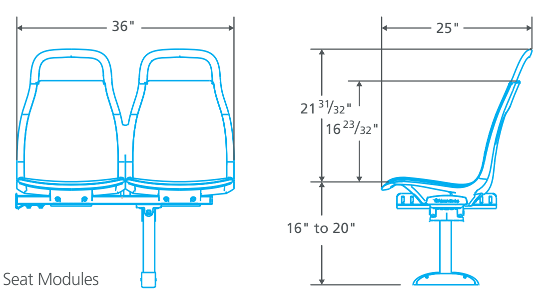
533C Navy

368C Go

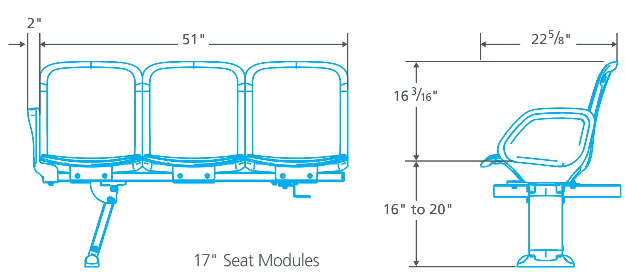
980 Grey

989 Blue

Dimensions



18" Seat Modules



17" Seat Modules

Model Types

- Transverse
- Transverse Flip-up
- Individual (Seat) Transverse Flip-up
- Longitudinal (17" & 18")
- Longitudinal Flip-up (17" & 18")
- Back-to-back
- Rear Cross

Detailed reference document available for each model type.

Our Mission

Since 1886, American Seating has set the standard for product design, durability and comfort. Our first transportation seat was introduced in 1931, and today we remain committed to exceeding the expectations of our customers. Our achievements serve as the platform for new and innovative products that are the benchmarks of our industry.

InSight is an iF Product Design award winner

AMERICAN SEATING

801 Broadway Avenue NW, Grand Rapids, MI 49504-4499
Phone 616-732-6600   800-748-0268   FAX 616-732-6401
americanseating.com

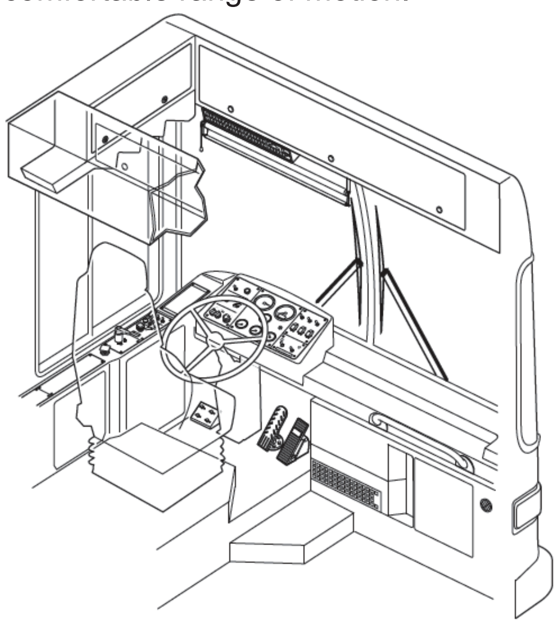
All products designed, engineered, manufactured, and tested in the USA.

American Seating is committed to lessening our impact on the planet through responsible stewardship of our environment.

OPERATORS AREA INSTRUMENTATION

The GILLIG Low Floor bus uses forward-looking technology combined with some unique ideas to avoid the inherent compromises found in most other low floor designs. Our concern for low cost, easy maintenance keeps the exterior and interior simple and uncluttered. This has led to an overall design that is pleasing, functional, practical, and safe.

Ergonomics dictate the design of the driver's workstation. Our design group went well beyond providing only sufficient seat adjustments and a tilt/telescoping steering column. Additional features include the functional placement of displays and controls, a driver's storage box, sun visors, etc. to fit within a driver's comfortable range of motion.

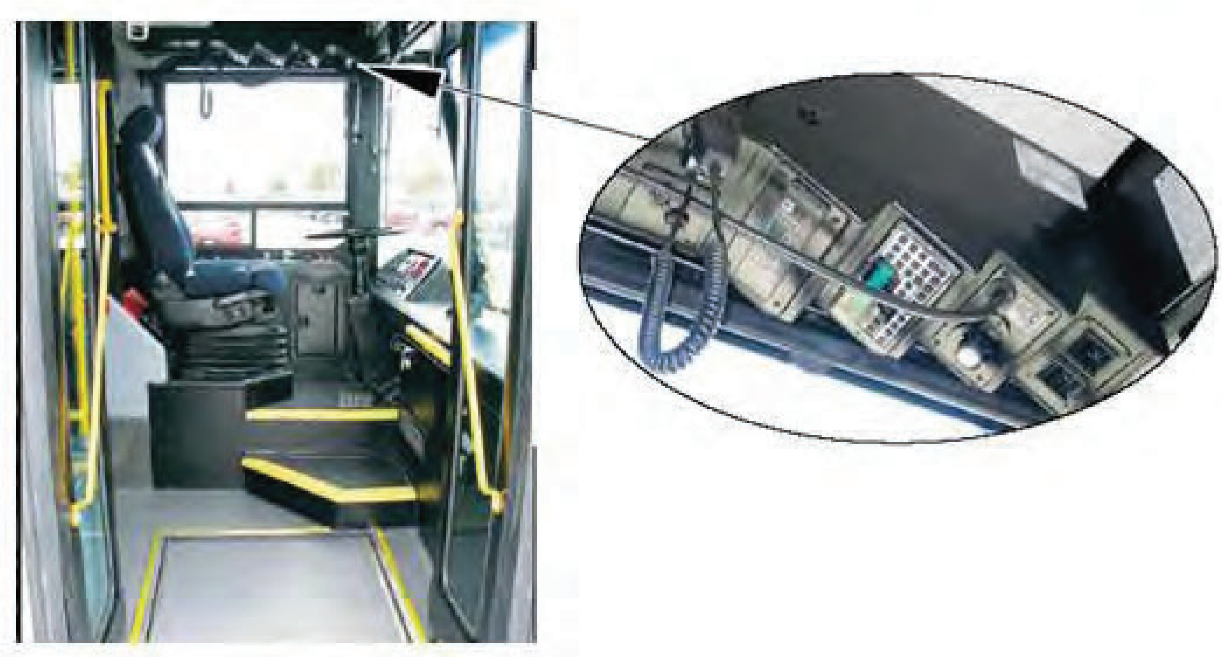


The driver's position has been designed to provide maximum comfort to drivers from the 95th percentile male to the 5th percentile female. To maximize the driver's comfort, additional ventilation is provided to the driver by a booster fan that delivers air through two overhead ventilators. Additional fresh air can be allowed into the bus through the full slider type driver's window.

Visibility, comfort, and vehicle control are other key factors of our design. GILLIG's Low Floor design incorporates a bulged, tilted back windshield to reduce interior glare and reflection. Customer feedback indicates that drivers prefer driving our buses because the bus provides better visibility, a smoother ride, and better handling. These factors leave the driver feeling more in control and more confident. We also provide the necessary space and comfort features, including superior heating and cooling that gives the driver an efficient, safe, and comfortable environment to work in.

The attached dash layout is a typical dash layout for your review. This is intended to show basic layout configuration only and not specific details. GILLIG will provide a custom layout for the Agency's review during the preproduction meeting.

OPERATORS AREA INSTRUMENTATION



Drivers Area Highlighting Ergonomic Sawtooth Display Panel

Drivers Front Dash Layout

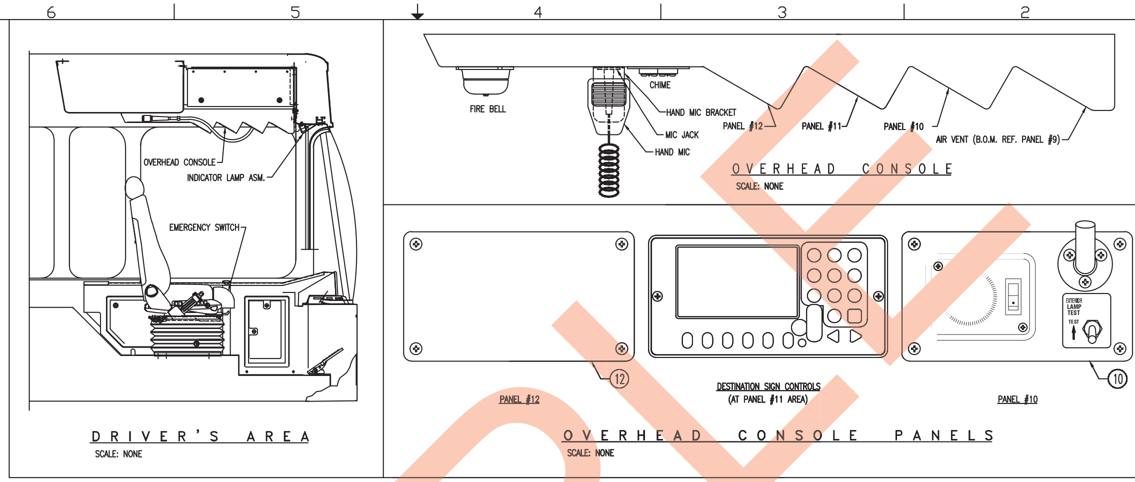
Left Side Dash Drivers Controls

Fire Suppression Controls and Cup Holder

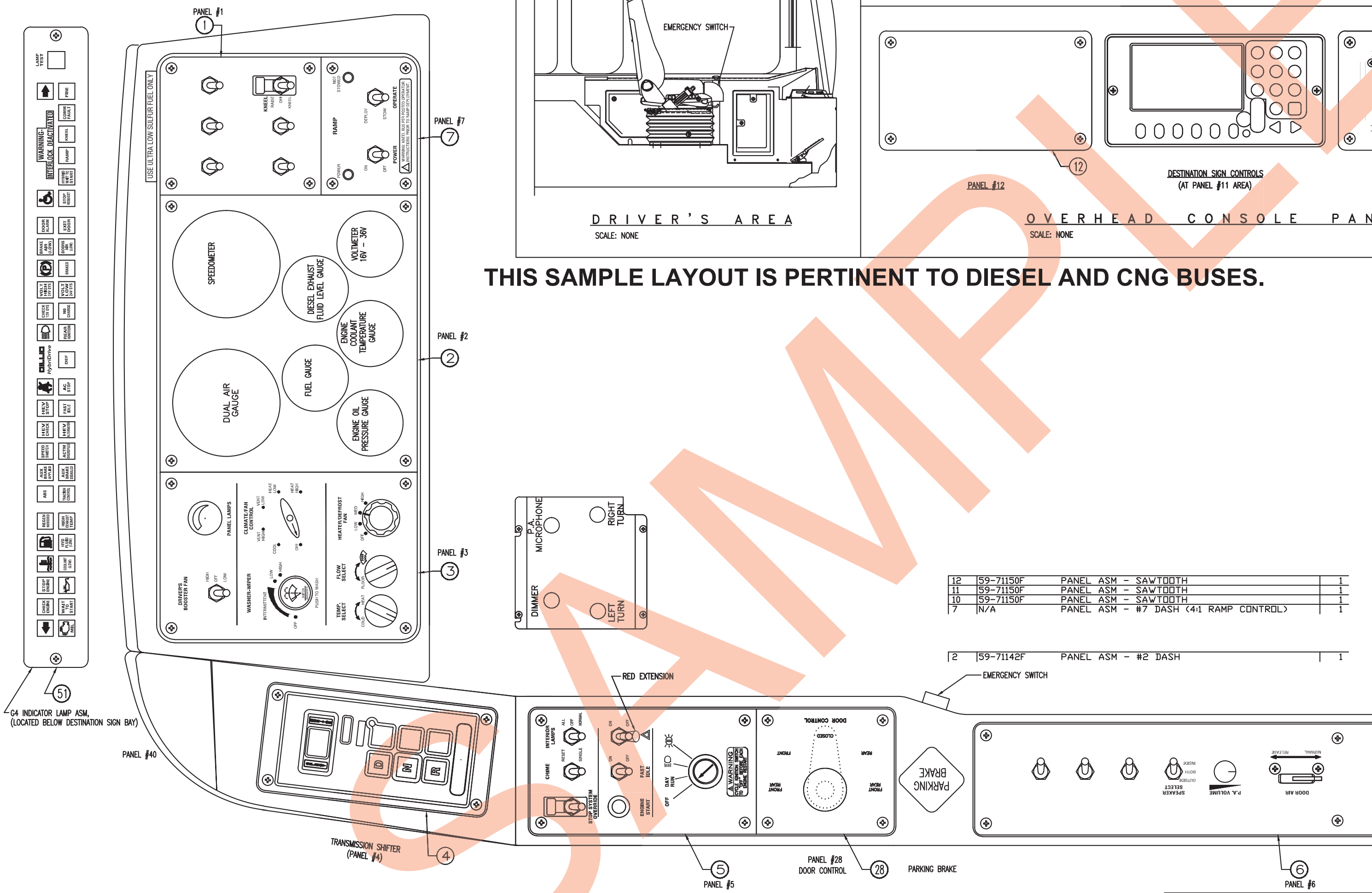
Drivers Door Control

REVISIONS

SYM	DWN	ZONE	DESCRIPTION	REL.	DATE
A			CUSTOMER APPROVAL & PRODUCTION RELEASE	REI	
A	KRM		CREATE & UPDATE FOR G4 VERSION	125427	8/6/18
B	KRM		MISC. UPDATES (SEE REI)	141023	10/11/19



THIS SAMPLE LAYOUT IS PERTINENT TO DIESEL AND CNG BUSES.



12	59-71150F	PANEL ASM - SAWTOOTH		1
11	59-71150F	PANEL ASM - SAWTOOTH		1
10	59-71150F	PANEL ASM - SAWTOOTH		1
7	N/A	PANEL ASM - #7 DASH (4:1 RAMP CONTROL)		1
2	59-71142F	PANEL ASM - #2 DASH		1

ITEMS 1, 2, 3, 5 & 6 ARE PART OF THE DASH LAYOUT BILL OF MATERIALS (DL-#####-000).
ALL OTHER ITEMS ARE SHOWN FOR REFERENCE ONLY.

ITEM NO	PART NUMBER	DESCRIPTION	QTY
54			
53			
52			
51	SEE B.O.M.	LAMP ASM., INDICATOR	1
50			
45			
44			
43			
42			
41			
40			
33			
32			
31			
30			
29			
28	20-53886N000	DOOR CONTROL, VAPOR, ANALOG	REF
27			
26			
25			
24			
23			
22			
21			
15			
14			
13			
12	30-37207F003	PANEL - OVERHEAD CONSOLE	1
11			
10	30-37207F052	PANEL - OVERHEAD CONSOLE	1
7	59-71147F	PANEL ASM - #7 DASH	REF
6	59-71146F	PANEL ASM - #6 DASH	1
5	59-71145F	PANEL ASM - #5 DASH	1
4	30-39344F000	PANEL - SHIFTER MOUNTING	REF
3	59-71143F	PANEL ASM - #3 DASH	1
2	30-60541F	PANEL - #2 DASH	1
1	59-71141F	PANEL ASM - #1 DASH	1

PARTS LIST

SIGNATURE ON THIS DRAWING INDICATES CUSTOMERS APPROVAL OF LAYOUT AND AGREEMENT THAT SAME IS IN COMPLIANCE WITH CUSTOMER'S SPECIFICATIONS. ONCE SIGNED THIS DRAWING BECOMES A PART OF

CONTRACT #____________________

PURCHASE ORDER #:____________________

SIGNED BY:____________________

ACTING ON BEHALF OF AND WITH THE AUTHORITY OF

____

ITEM NO	DESCRIPTION	QTY

GILLIG LLC
LIVERMORE, CA

QAC 3

MARK PART W/PN PER GIL DB #370.002
LH SHOWN, RH OPPOSITE — NONE

REMOVE ALL BURRS, BREAK SHARP EDGES

DIMENSIONING AND TOLERANCING ARE PER ANSI Y14.5M-1982 UNLESS OTHERWISE SPECIFIED TOLERANCES ARE IN INCHES:
DECIMALS .X ± .06 .XX± .03 .XXX± .010
ANGULAR ± .5°
THIRD ANGLE
1ST S.O.:

TITLE: INSTL - DASH/CONSOLE SWITCHES SSLF BAE HYBRID G4 DASH LAYOUT FORM

DWN: KRM	DATE: 11/27/17	MATER'L SPEC:	
CHKR'S INIT:	DATE:	MFG STD:	
APPR'S INIT:	DATE:	FMVSS COMPL: FMVSS 101	
ORIG REL #: REI 125427	SIZE D	DOCUMENT NO. DL-70424-002	
CAD SCALE: 2 = 1			

SHEET 1 OF 1

NOTES:
1. PANELS #3 AND #5 HAVE INCANDESCENT BACKLIGHTING PER FMVSS 101.
2. SOME FEATURES ARE FOR GRAPHIC PURPOSES ONLY AND DO NOT REFLECT ACTUAL CUSTOMER REQUIREMENTS. REFERENCE BILL OF MATERIAL FOR ORDER CLARIFICATION

The GILLIG Low Floor bus operator's area has been designed to provide maximum comfort to drivers from the 95th percentile male to the 5th percentile female. Our design group went well beyond providing only sufficient seat adjustments and a tilt/telescoping steering column. Additional features include the functional placement of displays and controls, a driver's storage box, sun visors, etc. to fit within a driver's comfortable range of motion.

For the driver's safety, the GILLIG Low Floor incorporates a stainless steel driver's platform into the bus chassis. This platform allows the driver to be protected from the typical accident strike zone. It also provides better driver visibility and allows the seated driver to be at a similar level as a passenger standing in the stepwell.

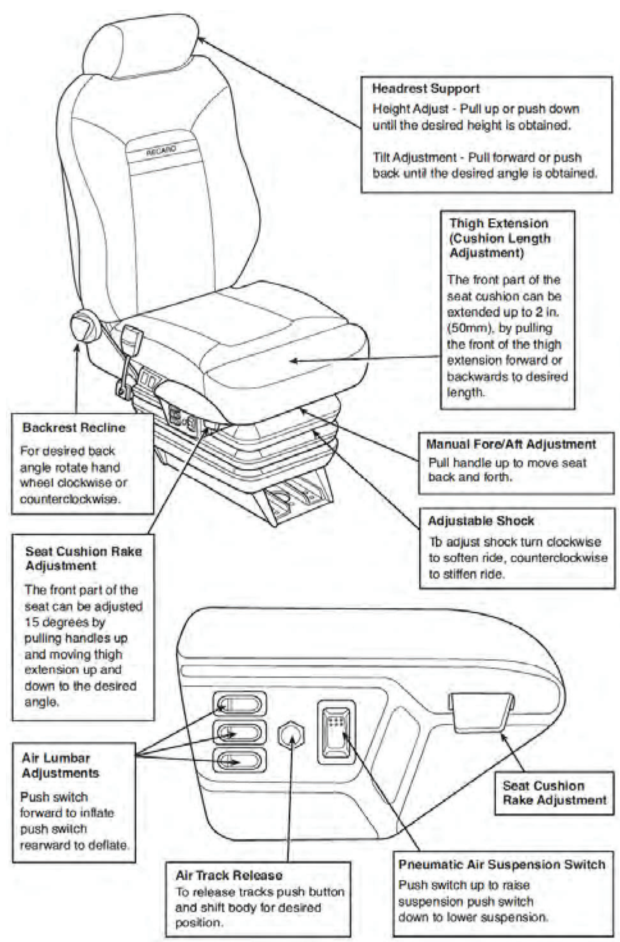
GILLIG's proposal includes a Recaro Ergo Metro driver's seat. The seat is mounted by bolting it to the floor of the driver's area. An air line from the vehicle air system is run from under the flooring to the left of the seat to supply air to the seat air cushion.

Optional features for the Recaro Ergo Metro include:

- FR Treated Foam (Docket 90A)
- Seat cushion alarm
- Seat belt alarm
- Arm Rests
- 74" three-point seatbelt

The Recaro Ergo Metro includes the following standard features:

- Pneumatic suspension
- Dual adjustable shocks
- Three-cell air lumbar
- Nine inches of fore and aft travel
- Air track release with center mechanical release
- 400 lb capacity
- High-density polyurethane foam
- Six inches of height adjustment
- Four-way adjustable headrest
- Meets FMVSS 302, 207, and 210 standards
- 15-degrees of rake adjustment
- Two inches of cushion thigh extension
- Two-year limited warranty



CORROSION PROTECTION: OVERVIEW

The design goal of producing a durable vehicle that would provide years of reliable service necessitated a construction that would be as corrosion resistant as possible.

All forms of corrosion were considered in the Low Floor bus designs, from basic oxidation caused by moisture and humidity to surface corrosion caused by chemical attack such as road or atmospheric salt or acid rain. Also considered was simple galvanic corrosion caused by ion transfer in contacting dissimilar metals, as well as the more complex inter-granular, oxygen cell, or metallic ion corrosion.

The corrosion resistance of GILLIG's Low Floor buses continues to increase as newer, more effective materials become available and as field experience in all varieties of conditions and environments is gained. Stainless steel is used extensively in the chassis construction, fuel tank, wheel wells, access door hinges, and electrical boxes, cushion clamps, and other areas. Aluminum extrusions are employed throughout the body construction, and 0.125-in. (0.218-cm) aluminum sheet is used to form the body panels and access doors. Improved undercoating materials, applied both before and after assembly, provide a high level of corrosion resistance to the finished vehicle.

Corrosion protection is achieved by a combination of:

- Careful material selection.
- Rigid process controls.
- Standardized surface preparation before the application of high-quality protective coatings.

Protective Coatings

GILLIG has increased the use of powder coated components, especially those sub-assemblies with moving parts that create nooks and crannies that can hold moisture. All GILLIG manufactured parts and parts that are provided through the supply chain are required to adhere to GILLIG manufacturing standards that specify the proper cleaning, priming, and quality checks that parts must go through. These procedures are in place to reduce areas that may hold moisture and therefore be more susceptible to corrosion.

Improved undercoating materials, such as our durable latex-based anti-corrosion under-coating, which is highly sag-resistant and intended for direct to metal underbody adhesion, has passed over 1,000 hours of salt-spray resistance per ASTM B-117 as well as 100% relative humidity testing per ASTM D-1748. The film is not affected when immersed in aggressive, caustic solutions. This undercoating is environmentally safe and meets the strictest of air quality regulations.

CORROSION PROTECTION: MATERIALS

The GILLIG Low Floor bus is manufactured to a very high standard of quality and finish. Aircraft-quality materials provide high structural integrity and naturally high corrosion resistance.

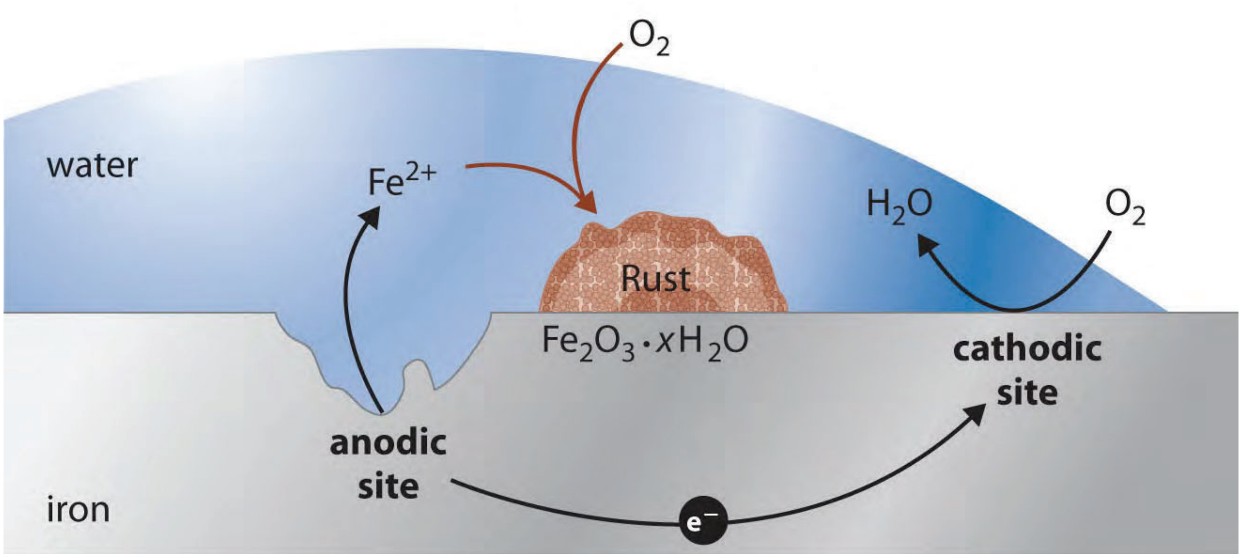
- Stainless-steel chassis structure with epoxy corrosion-protective coating applied at all body connection faces
- Type 3 hard anodized aluminum body structure
- Type 2 anodized aluminum mid-rail
- Fiberglass front and rear body panels
- Corrosion-resistant aluminum body skirts
- Aluminum rear and side-skirt hinged engine access doors
- Aluminum rivets on skirt panels and skirt-panel brackets
- Stainless-steel interior trim fasteners, to withstand interior bus wash and tracked-in road salt
- Stainless-steel external body screws with non-metallic galvanic corrosion barrier
- Nylon Sprague wiper spanner lock-nuts and acorn nuts
- Stainless-steel attachment hardware for the four rubber wheel-well fenders
- Stainless-steel compartment floor sheet for HVAC
- Powder coated chassis component-mounting brackets
- Stainless-steel coolant surge tank
- Aluminum radiator to side-door baffle to exclude rear-wheel-thrown road salt and debris from the faces of the turbo-after-cooler and radiator
- Corrosion- and chemical-resistant coating on cooling fan frame
- Stainless-steel cushion hose clamps, all locations
- Stainless-steel wheel wells
- Aluminum powder coated wheel-well stress panels
- Rubber mud guard for wheel arch fenders
- Primary stainless-steel grab handles, stanchions, and fasteners. Cast aluminum pow-der coated tees, hangers, and elbows
- High-solids, aluminum-filled epoxy corrosion protective coating applied to the entire aluminum sidewall body structure before assembly onto chassis
- Specially formulated sealant coatings for all body/chassis connections
- Stainless-steel fuel tank with stainless-steel mounting straps

- 7-ply treated marine-grade plywood or optional phenolic composite floor, with undersides and edges pre-sealed with undercoating
- All wheel-well joints fully sealed with high-performance sealant
- All floor joints sealed with high-performance sealant
- Stainless-steel battery compartment tray
- Stainless-steel with non-metallic battery hold downs (optional)
- Stainless-steel fuse box and seal
- Stainless-steel mounting bracket for battery disconnect and Vanner voltage equalizer
- Non-metallic, high-dielectric-strength barrier tape separates aluminum and steel materials in body and roof to prevent galvanic corrosion
- Stainless-steel rear settee enclosure and access cover
- Entire lower vehicle underbody and exposed chassis are treated with durable latex-based anti-corrosion undercoating
- Optional electrolytic “E” coating of radiator/CAC/hydraulic oil cooler.
- Corrosion-resistant ABS valves with bayonet connectors
- Exterior lamps mounted with rubber-jacketed nuts to prevent galvanic corrosion
- Stainless-steel rear bumper mounting bracket with pre-applied galvanic isolator
- Stainless-steel steel skirt panel hinges isolated with a high-dielectric-strength barrier tape

Corrosion of Ordinary Carbon Steel

Corrosion is essentially an electrochemical process in which metal ions react with the surrounding environment to form an oxide. Current (electrons) naturally flow between active areas on the metals surface (anodic sites) and other areas (cathodic sites), forming the electrochemical cell. This is essentially same principle that dictates the behavior of a battery.

The figure below describes the reaction of ordinary carbon steel with oxygen (O_2) that is present in the atmosphere. The anodic (active) areas may initially be remnants of mill scale, inclusions, discontinuities, or possibly the effect of pollutant on the oxide film. Electrons migrate away from the anodic sites, producing positively charged iron molecules. Oxygen from the water combines with iron in the steel to form iron oxide (Fe_2O_3), known more commonly as rust.



Typical carbon steel is approximately 98% iron (Fe). Iron oxide on carbon steel does not form a continuous layer on the steel because the iron oxide molecule has a larger volume than the underlying iron atoms. The iron oxide scale is essentially porous in nature, which allows for continued attack of the steel substrate, regardless of the thickness of the overall oxide layer.

Although the layer of iron oxide significantly slows the rate of corrosion and acts as a partial barrier for salts or other corrosive elements, the overall rate of corrosion is still unacceptably high in most applications. Thus, the only way for carbon steels to have true corrosion resistance is to surface them with some type of protective coating—e.g. paint, oil, or galvanizing.

GILLIG has elected to use 3CR12 stainless steel for their chassis instead of ordinary carbon steel.

Selection of 3CR12

Several factors besides corrosion resistance were considered when selecting GILLIG chassis material. The most crucial factors were strength, ease of fabrication, and toughness throughout the operating temperature range of the vehicle. 3CR12 has a generally higher fatigue and yield strength compared to typical structural grades of carbon steel. It is also easily welded and formed, without upsetting the internal grain structure of steel. 3CR12 has a greater range of temperature stability, avoiding a transition from ductile to brittle fracture behavior at low temperatures.

Corrosion Behavior on 3CR12

In contrast to carbon steel, stainless steels like 3CR12 derive their corrosion resistance from the element chromium: any steel containing at least 10.5% or more chromium is defined as a stainless steel. Chromium in stainless steel results in the formation of a passive layer, which is a thin, non-porous chromium oxide film that acts as a barrier to protect the underlying metal against further reaction with the corrosive atmosphere.

Also, chromium as an alloying element in steel fights corrosion because if the stainless steel surface is damaged and exposed to oxygen, this tightly adherent passive film on its surface reforms itself rapidly, thus maintaining its corrosion protection. This process is called re-passivation.

The chromium oxide prevents further oxidation of the stainless steel. 3CR12 contains approximately 11.5% chromium, which enables the steel to form this stable, corrosion-resistant protective film on its surface.

Quantifying these differences, general atmospheric corrosion testing of 3CR12 has given corrosion rates 115 times slower than that of exposed carbon steel under the same conditions.

Rusting on 3CR12

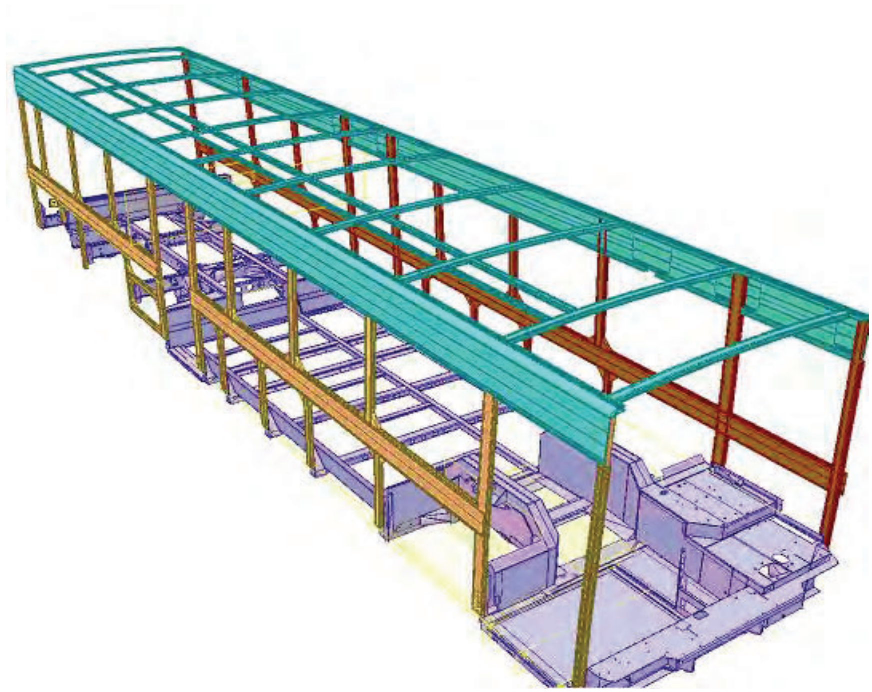
The presence of contaminants can affect corrosion resistance of stainless steels considerably. One of the most important factors is chloride concentration. If left unattended, chloride ions (from road salts and de-icing chemicals) concentrate on the surface of stainless steels enough to produce very small, local breaks in the passive layer of the stainless steel. At the site of the breaks, where the metal is temporarily unprotected, the wet, chloride-rich environment slows the rate of re-passivation, and the steel can develop micro pits. The development and dispersion of micro pits should not be confused with the general, all-over corrosion on non-alloyed carbon steels.

In practice, for low-alloyed or utility stainless steel materials like 3CR12, exposure to more aggressive or corrosive environments leads to the passive oxide layer growing thicker, forming a uniform rust-colored patina. Wetting the surface with salt water is considered to initiate corrosion, typically in localized areas, as is seen by small rust spots. Drying allows reformation of the passive layer, and subsequent wetting flushes out any remaining concentration of chlorides that may have resulted in active areas with micro pits. New areas of local corrosion may form with each wetting and drying cycle.

The build-up of corrosion product—i.e., red rust—covers the metal beneath. This rust layer then acts as a partial barrier to chloride ions and prevents further destruction of the metal below. Underneath the rust layer, the metal interface also has a significant chromium content due to the depletion of iron. Hence, corrosion of the underlying metal is reduced to extremely low rates. This is why it is considered that, while not aesthetically pleasing, the structural integrity of the 3CR12 steel section is not affected. 3CR12 has a proven history of maintaining structural integrity and cross-sectional consistency in corrosive and marine environments for more than 30 years, spanning several industries.

To maintain optimum appearance, frequent neutralization and washing of all chassis/undercarriage areas is important. If desired, areas with surface rust present can be treated by abrading with non-metallic or non-ferrous metal tools, which remove any unsightly surface rust and allow the clean, bare metal to naturally re-passivate.

CORROSION PROTECTION: LOCATIONS



The unique chassis platform of a GILLIG Low Floor consists of a stainless-steel structure with integral side impact barriers. The three chassis modules (front, center, and rear) are constructed of both open and tubular section structural shapes that are welded together in specially designed fixtures with common tooling points to those of the body. The final chassis assembly is fastened together using a Huck bolt system.

The robust, integral side impact barrier has been designed to provide maximum collision security to passengers inside the Low Floor section of the bus. This 15-in. (38-cm) high barrier also provides a significant structural element by equipping the center section of the frame with a sturdy perimeter.

The forward chassis structure features a tubular bridge section, which includes a large stainless-steel shear panel, over the front axle. The front structure that supports the bumper and the “A”-posts is a 12-in. (30-cm) high stainless-steel channel. This channel is supported by fabricated I-beams and the stainless-steel driver’s platform.

Corrosion protection is fortified with an application of a durable latex based anti-corrosion undercoating to the entire exposed underside of the completed chassis assembly.

Stainless-Steel Chassis

The GILLIG Low Floor chassis structure is manufactured from 3CR12 stainless steel. The corrosion rate of 3CR12 stainless steel is 115 times less susceptible to corrosion than that of carbon steel. Additionally, whereas carbon steel suffers from an “all over general corrosion”, 3CR12 would only develop micro-pits that do not propagate, and these become passive after some time.

To put this into perspective, if a plain unfabricated piece of 1/16” thick 3CR12 were left outside in a severe marine atmosphere (that is right on the coastline), it would take a minimum of 700 years to corrode through its thickness, whereas a piece of carbon steel in the same thickness would only take about 6 years to corrode through.

Such a material makes a perfect foundation for a bus chassis that’s subjected to harsh, corrosive atmospheres—and that’s why it was chosen for the GILLIG low floorbus.

Passenger and driver safety features are other important design criteria that have been incorporated into the design of the GILLIG Low Floor. In the Low Floor application, it should be noted that provision must be made to particularly protect the passengers from side impact, as they are located at a lower level than standard floor buses. With this in mind, the GILLIG chassis substructure incorporates a unique side impact protection barrier in the lower level. That side impact barrier combined with the driver’s front protection module provides for a strong and durable structural foundation.

The front stainless steel module design also allows for better ADA accessibility. The enlarged entrance area leads to a wide aisle way between the front wheel wells. It actually provides for a 36” width in that area and allows generous room for maneuvering the larger mobility devices.

Top: Front section of the stainless-steel chassis. Bottom: Center section of the stainless-steel chassis.

Aluminum Body Frame

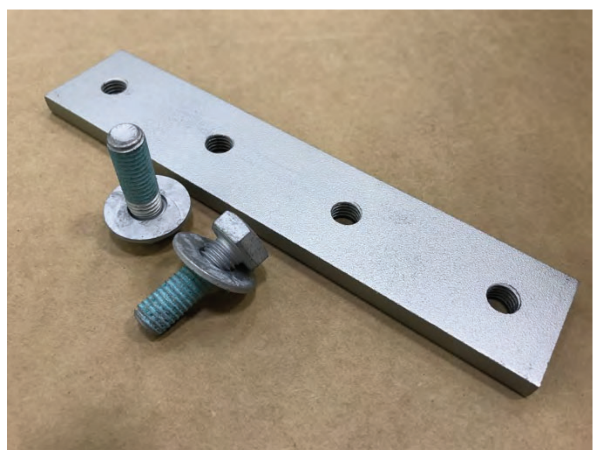
The GILLIG Low Floor body frame is assembled of aluminum extrusions, forgings, and castings. Aluminum is inherently corrosion resistant as formed since surfaces produce a barrier of oxide film within minutes of being produced. To extend this level of performance, all extrusions below the window line are treated with grades of anodizing and sealing which exceed military specifications and produce an exceptional corrosion barrier, and interior shear panels are formed of 5052 aluminum, which is one of the most corrosion-resistant grades of aluminum sheet available.

GILLIG's mid-rail extrusion receives a type 2 anodizing and sealing before assembly, after all machining is performed. The vertical body posts receive a type 3 hard anodizing and sealing. Both processes exceed military specifications.

After assembly and before exterior panel installation, in addition to anodizing, GILLIG sprays a high-solids aluminum-filled epoxy corrosion protection coating throughout the vertical sidewall body structure, from the lower edges of the structure to above the midrail extrusion.

GILLIG also uses a super durable powder coating on the major aluminum shear panels, each fastened with coated aircraft-grade structural rivets. All aluminum body extrusions are assembled with engineered corner gussets, attached with high-strength channel nuts and Geomet coated class 8.8 bolts.

There is no welding on the GILLIG Low Floor body structure.

Left: Coated Body Structure. Right: Geomet-Coated Body Attachment Hardware.

The Low Floor body structure is fastened to the chassis assembly using Geomet coated class 10.9 bolts and hardened washers. The Geomet coating offers excellent corrosion protection not only for the fasteners, but for the aluminum body structure as well. Geomet has 5 times the salt spray protection of a standard zinc-coated fastener.

The body structure/chassis connection is a heavily engineered feature on a GILLIG Low Floor bus. It provides unparalleled safety as well as ease of service, in the event of vehicle damage from a collision.

Before the body is connected to the chassis with Geomet hardware, a specially formulated hybrid epoxy/sealant coating is applied to the mating surfaces to add mechanical strength and seal out corrosive elements. After the connection is made, all joints are redundantly sealed.

Left: Protected & sealed body/chassis connection. Right: Sealed wheel well and stress panel arch.

The powder coated aluminum wheel arch stress panels are bonded to the side wall structure to create a weather tight seal. The stainless steel wheel wells and attachment rivets are also completely sealed to prevent water from entering the bus.

Roof Structure

The roof structure includes aluminum extrusions and sheet fiberglass-reinforced plastic (FRP), which are joined together with a two-component methacrylate adhesive, producing an incredibly strong structural bond. The FRP is chemically neutral and is not subject to corrosion. The aluminum, which is inherently resistant to corrosion, is painted with exterior paint if it will be exposed to the elements. Non-exposed interior surfaces are covered by insulating material.

Front/Rear Caps

Front and rear body caps are molded fiberglass, which are painted to match the customer’s design layout. Fiberglass does not corrode. Embedded tapping plates for installing lights, etc. are 304 stainless steel, to resist any corrosion.

Skirt Panels

Skirt (side) panels are manufactured from 0.125-in. (0.318-cm) thick sheets of 5052-H32 aluminum. This metal has high resistance to corrosion and is of medium strength. These pieces are high in stiffness to prevent drumming or oil caning. Both sides of the panels are first treated with multiple coats of epoxy primer before being painted with Axalta topcoats per the customer's design. The interior surface edging of the panel is painted with the epoxy primer as well as GILLIG's aluminum-filled epoxy corrosion protective coating.

Each of these processes are inspected and documented. The careful selection of materials and methods ultimately result in a bus that withstands the toughest of operating environments throughout the life of the bus. This is one of the many reasons GILLIG buses have a lower lifetime cost of ownership.

Skirt Panels – Brackets

The lower attachment brackets for the skirt panels are manufactured from corrosion-resistant 5052-H32 aluminum. Additional corrosion resistance is provided by adding a durable powder coating and edge sealing during assembly.

The brackets are installed using aircraft-grade structural aluminum rivets, avoiding any dissimilar metal contact.

Sealed & powder coated aluminum skirt panel bracket

Skirt Panels – Non-Hinged

The skirt panels are manufactured from 0.125-in. (0.318-cm) thick 5052-H32 aluminum. The material comes from a pre-primed aluminum coil that is treated with an epoxy paint.

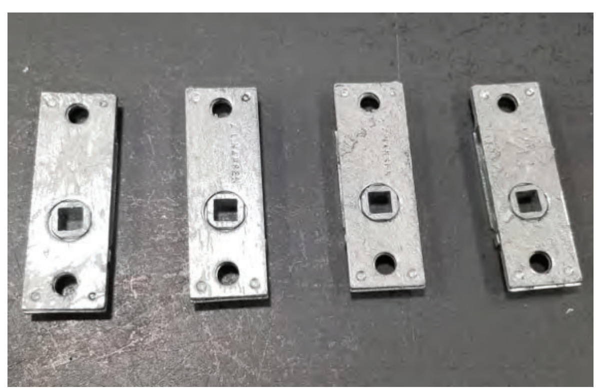
After receipt of the panels, GILLIG treats the shear edges and areas that will insert into the mid-rail with our high-solids aluminum-filled epoxy corrosion-protection coating.

Non-hinged skirt panels have a 2-in. (5-cm) piece of polyurethane foam tape every 12 in. (30 cm) before being inserted into the mid-rail channel. The tape eliminates road rattle and allows air flow inside the mid-rail channel which eliminates moisture saturation. The bottom edge of the skirt panel is bolted to the skirt panel brackets using Dacromet and/or Geomet coated fasteners.

Tape applied to top edge of coated skirt panel

Skirt Panels – Hinged

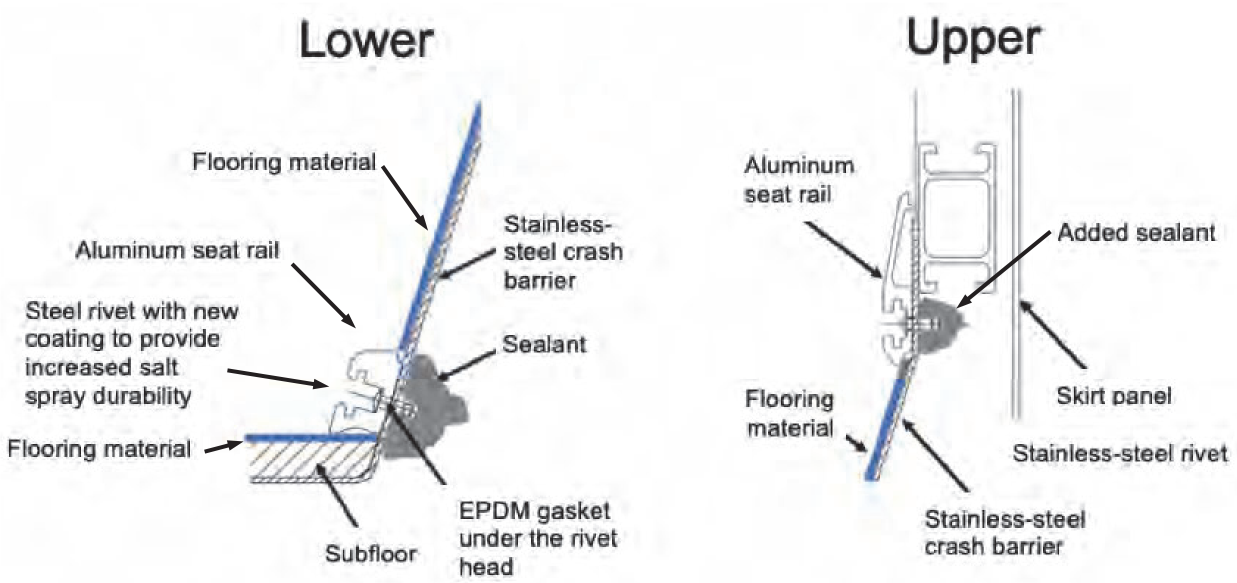
Hinged skirt panels are attached to the body with stainless steel hinges. The surface of the panel where it is attached to the hinge is coated with epoxy primer. Additionally, a continuous strip of high-dielectric-strength isolating tape is bonded between the hinge and the body attachment for added corrosion protection. These panels are locked in place with 5/16-in. (0.8-cm) stainless square key locks. The back of the stainless-steel lock is coated before being riveted to the panel with aluminum rivets. The body mounted lock catch is also treated.



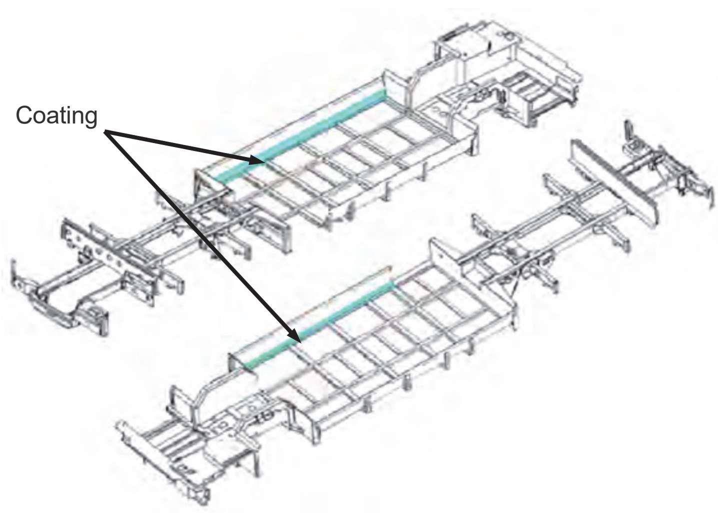
Left: Isolating tape applied over primed hinged panels.
Right: Stainless steel square key locks with pre-applied protective coating.

Seat Rail Mounting

The seat rails are secured to the chassis with rivets. The upper seat rail is mounted to the chassis with a stainless-steel rivet. The backside of the rivet is then sealed with Manus 75AM. The lower seat rail rivet is the same rivet except the coating is zinc-nickel plated that is rated at 2,000 hours of salt-spray testing before red rust is visible. The rivet also has a washer under the head to prevent water intrusion from entering the joint from the inside of the bus.



GILLIG also provides a barrier between the lower seat rail and the crash barrier. A galvanic corrosion coating is applied to the chassis crash barrier prior to the installation of the lower seat rail. The chassis crash barrier is cleaned and primed with an epoxy coating to eliminate the direct contact between the dissimilar metals providing protection against galvanic corrosion.



CORROSION PROTECTION: TESTING

GILLIG contracted with a specialty test lab to conduct an evaluation of our current corrosion protection process.

GILLIG and the test lab designed the test protocol to compare the cumulative real-world damage by corrosion, mechanical stresses, and environmental exposure with salt spray testing, which cannot replicate these other stresses.

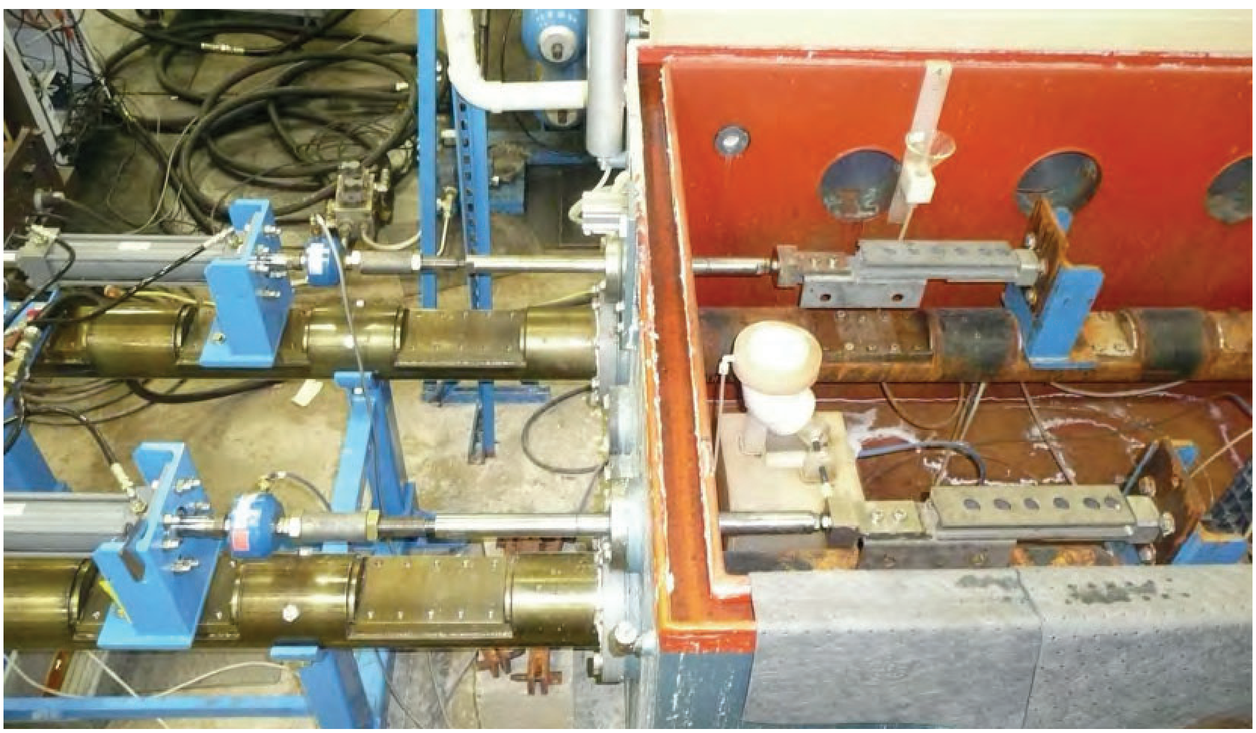
The test protocol combined cyclic mechanical loading and exposure to an array of corrosive substances, including several common de-icing salts. Samples were also pre-conditioned, involving temperature shock, humidity extremes, and abrasive blasting to demonstrate resilience to real-world environmental factors.

The goal was to design a comprehensive test that is aggressive enough to provide a conservative estimate of body /chassis structure protection over a 12-year life of a GILLIG bus.

Summary of Results

The post-test samples showed zero structural flaws; uniform isolation; protection on the aluminum surface mating to the chassis; and significant reduction in corrosion depth and concentration inside the aluminum extrusion gusset channels.

The testing supported an estimated bus life far exceeding the requirement of 12 years.



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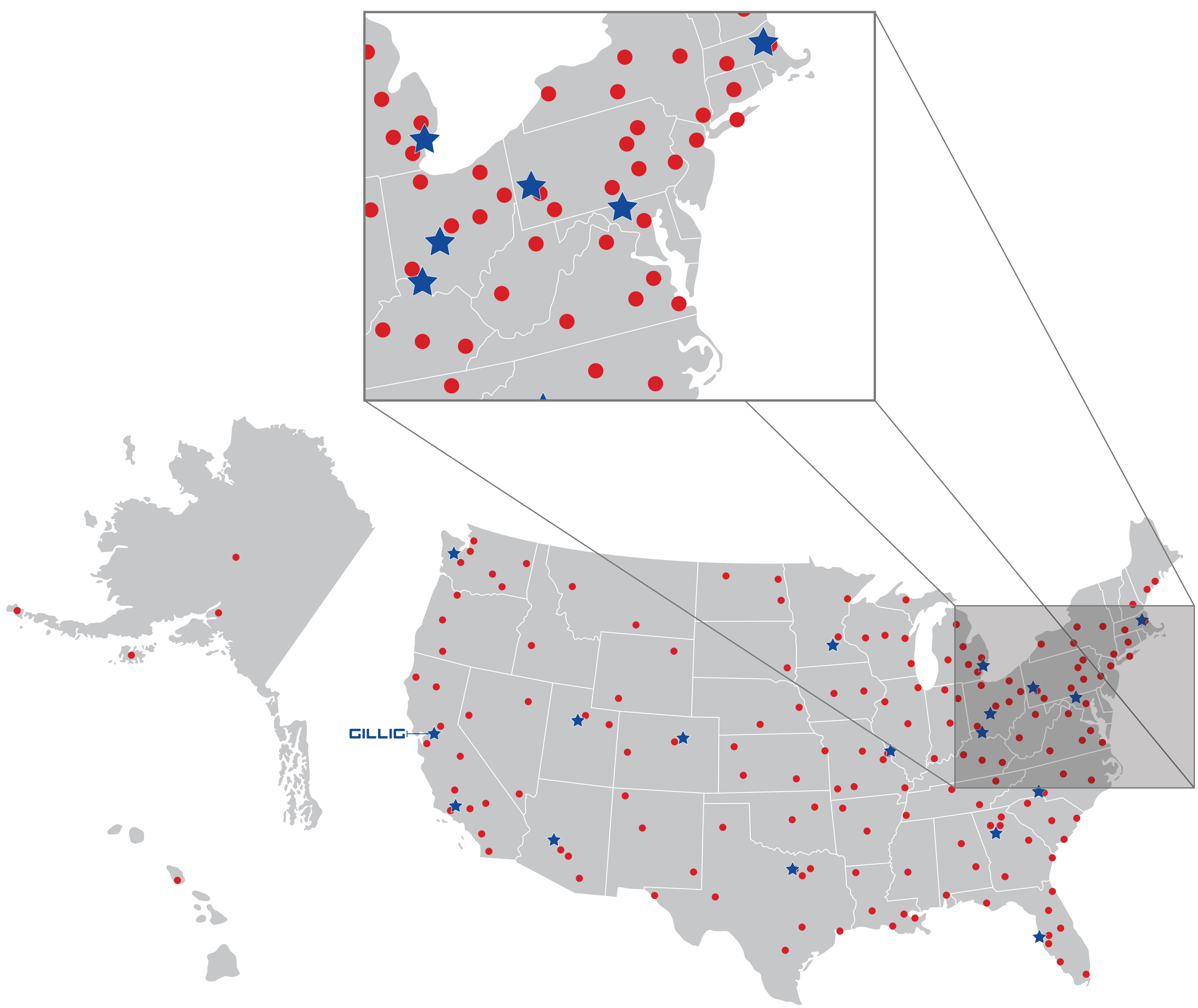

SERVICE DEPARTMENT

GILLIG maintains a fully qualified, trained Service Department to respond to the procuring Agency's request for assistance after delivery of equipment.

The Field Service Trainers and Field Service Representatives have extensive "hands-on" experience on our coaches. The Field Service Trainers are available to provide training to your staff on the proper operation and maintenance of the equipment. The Field Service Representatives are fully qualified to assist the procuring Agency in the maintenance of equipment, including, but not limited to major component replacement and repair, electrical troubleshooting, suspension and frame repair, as well as repair of all ancillary components and systems.

In-house qualified Field Service Representatives are available to troubleshoot questions by phone, Monday through Friday, 5:00 a.m. to 2:00 p.m. (PST).

WARRANTY DEPARTMENT

The Warranty Department is available to assist the procuring Agency processing warranty claims as required. The Warranty Processing Specialist will assist the procuring agency in the proper procedure for obtaining warranty parts, completion of the warranty forms, and the handling of parts for warranty claims processing.

ENGINEERING DEPARTMENT

We also maintain a fully experienced, qualified Engineering Department, directed by the Vice President of Engineering. The Engineering staff are available on request to assist in the resolution of engineering or design problems that may arise within the scope of the specifications during the warranty period.

The GILLIG Engineering Department is located at the manufacturing plant in Livermore, CA, and is continually available to assist the manufacturing process. The integrated staff performs all vehicle engineering, including the research and development of all systems integrated on our vehicles.

All current products were designed and developed by GILLIG Engineering. The entire GILLIG Low Floor transit bus is manufactured in the United States at this one location in Livermore, CA.

GILLIG

CUSTOMER CARE SUPPORT NETWORK

EXECUTIVE DIRECTOR, CUSTOMER CARE
Victor Doran

REGIONAL SERVICE MANAGERS
Eric Ocampo
Mark Bittner
Thomas Seymour

WARRANTY MANAGER
Michelle Tejeras

TECHNICAL SERVICE ADVISOR
Bo Vongamath

TECHNICAL TRAINERS	**BASED**
Russ Ando	Seattle, WA
Lyle Archambeau**	St. Paul, MN
Blaine Fagel	Charlotte, NC
Kevin Hardesty	Columbus, OH

FIELD SERVICE REPRESENTATIVES *	**BASED**
Cody Campeau	St. Paul, MN
Max Camper	Columbus, OH
Jason Fairclough*	Salt Lake City, UT
Jose Garcia	San Francisco, CA
Armando Garibay	Southern California
Matthew Gerbasi	Lowell, MA
Thomas Johnson	Phoenix, AZ
Scott Kovaly	Pittsburgh, PA
Tim Lopez	San Francisco, CA
William Lovelady	Jackson, TN
Sam Nicoara	Atlanta, GA
Paul Oden, Jr.	Cincinnati, OH
Joe Rhea*	Dallas, TX
Ken Riley	Charlotte, NC
Richard Salas*	San Francisco, CA
Steven Sayne*	Seattle, WA
Jason Schwalbert	Phoenix, AZ
Matthew Sharp	San Antonio, TX
Sang Tran*	Los Angeles, CA

GILLIG

CUSTOMER CARE SUPPORT NETWORK

FIELD SERVICE & WARRANTY

Phone - 800-735-1500
Fax- 510-785-1348

Victor Doran	Exec.Director, Customer Care	victor.doran@gillig.com
Eric Ocampo	Regional Service Manager	eocampo@gillig.com (call to schedule training)
Mark Bittner	Regional Service Manager	mark.bittner@gillig.com
Thomas Seymour	Regional Service Manager	Thomas.seymour@gillig.com
Michelle Tejeras	Warranty Manager	michelle.tejeras@gillig.com
Branden Andersen	Supervisor Service Engineering	branden.andersen@gillig.com
Steve Finley	Field Service Engineer	steve.finley@gillig.com
Johnny Phothipanya	Warranty Processing Specialist	johnny.phothipanya@gillig.com
Bo Vongamath	Technical Advisor Warranty	bo.vongamath@gillig.com
Dominic Nava	Parts Specialist	dominic.nava@gillig.com
Field Service	Customer Care Coordinator	FieldService@gillig.com
Warranty Claims	Warranty Admin	WarrantyClaims@gillig.com
Warranty Parts	Parts Specialist	WarrantyParts@gillig.com
Kristina Aldana	Administrative Assistant	kristina.aldana@gillig.com
Jacqueline Hernandez	Customer Care Admin	jacqueline.hernandez@gillig.com

Training instructors employed by GILLIG are fully qualified service personnel with extensive “hands on” experience on our coaches. They have been trained in all phases of coach repair including, but not limited to major component replacement and repair, electrical troubleshooting, suspension and frame repair as well as repair of all ancillary components and systems.

* Performs pre-delivery service at the customer site, as well as ongoing field product support services.
** ASE Certified Mechanic

FIELD SERVICE QUALIFICATIONS

VICTOR DORAN - Executive Director, Customer Care
Executive Director of Customer Care is responsible for supporting customers post delivery service needs including warranty, field service and training. Victor's 30+ years' experience includes Diesel Technician, Service Department Management, Custom Engineering and broad OEM Customer Service Support functions primarily in the Commercial Truck and School Bus market. In addition, Victor earned a Diesel Technician Certification from Ohio Diesel Tech. and a BSMET from Kent State University and joined GILLIG in 2020.

ERIC OCAMPO – Regional Service Manager
Eric has been with GILLIG since January 1987. He came to GILLIG from A.C. Transit where he worked for 2 ½ years involved in special projects. He has 1 year in R.O.C. diesel technology and electrical and 5 years as an automotive technician. He also received training on DDEC, Allison, Lift-U wheelchair lifts and Luminator destination signs for troubleshooting and repair. Eric spent 10 years as a Field Service Representative and was a Field Service Trainer from 1996-2013. In April 2002, he completed training with Cummins I.S.L. troubleshooting and familiarization, and in November 2004, he completed training with Allison Hybrid electric drives. Since 1999, he has received numerous extensive training classes from I.O. Controls Multiplex Systems covering the T-1, T-2, G-3 and the latest G-4 systems.

MARK BITTNER – Regional Service Manager
Mark joined our GILLIG family in 2019. He brings extensive knowledge and experience in transit bus maintenance and troubleshooting. He grew up in Pittsburgh, PA and is a graduate of Steel Center Technical School and Ohio Diesel Technical Institute. He began his career in 1986 with a Pittsburgh based Detroit Diesel Allison distributor. There he served in troubleshooting, repair and overhaul of all Detroit Diesel Allison Propulsion systems. From 1993 through 2018 Mark worked for the Port Authority of Allegheny County in Pittsburgh, PA. There he performed all aspects of transit bus maintenance, troubleshooting and repairs. While there he became a bus maintenance technical trainer and developed many vehicle maintenance, overhaul programs and provided technical support. Since 2005 Mark has been working with GILLIG busses at the Pittsburgh Port Authority of Allegheny County. Mark also enjoyed owning a business in Pittsburgh, PA with his two sons where they design and build racing engines and offer field service repairs for a diesel propulsion systems. Mark and his family now reside in the Florida.

THOMAS SEYMOUR – Regional Service Manager
Tom has been with GILLIG since November of 2018. Prior to joining GILLIG, he worked at the Kansas City Area Transportation Authority. He spent 13 years as a Class A Mechanic, and 1 year as the Maintenance trainer. He has multiple ASE certifications, HVAC Type II certification, and is a Certified CNG fuel Cylinder and Systems inspector. He holds a Class A CDL w/passenger endorsement. He has been trained on Voith transmissions, Allison transmissions, Cummins engines, Agility fuel systems, Lift-U, Thermo King Intelligaire I & II, Dinex T2/G3/&G4, J1939, and Amerex fire suppression. He has competed and won multiple awards at the APTA International Bus Roadeo.

MICHELLE TEJERAS – Warranty Manager
Michelle has been with GILLIG since March 2022. She comes from a Manufacturing and Distribution industry primarily in the Customer Support and Service Operations Arenas. Michelle has many years of experience in Warranty Operations Management. She has also been instrumental in the implementation of many major system installations including a Warranty Operations system, a Contact Management (CRM) System, and a Dealer Management System.

RUSS ANDO - Trainer
Russ resides in Washington State and covers the Pacific Northwest Region. Russ Joined GILLIG in March 2001 and worked in several areas on the production line, including line foreman. In July 2002, Russ joined the Field Service Department. He has done classic auto restoration since 1979 and has completed several body-off, frame-up restorations. Along with his knowledge of mechanics and hands on approach to his job, he earned a BFA with honors in illustration from California College of Arts and Crafts.

LYLE ARCHAMBEAU – Trainer
Lyle lives in St. Paul, MN and covers the Midwest region. He has been employed at GILLIG since 1989. He has three years' experience in Heavy vehicle Maintenance while stationed in the U.S. Army. Also, Lyle has five years' experience in the Automotive Maintenance Industry. He is ASE Certified in Auto Electric, Brakes, Suspension, Engine Performance and Engine Rebuilding. He has attended classes at Auto tech for Air Conditioning, and Engine Electronics Controls and Diagnosing.

BLAINE FAGEL – Trainer
Blaine joined GILLIG as an FSR in 2006 and moved to Trainer in 2010. He began in the trucking industry in 1990. He has been in the transit industry since 1995. He has fueled trucks/buses and performed preventative maintenance. He has also been a technician, union officer, shop supervisor, technical spec writer and QA officer. He worked for Lynx Orlando from 1995-2003 and Charlotte CATS from 2003-2006. He has been ASE Certified for heavy truck steering and suspension, A/C refrigerant recovery and recycle, as well as for bus/truck air brakes. Blaine is also a Type I & II Certified A/C Technician. He has taken many classes for electrical, preventative maintenance, suspension, hydraulics, brakes, A/C, wheelchair lift (Lift-U), Cummins, Detroit Diesel, Allison, Amerex as well as many managerial courses in people skills, time management, computer software for transit specific products, Excel, Word, Outlook, Adobe Professional, and PowerPoint.

KEVIN HARDESTY – Trainer
Kevin has been a technical coach trainer since 1987. He has been a field service trainer for GILLIG since 2005. Prior to being employed as a field service trainer for GILLIG, Kevin operated his own technical training company for 9 years. Kevin started as a technical trainer for the Flxible Corporation in 1987. He also spent 2 years at the Central Ohio Transit Authority as the Training Supervisor. During his time at these positions, he has performed technical writing and created numerous training classes using PowerPoint software. His other duties have included various field service tasks as required.

CODY CAMPEAU – Field Service Representative
Cody lives in New Richmond, WI and covers the Midwest region, he joined the GILLIG family in 2019 after working as a Field Service Technician contractor for GILLIG since 2010. During that time he gained experience performing retrofits to buses, checking in new buses and processing warranty issues.

MAX CAMPER – Field Service Representative
Max joined GILLIG in July 2022. He came from the Central Ohio Transit Authority where he spent nearly 30 years as a Diesel and Hybrid Technician, Supervisor, Warranty Compliance Coordinator and Senior Technical Trainer. Max started his career in the United States Army, receiving training in the United States Army Ordnance Center and School, Track Vehicle Repair. Max has participated in the APTA International Bus Roadeo and holds a Class B CDL with passenger endorsement. He is a certified CNG Fuel System Inspector, obtained his Universal 608 and has received factory training from Cummins, Detroit Diesel, International, Bendix, TK and more. Max is located in Columbus, OH.

JASON FAIRCLOUGH – Senior Field Service Representative
Jason has been employed with GILLIG since March 2001. He has 3 years' experience as a Quality Engineering Technician for Nova Bus Inc. Where he had taken several classes: Kizan, Metrology, Paint and Body. Jason also has a certificate from the National Fire Academy, for Hazardous Materials Incident Analysis, Hydraulics and Fluidics. While at GILLIG, Jason has taken classes in I/O, Air Systems, Allison Electric Drive, and Service Training. In addition, Jason has been building and racing vehicles since 1989.

JOSE GARCIA - Field Service Representative
Jose joined GILLIG in the Production Department in 2015. He started in second shift and became a lead after four months. After one year, he moved to first shift labor pool and worked various departments before joining Field Service. Before GILLIG, Jose worked for 15 years as an auto mechanic. He started as a lube mechanic as a tech 1, then became a tech 4 master mechanic. He attended De Anza College and completed the automotive program. He also completed 3 ASE certified tests.

ARMANDO GARIBAY – Field Service Representative
Armando joined the GILLIG family in September 2022. He brings with him 12 years of experience in the commercial bus manufacturing industry, 7 of those years were leading a production line specializing in transit HVAC systems installation, other 5 years were spent overseeing the acceptance process of large volume fleet deliveries throughout the country as Field Service Repesenative. Certifications include a Universal Type HVAC certification through Mt. San Antonio Community college in Walnut California and CNG fuel cylinder and systems certification though NGVi, the leading provider of CNG technical training.

MATTHEW GERBASI - Field Service Representative
Matt joined GILLIG in 2021 as Field Service Representative for the Northeast. Prior to joining GILLIG he worked at Transport of Rockland in Rockland County, NY. He started as a technician then worked his way up to Maintenance Manager. Matt has multiple ASE certifications and is trained in multiple systems such as Cummins, Allision Hybrid, Detroit Diesel, Amerex, Lift-U, Ricon, Dinex and Thermoking. Matt studied at Lincoln Technical Institute and has 11 years of heavy-duty experience.

THOMAS JOHNSON – Field Service Representative
Thomas obtained his A.S. degree in Automotive Technology from Pima Community College. Before joining GILLIG, he spent 15 years as a Maintenance Mechanic at SunTran Transportation in Tucson, AZ performing repairs and diagnostics on their transit fleet.

SCOTT KOVALY – Field Service Representative
Scott was born and raised in Pittsburgh PA where he currently live with his wife, son and daughter. He graduated from Rosedale Technical College in 1988. After Rosedale he worked for GM, VW and Ford as the transmission and drive-ability specialist until 1994. He began his transit career with the Port Authority of Allegheny County in 1993 where he held various positions to include, hourly technician, materials control specialist, maintenance technical trainer, assistant manager of maintenance, manager of maintenance and bus procurement specialist. Scott holds ASE Master Technician status in Transit, Automotive and Heavy disciplines. He joined the GILLIG family in October of 2019 with the Field Service Department.

TIMOTHY LOPEZ – Field Service Representative
Tim has been employed with GILLIG since January 2007. He worked in Labor Pool for five years and three years in Ready Row. Two of the three years in Ready Row he obtained his Commercial Driving License. While working in Ready Row he took customers on test drives on their new buses and explained the functionality of the bus. He studied Automotive Maintenance and Repair along with Machine Shop in High School Regional Occupation Center (R.O.C.). He received an Associate of Occupational Studies degree from Universal Technical Institute.

WILLIAM LOVELADY – Field Service Representative
Bill joined GILLIG After spending 24 years at the Jacksonville Transportation Authority as a bus operator, technician, and trainer, he has hundreds of transit training hours under his belt. His key responsibilities include the post-delivery inspection, repair, and maintenance of all GILLIG buses deployed to the South Atlantic area. Bill prides himself in delivering exceptional customer service and always puts our customer’s needs first.

SAMUEL MAC NICOARA - Field Service Representative
Sam was born in Romania and immigrated to the US in 1980. In 1994, he graduated Sierra Academy of Aeronautics in Oakland, CA and received an aeronautical degree in Airframe & Powerplant as well as flight engineering. He applied his training in the aviation field and helped expand a superconducting magnet fabricating plant that he managed for over 10 years. In 2014, he joined GILLIG and worked as a troubleshooter in the Electrical Department. In 2016, he joined Field Service as a field service representative, servicing customers nationwide.

PAUL ODEN, JR. – Field Service Representative
Paul has in-depth experience working on GILLIG buses. For 19 years, he has served as a mechanic for the Southwestern Ohio Regional Transit Authority in Cincinnati, maintaining GILLIG buses and Cummins powertrains. He particularly enjoyed working on schematics and using his problem-solving skills. Paul joined GILLIG in October of 2019.

JOE RHEA - Senior Field Service Representative
Joe has been employed with GILLIG since 1988 and has had training in Voith, Transmission troubleshooting, & Lift-U Wheelchair lifts and Luminator Electric Destination Signs. He has also attended training classes by the GILLIG trainer in the Electrical System, Air System and Hydraulic systems on the GILLIG buses. Joe lives in Central Texas and covers the Southern Region.

KENNETH RILEY – Field Service Representative
Ken joined the Marine Corps in the early 1990’s where he learned how to purify water and repair equipment. He went to work for Walmart logistics in 2000 where he eventually worked as a trailer and tractor mechanic working on Detroit series 60 and Cummins N14 engines on International Semi-trucks. He learned Cummins Insite and earned Detroit, Cummins and International certifications. In 2005 he earned certifications in Level 1,2,3, Out of Service and hazmat inspections as a Commercial Vehicle Officer for the State of Washington. Ken started working in Transit in 2005 at Island Transit in Whidbey Island Washington as a Journeyman Mechanic. He was promoted to Lead Mechanic in 2010 then Maintenance Supervisor in 2012 and Maintenance and Facilities Manager in 2014. Ken led his team to be recognized at the Washington State Transit Association for the Spirit Award on both Fleet Technicians and Facility Technicians. Ken joined GILLIG in January 2022.

RICHARD SALAS – Senior Field Service Representative
Richard has been employed with GILLIG since 1998. He worked in Labor Pool for one year and worked 4 years as a Working Foreman in in the Trim department. He was also the Working Foreman for the Maintenance Department on 3rd shift. He has attended training courses for the Dinex and Air systems. He is based out of the San Francisco area.

STEVEN SAYNE – Field Service Representative
Steven has been employed with GILLIG since June 2003. He worked with 1st shift Maintenance Department for 3 years. He was also the Working Foreman for the Maintenance Department on 2nd shift for 5 years. He has 10+ years of automotive and machine service and repair experience. He also has 10+ years of electrical and electronics service and repair experience. He has attended training courses for the Dinex and Air systems. He resides in Washington State and covers the Pacific Northwest Region.

JASON SCHWALBERT – Field Service Representative
Jason has been employed with GILLIG since December of 2017. Prior to that, he worked in the Phoenix Transit System for over 17 years as a Project Lead performing duties ranging from Transit Bus Maintenance to Shop Management. Jason has accumulated many Certifications and Licensing over the years including 3 ASE Master Certifications, Both A/C Section 608 Universal, & Section 609 certifications, and a Class B CDL w/Passenger Endorsement. He has earned an Associate Degree in Automotive, Diesel, and Industrial Technologies from Universal Technical Institute. Jason lives just outside Phoenix in Goodyear AZ.

MATTHEW SHARP – Field Service Representative
Matt sharp worked 4 years at KCATA in Kansas City, MO as a class mechanic and was certified in facilities. Prior to being a transit mechanic, Matt had 20 years experience in the heavy equipment industry as a mechanic and operator, working 3 years for Murphy tractor and equipment as a heavy equipment field mechanic. Matt has vast knowledge in heavy repair and electrical diagnostics from working on Caterpillar heavy equipment specializing on 953 track loaders. Working at KCATA he diagnosed and repaired all aspects of GILLIG diesel and CNG buses.

SANG TRAN – Senior Field Service Representative
Sang joined GILLIG in March 1997. He first started out in Dept. 04 for a few months then transferred to the Labor Pool in late 1998. For the following years, he worked throughout most departments, and spent most of his time in Dept. 03 (Electrical), performing work duties such as front dash harnesses/main electrical panel installations, engine power trouble shooting for buses to start before they get into Rack area (Dept.09). In mid-2001, Sang became a Field Service Representative and relocated to Fairfax County in State of Virginia. During his service years, he had attended training courses for Dinex and Air Systems. Before joining GILLIG, Sang worked for Morehouse Foods Co. in Emeryville, CA as a lead machinist and oversaw the high volume of bottling, labeling, capping machines, and performed electrical trouble shooting problems as required. Upon CNG market demand in Southern California, Sang lives in Orange County, CA in and covers the Pacific Southwest region.

BO VONGAMATH – Technical Service Advisor
Bo has been with GILLIG since January of 1999. He worked 2 years in the Labor Pool, 3 years in the Electrical Department and 4 years as a Quality Inspector in the Field Service Department. He also received training on Allison Electric Drive, Certified ASE Refrigerant Recovery and Recycling. Before GILLIG, Bo worked at Chuck E. Cheese as their Electronic Technician for 10 years.

ENGINEERING SUPPORT

GILLIG maintains a fully experienced and qualified Engineering Department directed by the Vice President of Engineering. The Engineering staff is involved in all design requests and is also made available to the customer on request to assist in the resolution of engineering or design problems that may arise within the scope of the specifications during the production and/or warranty period.

The GILLIG Engineering Department is located at the manufacturing plant in Livermore, CA, and is available to assist the manufacturing process. The integrated staff performs all vehicle engineering, including the research and development of all systems integrated on our vehicles.

All current products were designed and developed by GILLIG Engineering. Attached is our staff description and organization.

GILLIG

GILLIG ENGINEERING ORGANIZATION

Name	Function	Education	Background
G. Vismara	Vice President, Engineering	BSME	32 yrs. industry experience at Peterbilt, Loral Space Systems & GILLIG
K. Vorsatz	Sr. Director, Current Product Engineering	BSME	16 yrs. industry experience at BAE Systems & GILLIG
T. Meagher	Sr. Director, New Product Engineering and Advanced Engineering	BSME, BSEE	36 yrs. industry experience at Ford, Caterpillar, Case New Holland & GILLIG
R. Donovan	Director, Validation	ASME, BSEE, MBA-Executive Leadership	28 Yrs. Industry Experience. General Motors & GILLIG
A. Van Haeften	NPE Manager, Mechanical	BSME, PE	15 yrs. industry experience at Westinghouse, Park Hannifin & GILLIG
C. Ababseh	Manager, Mechanical Engr Body & Interior - CPE	BSME	17 yrs. industry experience at GILLIG
F. Andrade	EE Manager, NPE	BSEE	10 yrs. industry experience at E-N-G Mobile Systems & GILLIG
H. Tuft	Manager, Powertrain & Structures - CPE	BSME, MSME	2 yrs. experience at Electroglas Inc & AutoCat USA Inc., 16 yrs. experience at GILLIG
J. Ralleta	Manager, Order Management	College	13 yrs. experience at GILLIG
M. Itanna	Manager, Electrical Engineering - CPE	BSEE, MSc. EE, MBA-Organizational Leadership	12 yrs. industry experience at Parker Hannifin, United States Stee (USS), Emerson/Vertiv & GILLIG
M. Pinto	Continuous Process Improvement Manager	BSME, MSME, MSPM and PMP	18 yrs. industry experience at Ford, Volkswagen & GILLIG
R. Quebbeman	Manager, Order Management	AS Mech. Engr.	51 yrs. industry experience bus and truck design - Mack, International & GILLIG
S. Vanderlip	Manager, Mechanical Engineering Systems	BSETME, PE	37 yrs. industry experience at Peterbilt & GILLIG

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ENGINEERING SUPPORT

B. Bachellor	Supervisor -Passengers Interior	BSME	6 yrs. industry experience at Lennox & GILLIG
D. Garcia	Bill of Material Supervisor	H.S.	7 yrs. industry experience at GILLIG
F. Fotos	Supervisor - CPE	BSEE, MEM	7.5 yrs. industry experience at Northrop Grumman & GILLIG
G. Roderick	Supervisor, Order Processing	AA	36 yrs. industry experience at GILLIG
J. Dalmeida	Supervisor, Driver's Interior	BSME	11 yrs. industry experience at New Flyer & GILLIG
J. Reekie	Supervisor, Powertrain	MSME	12 yrs. industry experience at Caterpillar, BP/Castrol & GILLIG
S. Yusoff	Supervisor, Structures	BSAE, MBA	11 yrs. Industry experience at Electro Motive Diesel, Hendrickson International and GILLIG
A. DeGracia	BOM Specialist	AA Theology	13 yrs. Industry experience
A. Frey	Sr. Mechanical Engineer I	BSME	12 yrs. industry experience at Cummins & GILLIG
A. Heidari	Sr. HIL Architect / Systems Engineer	BSEE	7 yrs. Experience at Sage Analytical, NATC and GILLIG
A. Khalil	Sr. Mechanical Engineer II	BSME	7 yrs. industry experience at power generation, additive MFG, electronic thermal systems & GILLIG
A. Monserret	Mechanical Engineer II	BSME	3 yrs. industry experience at GILLIG
A. Rosales	Associate Mechanical Engineer	BSME	1 yr. industry experience
A. Wan	Sr. Electrical Engineer II	BSEE	21 yrs. industry experience at BAE Systems, KLD Tech, Tropos Tech, & GILLIG
B. Haley	Mechanical Engineer II	BSME	8 yrs. industry experience Product development
B. Nguyen	Design Engineer, Electrical	BSEE	17 yrs. industry experience at HP, Kla-Tencor and GILLIG
B. Wu	Design Engineer	BSEE	27 yrs. industry experience at Bakery Automation, Building HVAC Controls, and GILLIG
C. Clemensen	Mechanical Engineer 1	BSME	3.5 yrs. Industry experience at Schneider Electric & GILLIG
C. Espinosa	Mechanical Engineer II	MSME	11 yrs. industry experience at Lawrence Livermore Lab, SFMTA & GILLIG
C. Gonzalez	BOM Specialist	College	14 yrs. GILLIG experience
C. Nguyen	Production Support Technician		23 yrs. industry experience at GILLIG
C. Silva	BOM Analyst	HS	34 yrs. industry experience at GILLIG

ENGINEERING SUPPORT

D. Aranovich	CAD Designer	BS Engr Tech	26 yrs. industry experience at Metaldyne, Ford, LightSail Energy & GILLIG
D. Haiduk	CAD Designer	MSME	20 yrs. industry experience in several international electro-mechanical companies & GILLIG
D. Lewis	Electrical Engineer	BSEE	26 yrs. Industry experience at Blue Bird Corp, Heil Environmental, United Streetcar, Freightliner, E-One, RFA/Roadtec, and GILLIG
D. Williams	Mechanical Engineer II	BSME	4 yrs. industry experience at civilian/government proving grounds & GILLIG
E. Hughes	Mechanical Engineer II	BSME	3 yrs. industry experience at GILLIG
E. Martin	Mechanical Engineer 1	BSME	2 yrs. Industry experience at Northrop Grumman and GILLIG
EJ Mariscal	BOM Specialist	HS	21 yrs. industry experience at GILLIG
F. Alarcon	BOM Analyst	College	15 yrs. Industry experience
F. Cruz	Configurator Specialist	BSC-Mgmt.	20 yrs. industry experience at GILLIG
G. Estantino	Mechanical Engineer II	BSME	6 yrs. industry experience at ICON Aircraft & GILLIG
G. Mortazavi	Electrical Engineer I	MSEE	5.5 yrs. industry experience at Chicago Transit Authority & GILLIG
H. Mehrzai	Electrical Engineer	MSEE	4 years industrial experience at Grossi Electric Inc, Viant Medical, and GILLIG
H. Perez	Production Support Tech	H.S.	8 yrs. industry experience at GILLIG
H. Sanchez	Sr. Mechanical Engineer I	BSME	7 yrs. industry experience GCM & GILLIG
J. Abrew	BOM Specialist	H.S.	31 yrs. industry experience at GILLIG
J. Fisher	Sr. Mechanical Designer	HS	24 yrs. industry experience at Burke Porter Machinery, Stewart & Stevenson & GILLIG
J. Ocampo	BOM Analyst	College	31 yrs. industry experience at GILLIG
J. Ruiz	BOM Analyst	High School	7 yrs. Industry experience
J. Seei	Configurator Specialist	HS	23 yrs. experience at GILLIG
J. Solis	Electrical Engineer	BS Mechatronic Engineering	1 yr. industry experience at GILLIG
J. Turner	Sr. Electrical Engineer I	BSEE	8 yrs. industry exp at GILLIG
J. Yang	Electrical Engineer - NPE	MSEE	18 yrs. industry experienceat Auto, Commercial Avionics, Autonomous Vehicle. BAE & GILLIG & LIGHT
K. Fernandez	Configurator Specialist	H.S.	9 yrs. industry experience at GILLIG

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ENGINEERING SUPPORT

K. Kung	Electrical Engineer II	BSEE	14 yrs. industry experience at New Logic Research, Elma Electronics, Novate Solutions, and GILLIG.
K. Lynch	BOM Specialist	High School	25 yrs. GILLIG experience
K. Nguyen	Product Validation Engineer	BSME	5 Yrs. Industry experience, UniTrans & GILLIG
L. Bush	Sr. Electrical Engineer I	BSIT	20 yrs. industry experience at Compass, Autocam, TPI, Dow Jones & GILLIG
L. Nguyen	Sr. Electrical Engineer II	BSEE	17 yrs. industry experience at Panasonic Automotive & GILLIG
L. Perez	Mechanical Engineer I	BSME	
M. Genova	Mngr. Product Safety & Compliance	MSAE	22 yrs. industry experience at AVL, Fiat, Landirenzo-Baytech USA, & GILLIG
M. Janov	Sr. Electrical Engineer I	BSCmpE	6 yrs. industry experience at Fetch Robotics, NASA Langley, SpaceX, & GILLIG
M. Mohammedkair	Sr. Electrical Engineer I	BSEE	10 yrs. industry experience at GILLIG
M. Ortega	Electrical Engineer I	BSEE	4 yrs. industry experience at GILLIG
M. Rands	BOM Specialist	H.S.	10 yrs. industry experience at GILLIG
M. Roberts	Sr. Mechanical Engineer II	MSME	8 yrs. industry experience at BHJ Dynamics & GILLIG
M. Ruth	Sr. Electrical Engineer II	BS EMET	22 yrs. industry experience at Harley Davidson, Voith, & GILLIG.
M. Shaieb	Sr. Mechanical Engineer I	BSME	41 yrs. industry experience at BAE Systems & GILLIG
N. Clopton	Sr. Mechanical Engineer II	BSME	14 yrs. industry experience Parker Hannifin, Racor Division
N. Henderson	Sr. Mechanical Engineer I	BSME	8 yrs. industry experience at Zodiac Aerospace & GILLIG
P. Orr	Mechanical Engineer 1	BSME	6 mo. Industry experience at Haas Automation and GILLIG
P. Titus	Sr. Product Validation Engineer	3yr. College toward BSEE, various Training certificates	35 Yr. industry manufacturing and management experience, Sun Microsystems, Oracle, Fujikura and GILLIG
P. Zimmerman	Production Support Specialist		28 yrs. industry experience at GILLIG
R. Brar	Sr. Mechanical Engineer II	MS Aerospace Engineering	10 yrs. industry experience at Int'l Cars & Motors, Heil Trailer & GILLIG
S. Dunbar	Electrical Engineer	BSEE	6 yrs. industry experience at GILLIG
T. Agawa	Sr. Mechanical Engineer I	BSIT	33 yrs. industry experience at GILLIG & Peerless Lighting
T. Doom	Mechanical Engineer 2	BSME	8 yrs. Experience at Aisin, B & H Labeling & GILLIG

T. Gilbert	Sr. Product validation Engineer	BSEE/MSEE	7Yrs. Industry Experience, Space Systems/Loral, Brava & GILLIG
T. Jones	CAD Specialist	AA Mechanical	18 yrs. industry experience NABI & GILLIG
T. Nguyen	Electrical Engineer	BSEE	2.5 yrs. industry experience at EBMUD, Teledyne RISI, and GILLIG
T. Talavera	BOM Analyst	College	5 yrs. Industry experience
V. Ng	Mechanical Engineer I	BSME	5 yrs. industry experience Kinetic Systems, T&H Manufacturing and GILLIG
V. Vo	Production Support Specialist		16 yrs. industry experience at GILLIG
W. Nairn	Production Support Lead	College	20 yrs. industry experience at GILLIG

WARRANTY SUPPORT

GILLIG stands behind the quality of our products and we have selected supplier partners who share this belief as well. We have provided our GILLIG APPLICATION FOR WARRANTY PROCEDURE which describes the process by which GILLIG handles warranty claims. Normal warranty work (other than that work required to be performed by sub-suppliers as discussed below) will be performed by the Agency's maintenance department and reimbursed by GILLIG at the documented warranty labor rate. In the unlikely event that abnormal warranty is required, GILLIG will work with the Agency to resolve any such warranty projects which Agency believes should be repaired directly by GILLIG.

Due to the nature of some components and the associated warranties, GILLIG believes that warranty work on the following should initially be managed by the sub-suppliers:

- Engine
- Transmission
- Axles
- Air Conditioning Unit
- Batteries
- Destination Signs
- Video Surveillance Systems
- Intelligent Transit Systems
- Agility CNG Fuel System

GILLIG routinely assists customers in resolving warranty matters when local vendors are unable or unwilling to provide necessary support by involving GILLIG's contacts either at the local service facilities or through the component manufacturer's corporate levels.

Feel free to contact our Field Service Department for assistance or if you have questions:

Field Service Coordinator
GILLIG Service Department
451 Discovery Drive
Livermore, CA 94551
(510) 264-5073
FieldService@GILLIG.com

GILLIG

WARRANTY SERVICE STAFF

The Customer Care Department is available to assist the procuring Agency in processing warranty claims as required. GILLIG's Field Service Representatives will assist the procuring agency in the proper procedure for obtaining warranty parts, completion of the warranty forms, and the handling of parts for warranty claims processing. In-house qualified Field Service Representatives are available to troubleshoot questions by phone Monday through Friday, 5:00 a.m. to 2:00 p.m. and have direct access to GILLIG's Engineering Department in order to provide quick turnaround should additional technical assistance be required.

EXECUTIVE DIRECTOR, CUSTOMER CARE
Victor Doran

WARRANTY MANAGER
Michelle Tejeras

REGIONAL SERVICE MANAGERS
Eric Ocampo
Mark Bittner
Thomas Seymour

TECHNICAL ADVISOR WARRANTY
Bo Vongamath

WARRANTY PARTS SPECIALIST
Dominic Nava

WARRANTY PROCESSING SPECIALISTS
Johnny Phothipanya

FIELD SERVICE COORDINATOR

Our Warranty group essentially deals with repair, replacement, or reimbursement for product failures during the warranty period of a particular product. A warranty claim, describing the failure (and other relevant details) must be filed in order to start the process of getting the failure fixed.

The warranty claim is reviewed by the Warranty Processing Specialist and a determination on its status (accept, accept with adjustments, or reject) is made, often after discussions with GILLIG's Q.A., Manufacturing, or Engineering Departments, or with vendor OEMs. The claim response is then sent back to the customer, as well as being relayed to relevant GILLIG departments for corrective action, including as necessary, reimbursement or replacement for the customer, design or manufacturing review at GILLIG, reporting to and recovery from the vendor, as well as additional information collection, testing and/or redesign for GILLIG or the vendor, when needed. We usually ask for failed parts to be returned to help with failure analysis and vendor recovery.
If you disagree with a warranty claim decision, you can resubmit the claim along with additional justification supporting your position, to the Service Manager for reconsideration. Your claim will be reviewed and you will be notified of the review decision within a week or two.

GILLIG INSTRUCTIONS

FOR COMPLETING APPLICATION FOR WARRANTY CLAIM

GILLIG requires only one failure per claim. A single claim can be for multiple buses as long as they're for the same failure, and have identical labor claimed. The VIN and mileage of each bus on the claim should accompany the Application for Warranty.

GILLIG uses the information on the Application for Warranty to detect failure trends and make improvements, failure descriptions such as "B.O.", "Inop" or "Found Bad" will not suffice. The reason for removal and any troubleshooting procedures should be included to help expedite claims. GILLIG prefers the Repair Order be included with the claim.

Warranty repairs exceeding "Standard Repair Times", (SRT), should have prior authorization to prevent large cuts in reimbursement. To obtain prior authorization, please contact your Warranty Processing Specialist by calling GILLILG Field Service or emailing WarrantyClaims@gillig.com.

Claims for normal replacement items, such as light bulbs, and mechanical adjustments, such as doors or alignments, are not normally approved unless their failure was caused by a warrantable defect. In addition, consumables, such as belts, tires and brake linings, are not warrantable, unless their failure was caused by a warrantable defect of another component.

Warranty claims should be submitted to GILLIG within 30 days of the date of failure. Claims can be emailed to WarrantyClaims@gillig.com.

Claims need to have unique claim numbers assigned. Each property should have a unique prefix, and then whatever number best suits your operation, (such as the Repair Order number). If you do not have or do not know your unique prefix, please contact your Warranty Processing Specialist.

GILLIG will pay at the direction of the bus owner, not the hired contractor or repair shop, until and unless the bus owner directs it.

GILLIG cannot pay an invoice not made out to GILLIG, unless it's listed as a sublet bill on an Application for Warranty Claim.

GILLIG

APPLICATION FOR WARRANTY

It is not necessary to use GILLIG pre-printed forms, but any form used will need the following information:

1. Unique Claim Number (must be pre-approved by GILLIG Warranty).
2. Date claim is being filled out
3. Unit Serial # (Last six digits of the VIN)
4. Coach Number
5. Bus Owner, or Bus Property Name
6. Date bus placed in Revenue Service
7. Odometer or Hub mileage at time of failure
8. Date of Failure
9. Where Repaired (if not at the owner's property)
10. If Claim concerns the Engine, the Engine Serial Number
11. If Claim concerns the HVAC, the Air Conditioning Unit Serial Number
12. If Claim concerns the Transmission, the Transmission Serial Number
13. Complete description of failure, (Repair Order preferred)
14. Were any parts used? (Yes or No)
15. Description of parts used with the GILLIG Part Number
16. Original Part Number (If replacement Part Number differs Original Part Number)
17. Price of the part(s) unless provided by GILLIG
18. Number of parts used
19. Provide subtotal for each part
20. Total all the parts used for this claim
21. Provide contractual warranty labor rate
22. Number of hours worked
23. Multiply number of hours by the labor rate for the total labor claimed
24. Work done by outside firm or tow to be entered and copy of invoice attached
25. Total Sublet cost(s)
26. Total amount for the claim
27. If bus is in California and claim is emission-related, Engine Hours (from ECM or hourmeter)
28. Name & Contact Information of warranty person to answer any questions of claim
29. Email or Phone Number for person having knowledge of claim
30. Name & Contact Information of person who submitted claim
31. Email or Phone Number for person who submitted claim
32. Address of where to send reimbursement or parts credit.

See attached copy of claim with corresponding numbers to indicate where to put the above information.

GILLIG

APPLICATION FOR WARRANTY

Required fields are marked with an asterisk (*)

*CLAIM NUMBER: #1 *DATE: #2

MAIN (510) 785-1500 | FAX (510) 785-1348

*UNIT SERIAL # #3 ______

*OWNER #5 ______

BUS OR COACH # #4 ______

*MILEAGE AT FAILURE #7 ______

*IN SERVICE DATE #6 ______

WHERE REPAIRED #9 ______

*DATE OF FAILURE #8 ______

ENGINE SERIAL # #10 ______

A/C SERIAL # #11 ______

TRANSMISSION SERIAL # #12 ______

*DESCRIBE SPECIFIC (COMPLAINT, CAUSE, CORRECTION) REPAIRS REQUIRED AND ATTACH COPY OF REPAIR ORDER

#13 ______

IF REPLACEMENT PART NUMBER DIFFERS FROM ORIGINAL PART NUMBER, LIST THE ORIGINAL PART NUMBER HERE #16 ______
(IF MORE SPACE IS NEEDED, PLEASE USE SEPARATE SHEET AND ATTACH TO BACK OF CLAIM)

#14

REPLACEMENT PART NUMBERS PARTS USED: YES ☐ NO ☐	PRICE EACH	QTY. USED	SUBTOTAL
#15	#17	#18	#19

PARTS TOTAL $ #20

*LABOR RATE #21 / *HR. #22

*LABOR TOTAL $ #23

SUBLET (ATTACHED INVOICE COPIES)	PARTS	LABOR	TOTAL
1. #24			
2.			

SUBLET TOTAL $ #25

*GRAND TOTAL $ #26

NOTE: IF CALIFORNIA BUS, NEED ENGINE HOURS FROM HOURMETER OR ECM #27

*NAME/PHONE OF CONTACT FOR ADDITIONAL INFO #28 ______ // ______

______ // ______

E-MAIL ADDRESS(ES) #29 ______

*SUBMITTED BY / PROPERTY NAME & ADDRESS #30 ______

E-MAIL ADDRESS(ES) #31 ______

*REIMBURSEMENT NAME AND ADDRESS (IF DIFFERENT FROM ABOVE) #32 ______

E-MAIL ADDRESS(ES) ______

NOTE: Warranty will be denied if the defective material is not received by GILLIG within 30 days of the failure date.

GILLIG | 451 DISCOVERY DRIVE | LIVERMORE, CALIFORNIA 94551 | 800.735.1500

Application_for_Warranty_20170719

WARRANTY PARTS ORDERING PROCEDURE

1. Determine part(s) being ordered by referring to the parts manual for the specific bus in question. If the part can't be found or isn't listed, you can call GILLIG's Warranty Parts Specialist at 510-264-4433 or WarrantyParts@gillig.com.

2. The information needed:
   a. GILLIG part number
   b. Quantity
   c. Description of part (pump, motor, etc.)
   d. VIN, (Last 6 digits of VIN)
   e. Description of Failure
   f. Mileage at failure
   g. Instructions on where to send parts, (if applicable)

3. If bus is within the base bus warranty, GILLIG will ship the warranty part(s) to your location. Parts will be sent prepaid, best way, (normally second day). If the part is needed there the next day, it can be sent overnight and the difference of shipping cost will be charged back.

4. Normally, GILLIG will want the failed part returned. If so, then we will email an RGA. The defective part should be returned to:

GILLIG, LLC
ATTN: RGA # __________
1100 Voyager Street, Dock B
Livermore, CA 94551

<u>PARTS THAT ARE REQUESTED TO BE RETURNED SHOULD BE SENT WITHIN 30 DAYS. IF THE PARTS ARE NOT RETURNED WITHIN THAT TIME, THE COST WILL BE INVOICED BACK.</u>

5. If the bus is outside the base bus warranty, but the failed component still has warranty coverage from the supplier, the part will have to be purchased from GILLIG's Parts Department, which can then be claimed on an Application for Warranty Claim. GILLIG will roll that over to the supplier, and whatever reimbursement the supplier makes will then be forwarded to the end user.

PARTS RETURN PROCEDURE

Defective part should be returned to GILLIG within 30 days of receipt of GILLIG's Return Goods Authorization, (RGA).

All parts should be capped or plugged to prevent leakage, if applicable. Excess dirt or grease should be removed to facilitate handling.

Removed part should be handled/packed as if new.

Parts should never be sent "COD".   GILLIG may provide a call tag, or the shipping cost can be included on the Application for Warranty.

Call tags are only utilized when the bus is still covered by the base bus warranty. If a call tag is being requested, we will need to know 1) RGA # & 2) Total weight of package.

Part(s) must be tagged with the following information:

A. Last 6 digits of VIN
B. Date bus went into Service & Mileage at Failure
C. Concise reason for removal
D. Bus owner's name/name of transit agency

GILLIG

CHANGE CONTROL

GILLIG's change control process involves several departments within the organization and working with our component suppliers as their products reach end of life. GILLIG believes in a constant improvement process, this is controlled thru an Engineering Production Change (EPC) process managed by our Materials Department. A meeting is scheduled once a month with Materials, Purchasing, Engineering, Manufacturing, Sales and Parts, to discuss product improvements/new design and supplier end of life notifications.

Once a change has been identified the subject matter is reviewed by Engineering for design, Purchasing for cost, Manufacturing for production impact, Parts for aftermarket support and Materials/Sales for customer implications. Once approved by all departments, Engineering and the Bill of Material group will release the component details (parts, installation drawings, customer, dates) and production implementation plan thru our documented EPC control process.

GILLIG

FIELD SERVICE MODIFICATIONS

GILLIG's focus on designing and building the most reliable and cost-effective bus in the industry necessitates selecting supplier partners who share our philosophies on quality and reliability. As a result of this focus, GILLIG has no major fleet defects (grounded fleet), a minor number of vendor defects and the lowest warranty claim experience in the industry.

Over the past five years, GILLIG has sent out several Field Service Bulletins which communicate suggested maintenance procedures, clarifications of previously released procedures and supplier or GILLIG proposed repairs. Seven of these bulletins were minor field repairs resulting from design improvements intended to prevent future failures.

We have provided a sample for your reference.

FIELD SERVICE BULLETIN

FS-2019-02: Product Alert - *FS 300 Hose Identification*

Date: May 6, 2019

Model: All

Model Years: 1997 – 2019

Because of a supply issue with the blue hose covering, Eaton is temporarily making FC-300 hose using black covering. FC-300 hose assemblies made between October 2018 to May 2019 will be affected by this change.

To avoid being mistaken for FC-350 hose, Eaton has applied the following unique identifiers to the FC-300 hose assemblies:

1. ***Yellow ink markings to the hose identifying it as FC-300.***
   Note: White ink markings are used on FC-350 hose assemblies.
2. ***Blue stripe around the hose identifying it as FC-300.***
   a. ***Hoses 2-ft and shorter will have a blue stripe located in the center of the hose length.***
   b. ***Hoses longer than 2-ft, up to 4-ft in length have a blue stripe located at each end, adjacent to the fitting.***
   c. ***Hoses longer than 4-ft have a blue stripe located at each end, adjacent to the fitting, and an additional stripe located in the center of the hose length.***

In addition, the hose will still have a foil tag with the Gillig part number.

Note: FC-300 and FC-350 have different pressure ratings, so it's important to not mix them.

Approved:

Robert L. Birdwell, Executive Director
Quality Control & Field Service

Product Alert

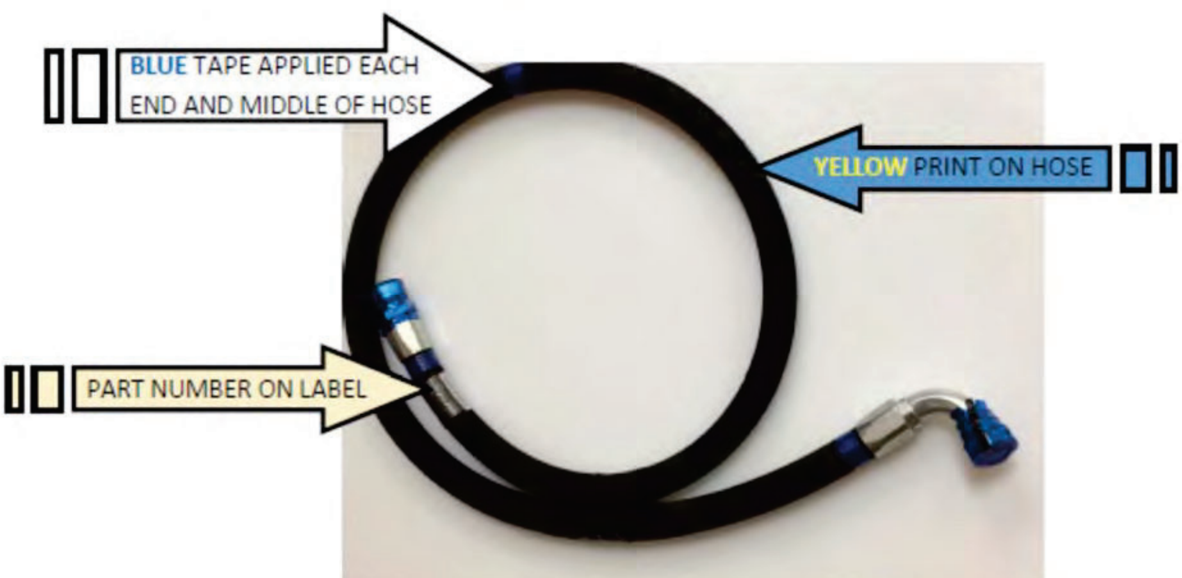
Affected products: Gillig hose assemblies part numbers 46-xx**B**xxxx-xxxx

Gillig hose assemblies made with Eaton FC300 hose, which typically have a blue yarn cover will temporarily have a black cover.

Due to a supply issue with blue yarn Eaton is temporarily making FC300 hose with black colored yarn and applying yellow print instead of white print. The hose is otherwise identical to what has always been supplied and meets all specifications for use.

HOW TO IDENTIFY THIS HOSE AS CORRECT

1. BLUE TAPE IS BEING APPLIED TO EACH ASSEMBLY AS A QUICK CHECK THAT IT IS FC300 HOSE
2. HOSE WILL HAVE YELLOW PRINTING INSTEAD OF WHITE
3. PART NUMBER ON LABEL WILL IDENTIFY THE CORRECT HOSE ASSEMBLY



FS-2019-02
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Original blue FC-300

TASK DESCRIPTION	SRT
BATTERY ELECTRIC BUS MAIN COMPONENTS	
R&R ESS JUNCTION BOX	2.00
R&R HVAC JUNCTION BOX	2.00
R&R FRONT PLUG-IN CHARGER	4.00
R&R REAR PLUG-IN CHARGER	2.00
R&R HV CABLE	TIME VARIES DEPENDING ON CABLE
R&R BATTERY TMS	4.00
R&R PASSENGER ECOOLANT HEATER	6.00
R&R AIR COMPRESSOR (POWEREX)	2.00
R&R POWER STEERING PUMP	1.50
R&R ELECTRONIC COOLING PACKAGE	5.00
R&R MAIN BATTERY DISCONNECT SWITCH (KISSLING)	2.00
R&R ESS PACKS (ROOF)	1.00
R&R ESS PACK (CHASSIS)	3.00
R&R ESS PACKS (POWERTRAIN COMPARTMENT)	12.00
R&R TRACTION MOTOR INVERTER & TRACTION MOTOR	12.00
R&R DC/AC CONVERTER	4.00
R&R DC/DC CONVERTER	4.00
R&R SYSTEM CONTROL MODULE	1.00
R&R BATTERY MANAGEMENT SYSTEM	1.00
R&R CHARGE CONTROLLER	1.00
R&R PRIMARY HV JUNCTION BOX	6.00
WHEELCHAIR RAMP MECHANICAL	
REMOVE/INSTALL RAMP ASSEMBLY	2.00
CLEAN/REPLACE/ADJUST CHAIN	1.00

WHEELCHAIR RAMP ELECTRICAL

REPLACE FLASHER FOR RAMP BEEPER	0.50
CLEAN/REPAIR/REPLACE CONTROLLER BOARD	1.00
CLEAN/REPAIR/REPLACE DUETSCH PLUG	0.60
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPAIR/REPLACE WIRING	2.50

FRONT AXLE

REPLACE KING PIN/BOTH SIDES	7.90
REPLACE TIE ROD END/BOTH SIDES	1.70
ALIGN FRONT END	0.90
REPLACE TIE ROD ASSEMBLY	1.70
LUBRICATE KING PINS/DRAGLINK/TIE ROD ENDS	0.70
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.30
R&R ABS SENSOR	0.50
ABS CABLE	1.50

REAR AXLE

REPLACE REAR AXLE	8.00
REPLACE DIFFERENTIAL	6.00
REPLACE GASKET, O-RING OR SEAL	6.00
REMOVE/INSTALL REAR AXLE FOR TOWING PURPOSES	0.70
ADD/CHANGE DIFFERENTIAL GREASE	0.40
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
PINION SEAL	2.00
R&R ABS SENSOR	1.00
ABS CABLE	1.50

GILLIC

STANDARD REPAIR TIMES

AXLE HUB

REPLACE AXLE HUB	4.20
REPLACE AXLE BEARING	0.60
REPLACE AXLE HUB SEAL	1.70
REPLACE WHEEL STUDS/NUTS	0.30
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50

BRAKES

REPLACE BRAKE SPIDER	1.80
REPLACE SLACK ADJUSTER	0.80
REPAIR/REPLACE SLACK ADJUSTER LINKAGE	0.70
LUBRICATE BRAKE PINS	0.90
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
FRONT BRAKE JOB	1.50
REAR BRAKE JOB	3.00
FULL FRONT BRAKE JOB INCLUDING WHEEL SEAL	4.00
FULL REAR BRAKE JOB INCLUDING WHEEL SEAL	4.50
R&R BRAKE CALIPERS ON DISC BRAKES	2.50

SUSPENSION

REPLACE AIR BAG	1.50
REPLACE LEVELER VALVE/LINK	1.10 EA
ADJUST AIR BAG HEIGHT	0.60
REPLACE UPPER AND LOWER TORQUE ROD	0.80
REPLACE UPPER TORQUE ROD MOUNT/BRK	2.00
REPLACE SHOCK ABSORBER/BUSHINGS	0.90
REPLACE LOWER TORQUE ROD MOUNT/BRK	4.00
REPLACE SHOCK MOUNT	1.10
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
KNEELING VALVE	2.00

CONFIDENTIAL

GILLIC

STEERING

REPLACE STEERING GEAR	3.00
REPLACE MITER BOX	1.20
REPLACE PITMAN ARM	1.10
REPLACE DRAGLINK/END	1.00
REPLACE STEERING POPPET KIT	1.50
REPLACE STEERING WHEEL	0.80
REPLACE POWER STEERING PUMP	2.00
REPAIR HORN SYSTEM	1.00
RESEAL STEERING GEAR/ANGLE BOX	2.40
REPAIR/REPLACE STEERING COLUMN	2.00
LUBRICATE STEERING COMPONENT	1.00
REPAIR/REPLACE POWER STEERING RESERVOIR	1.50
ADD OIL OR FLUSH SYSTEM	0.50
REPAIR/REPLACE PIPE/HOSE	1.30
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
R&R TRW EASY STEER COLUMN	2.00

TIRES

REPLACE TIRES	1.50
REPAIR TIRE	1.10
BALANCE TIRES	1.00
ROTATE TIRES	1.70

EXTERIOR BODY

REPAIR/REPLACE BODY FRAMEWORK COMPONENT	2.00
REPAIR/REPLACE BULKHEAD	1.80
REPAIR/REPLACE EXTERIOR BODY PANEL	1.00
REPAIR/REPLACE FENDER RUBBER/TRIM	1.00
REPAIR/REPLACE/INSTALL/TIGHTEN MIRROR	0.60

REPAIR/REPLACE/ADJUST WIPER/WASHER COMPONENT	0.80
REPAIR/REPLACE/TIGHTEN BUMPER	1.00
REPAIR/REPLACE ROOF HATCH	0.80
SAND/PAINT EXTERIOR BODY-LEFT HAND	5.10
SAND/PAINT EXTERIOR BODY-RIGHT HAND	5.10
REPAIR/REPLACE MUD FLAP	0.90
REPAIR/REPLACE RUB RAIL	0.50
SEAL WATER LEAK INTO COACH	2.00
REPAIR/REPLACE BATTERY TRAY	2.80
W/S WIPER MOTOR	1.00
FRONT CAP	20.00

INTERIOR BODY

REPAIR/REPLACE FLOOR	22.00
REPAIR/REPLACE MODESTY PANEL	1.20
REPAIR/REPLACE INTERIOR BODY PANEL	0.90
REPAIR/REPLACE DRIVER'S SEAT/CUSHION	1.10
REPAIR/REPLACE/INSTALL/TIGHTEN MIRROR	0.30
REPAIR/REPLACE/INSTALL FAREBOX	0.80
REPAIR/REPLACE SUN VISOR	0.60
REPAIR/REPLACE WINDOW LATCH	0.80
REPAIR/REPLACE/INSTALL DRIVER'S SEAT BELT	0.60
REPAIR/REPLACE BELLCORD/GUIDE	0.70
REPAIR/REPLACE PASSENGER SEAT/COVER/CUSHION	0.30
REPAIR/REPLACE STEPWELL-FRONT 0252, REAR 0320	0.80
REPLACE COVERING FOR BRAKE/THROTTLE PEDAL	0.80
REPAIR/REPLACE STANCHION/MOUNT	0.50
REPAIR/REPLACE ENGINE HATCH COVER	1.00
REPAIR/REPLACE FLOOR COVERING	16.00

WINDOWS AND GLASS

REPLACE PASSENGER WINDOW GLASS/LOWFLOOR/BRT PER SIDE	2.00
REPLACE WINDSHIELD GLASS	2.00
REPLACE DOOR GLASS	0.80
REPLACE DESTINATION SIGN GLASS	1.00
REPAIR/REPLACE WINDOW FRAME/RUBBER	0.80
SEAL WATER LEAK INTO COACH	1.30
REPAIR/REPLACE EMERGENCY WINDOW RELEASE	0.80
REPLACE WINDSHIELD GLASS BRT 1 PC	3.00
REPLACE BRT OPERA WINDOW	1.00

PASSENGER DOORS

REPAIR/REPLACE PASSENGER DOOR ASSEMBLY	1.90
REPLACE PASSENGER DOOR MOTOR	1.20
REPAIR/REPLACE/ADJUST PASSENGER DOOR LINKAGE	0.90
REPAIR/REPLACE TOUCH-BAR	1.40
REPAIR/REPLACE ENGINE COMPARTMENT DOOR	0.50
REPLACE LIFT-U MAT	0.60
REPAIR/REPLACE DOOR CONTROL VALVE	0.50
REPAIR/REPLACE FRONT DOOR SHUT OFF VALVE	1.00
REPLACE RELAY	0.60
REPLACE/ADJUST PROXIMITY SWITCH	0.50
REPAIR/REPLACE REAR DOOR SOLENOID	0.70
LUBRICATE DOOR LINKAGE/HINGE	0.50
REPAIR/REPLACE PIPE/HOSE	0.30
REPAIR/REPLACE SENSITIVE DOOR EDGE	1.10
REPAIR/REPLACE WIRING	0.50
RECONDITION PASSENGER DOOR ENGINE	1.50

GILLIC

STANDARD REPAIR TIMES

COMPARTMENT DOORS (EXTERIOR)

REPAIR/REPLACE ENGINE DOOR	1.10
REPAIR/REPLACE RADIATOR DOOR	0.50
REPAIR/REPLACE BATTERY DOOR	0.80
REPAIR/REPLACE FUEL DOOR	1.00
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50

SPECIAL EQUIPMENT/ACCESSORIES

REPAIR/REPLACE BIKE RACK	0.50
REPLACE/INSTALL REFLECTIVE TRIANGLES	0.30
REPLACE/INSTALL FIRE EXTINGUISHER	0.30
REPAIR/REPLACE/INSTALL ADVERTISING SIGN FRAME (PER)	0.80
REPAIR/REPLACE/INSTALL PASSENGER COUNTER	0.80
REPAIR/REPLACE/INSTALL DRIVERS BOX	0.90
REPAIR/REPLACE/INSTALL WHEELCHAIR RESTRAINTS (ALL)	1.10
INSTA CHAIN REPAIRS-SOLENOID	1.00

TWO WAY RADIO

REPLACE RADIO/CONTROL HEAD	0.90
REPLACE RADIO CONTROL UNIT	1.30
REPAIR/REPLACE RADIO POWER UNIT	1.00
REPAIR/REPLACE ANTENNA	1.30
INSTALL COMPLETE RADIO ASSEMPLY	1.50
REPLACE HANG UP CRADLE ASSEMBLY	0.50
REPAIR/REPLACE WIRING	0.50

HEATER AND DEFROST SYSTEM

REPLACE HEATER CORE	2.00
REPLACE MARINE PUMP	1.00
REPLACE DEFROSTER/HEATER MOTOR	1.50

REPLACE WATER MODULATOR VALVE	1.00
REPLACE/ADJUST THERMOSTAT/GRADUSTAT	0.30
REPAIR/REPLACE HEAT CONTROL VALVE/CABLE	1.10
CLEAN/REPLACE HEATER FILTER	0.10
REPLACE CIRCUIT BREAKER	0.20
REPLACE SWITCH	0.70
CLEAN/REPAIR/REPLACE AMPHENOL PLUG	1.00
REPLACE HEATER RESISTOR	0.80
REPAIR/REPLACE PIPE/HOSE	1.00
REPAIR LEAK	0.40
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPLACE RELAY, SWITCH, DIOD, ETC.	0.60
REPAIR/REPLACE WIRING	0.80

AIR COMPRESSOR AND SUPPLY SYSTEMS

REPLACE AIR COMPRESSOR GOVERNOR	0.90
REPLACE AIR DRYER	1.50
REPLACE SAFETY VALVE	0.50
SERVICE/REPLACE PURGE VALVE	0.90
REPLACE AIR SWITCH	0.50
REPLACE CHECK VALVE	0.50
REPLACE GASKET/O-RING/SEAL	1.40
REPAIR/REPLACE PIPE/HOSE	1.40
REPAIR LEAK	0.90
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50

GILLIC

AIR BRAKE SYSTEMS

REPLACE BRAKE TREADLE VALVE	1.50
REPLACE BRAKE RELAY VALVE	2.00
REPLACE QUICK RELEASE VALVE	0.50
REPLACE REAR BRAKE CHAMBER	1.00
REPLACE FRONT BRAKE CHAMBER	0.60
REPLACE AIR SWITCH	0.60
REPAIR/REPLACE PIPE/HOSE	0.80
REPAIR LEAK	0.80
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPLACE RELAY, SWITCH, DIODE, ETC.	0.50

BRAKE INTERLOCK SYSTEMS

REPLACE/ADJUST AIR REGULATOR VALVE	0.70
SERVICE/REPLACE SOLENOID/SKINNER VALVE	1.10
REPLACE CIRCUIT BREAKER	0.30
REPLACE RELAY	0.50
REPLACE/ADJUST MICRO SWITCH/BRACKET	0.50
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPLACE SWITCH	0.60
REPAIR/REPLACE WIRING	0.80

ELECTRICAL ACCESSORIES

REPAIR/REPLACE PASSENGER CHIME	0.50
REPAIR/REPLACE BACK UP BEEPER	0.50
REPLACE/INSTALL AM/FM RADIO/ANTENNA	0.90
REPAIR/REPLACE NEXT STOP COMPONENT	0.90
REPAIR/REPLACE HORN COMPONENT	0.80
REPAIR/REPLACE DRIVER'S FAN	0.70
REPAIR/REPLACE P.A. SYSTEM COMPONENT	1.00

REPAIR/REPLACE MIRROR SWITCH/MOTOR/WIRING	1.00
DINEX MODULES/MULTIPLEXING	0.50
W/S WIPER MOTOR	1.00
R&R AMEREX CONTROL MODULE	0.50
R&R AMEREX HEAT SENSOR(THERMISTOR)	0.50
R&R GILLIG FIRE DETECTION WIRE	1.00

CHARGING SYSTEMS

REPLACE/ADJUST REGULATOR	0.70
REPLACE VANNER EQUALIZER	1.00
REPLACE CIRCUIT BREAKER	0.30
REPLACE RELAY	0.30
REPLACE DIODE	1.10
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.50
REPLACE RELAY, SWITCH, DIODE, ETC.	0.50
REPAIR/REPLACE WIRING	0.80
CHECK/TROUBLESHOOT CHARGING SYSTEM	1.50

BATTERY

REPLACE BATTERIES	0.70
SERVICE AND CLEAN OFF BATTERIES	0.50
TIGHTEN/REPLACE CLAMP, FITTING OR FASTENER	0.40
DISCONNECT ALL POWER BEFORE WELDING	1.50

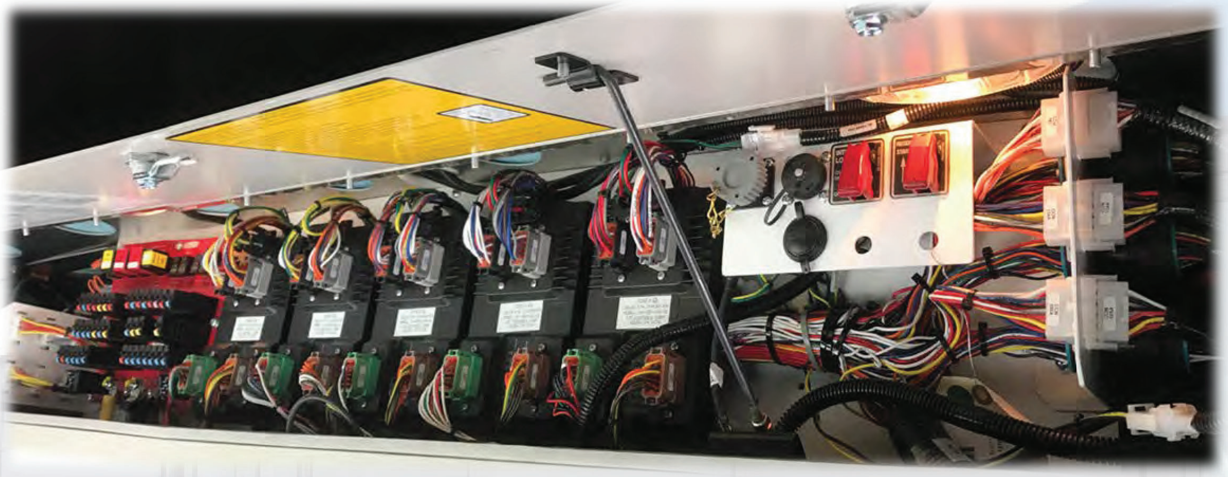
INTERIOR LIGHTING SYSTEMS

REPLACE FLOURESCENT TUBE/BULB/LED	0.50
REPAIR/REPLACE LENS	0.30
REPAIR/REPLACE BULB SOCKET/PIGTAIL	0.50
REPLACE LIGHT BALLAST	0.60
REPLACE CIRCUIT BREAKER	0.30

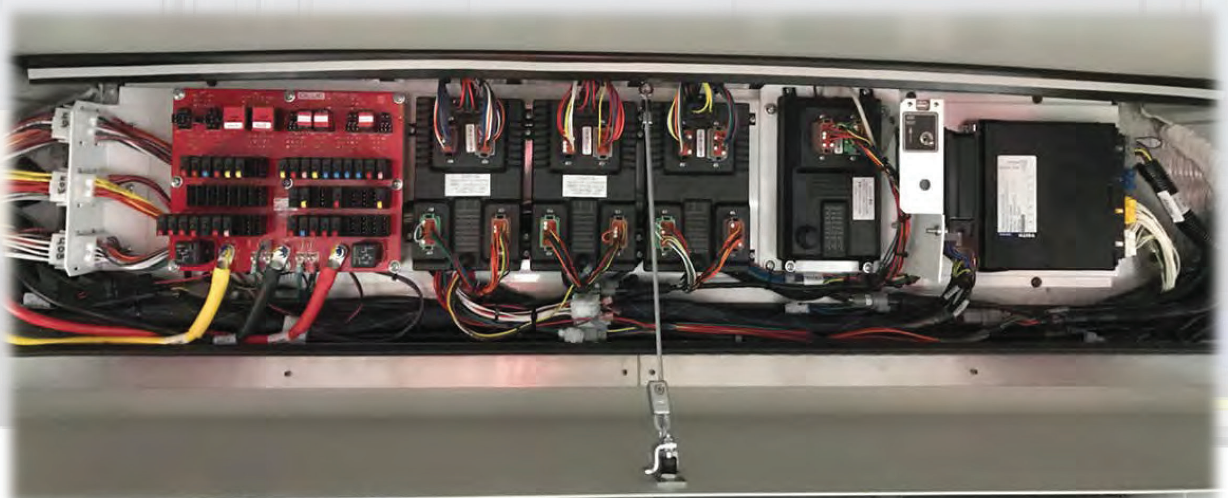
G4 Multiplex Electrical Control System

Specially designed for GILLIG

G4 System installation

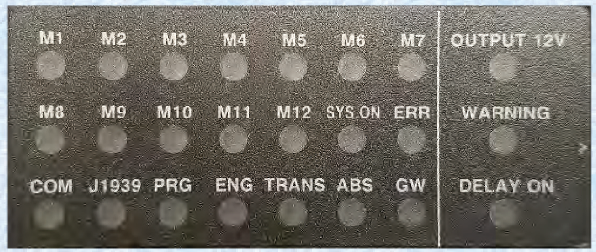


Front Zone
(in front above driver area)



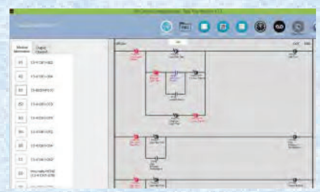
Rear Zone
(toward the end of bus)

Main Bus Controller (MBC-HUB)
(1 per bus)



LED indicators for

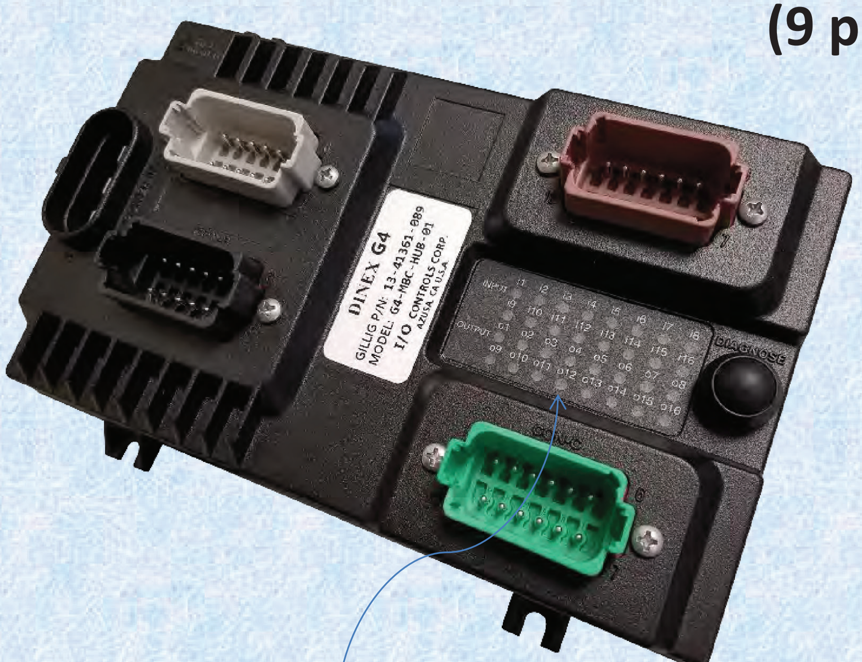
1. All modules are on-line and working (M1-M12)
2. Heartbeat (communicating) of Power-Train (Engine-Trans-ABS)
3. Low voltage output warning (<20VDC)



Single USB Port (Service & Diagnostics)

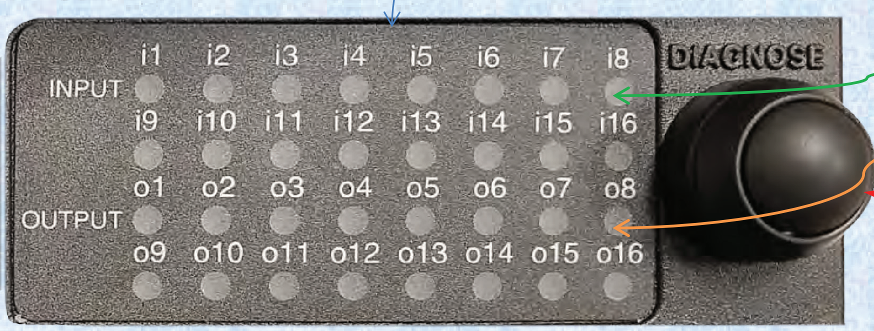
1. Program download
2. Troubleshooting (Real-time Ladder Logic display),
   Real-time Power-Train information

G4-DIO-1616-GL (Salve Module)
(9 per bus)



Features

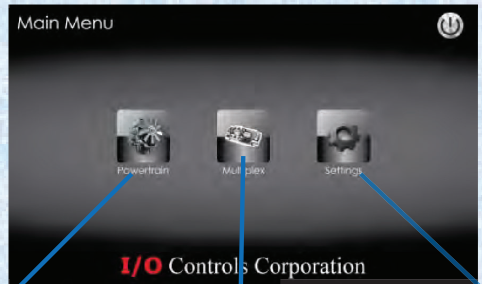
1. All 9 modules are identical and interchangeable
2. Hot swappable
3. No special tool required when change module



LED indicators for

1. Input “ON” or “OFF” status (i1 to i16 (16 inputs)
2. Output “ON” or “OFF” status (o1 to o16 (16 outputs)
3. Diagnostic button (check for output “Load” status, i.e. “overload”, “short”, “underload”

Touchscreen Handhold Tool (Optional)



Functions

1. Monitor Power-Train Heartbeats (0n-Off)
2. Real-time display of power-train data (PGN, SPN)
3. Real-time inputs (switches) & outputs (loads) status display
4. Real-time ladder logic display
5. Upload new program
6. Optional wireless capabilities (Wi-Fi, Bluetooth, Cellular)

MULTIPLEX SYSTEM

The bus uses the Dinex-G4-MPX multiplex system made by the I/O Controls Corporation. The multiplex system makes it possible to move large amounts of electrical sensor and switching information between remote locations on the bus using only a small cable. This eliminates a huge wire bundle (conventional wiring harness) still found on some buses. The multiplex system also provides better control and troubleshooting capabilities for the electrical system.

NOTICE

A multiplex service manual from I/O Controls, *Dinex G4 Multiplex System for GILLIG Bus*, is included on your GILLIG documentation CD.

For the most up-to-date information, contact the I/O Controls Corporation.

I/O Controls Corporation
1357 West Foothill Blvd.
Azusa CA 91702
Phone (626) 812-5353
www.iocontrols.com

Theory of Operation

The multiplex system consists of modules installed at various locations on the bus (refer to Figure 9-21 for locations). "Clean" power for the system is provided by a unit mounted in the Rear Enclosure Electrical Panel. The system works as follows: One of the modules, the G4-MBC-HUB (Figure 9-20), is a programmable primary module "brain" unit. The others are secondary units, which either inform the rest of the system of inputs from the bus, or direct power to outputs at the command of the primary module.

An input (from a switch, sensor, etc.) is received by a module. The module will send a signal to the G4-MBC-HUB master module. Each Module is using a jumper as identification, refer to the *Schematics Manual* for each module jumper setting. Modules programmed to take action when they get a particular command will do so. This process continues constantly; every module is constantly in communication with the G4-MBC-HUB module.

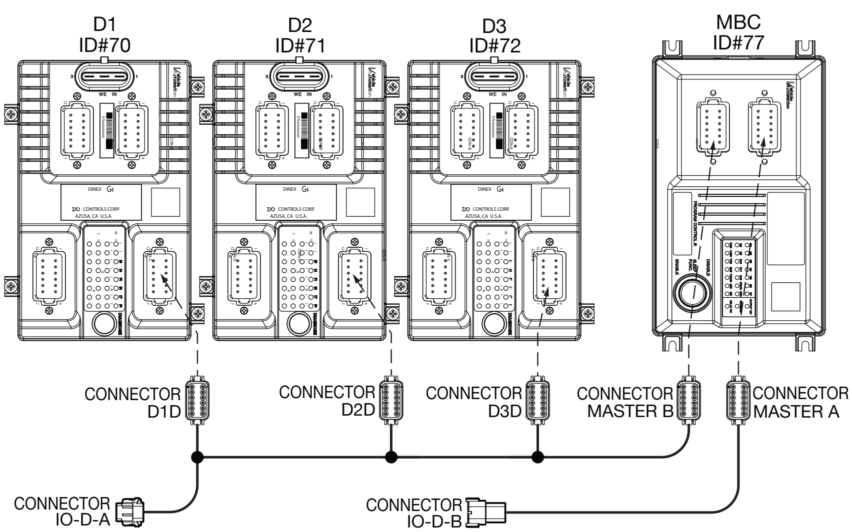


Figure 9-20, Rear Electrical Compartment

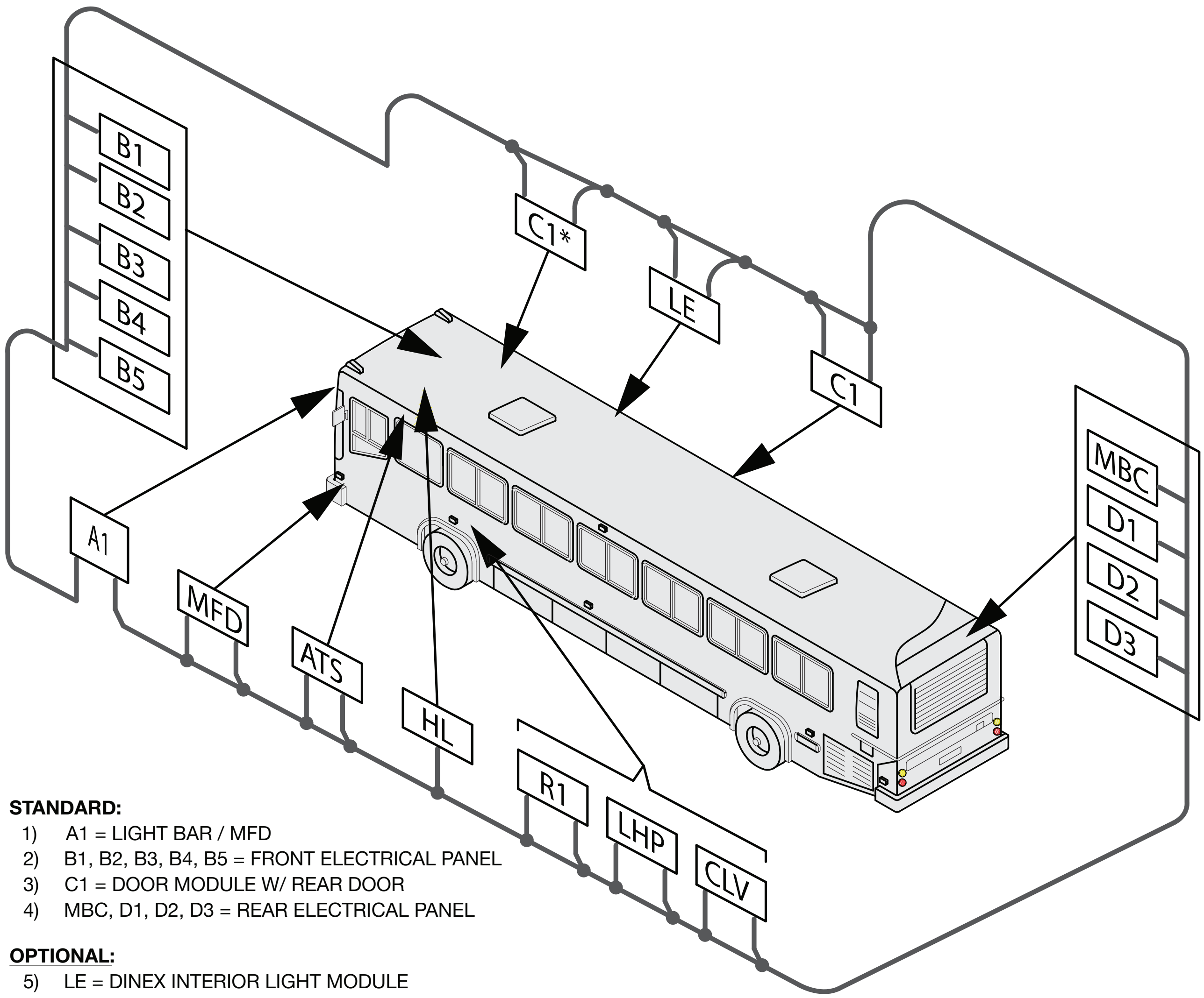
The I/O system has the capability of communicating with the J1939 network.

Multiplex System Components

The multiplex modules are located in various locations inside the bus. Refer to Figure 9-21 for a diagram of these locations. The different types of modules are described below. Refer to the *Schematics Manual* to determine the components equipped on your bus.

Multiplex System Connections

The modules in the system are connected by small cable bundles wrapped in plastic conduit and joined by Deutsch connectors. Do not cut or modify any of the multiplex system wiring. Refer to the *Schematics Manual* for your bus to determine cable routing.



STANDARD:
1) A1 = LIGHT BAR / MFD
2) B1, B2, B3, B4, B5 = FRONT ELECTRICAL PANEL
3) C1 = DOOR MODULE W/ REAR DOOR
4) MBC, D1, D2, D3 = REAR ELECTRICAL PANEL

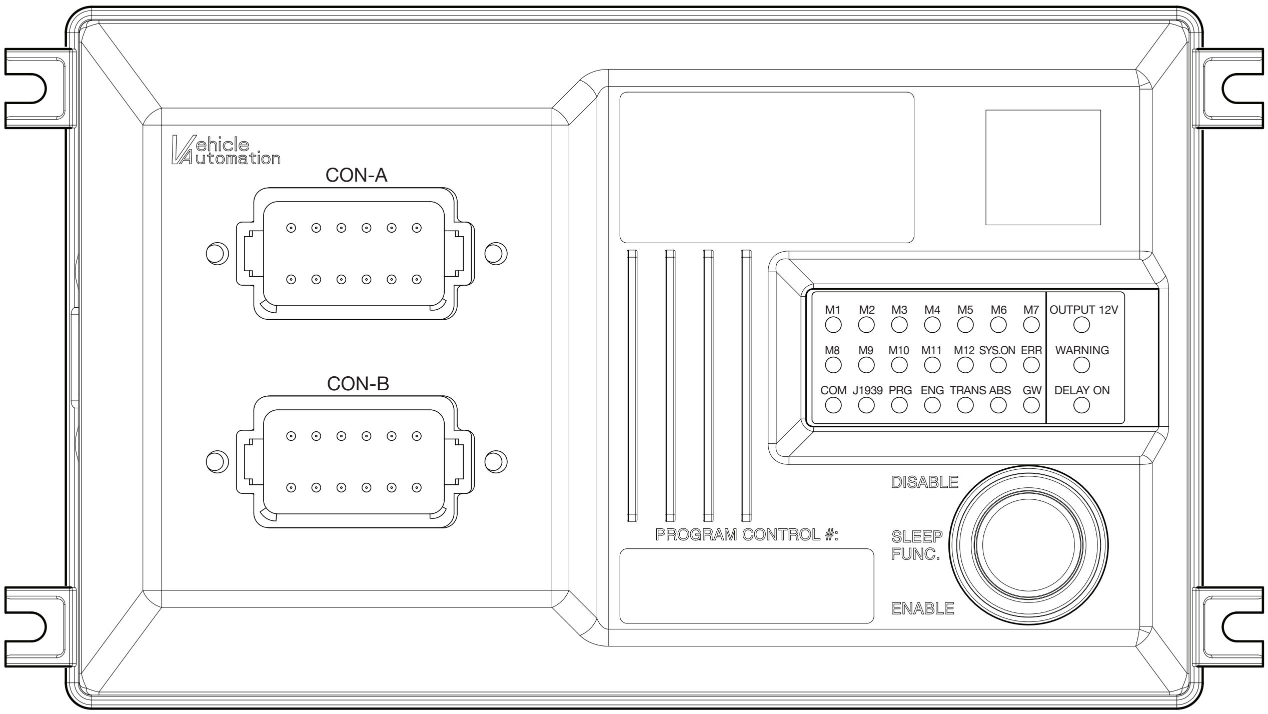
OPTIONAL:
5) LE = DINEX INTERIOR LIGHT MODULE
6) CLV (SYS-01) = CLEVER INTERFACE MODULE
7) LHP (SYS-02) = LOGGING MODULE
8) R1 = RADIO BOX MODULE
9) HL = DINEX HEADLIGHT MODULE (AT WASHER PANEL)
10) ATS = AUTO TEST SYSTEM MODULE
11) MFD (A2/A3) = MFD MODULE
12) C1* = C1 MODULE W/O REAR DOOR

Figure 9-21, Typical Multiplex Component Locations

G4-MBC-HUB Main Bus Controller

The G4-MBC-HUB module (Figure 9-22) is a programmable network controller located in the rear bulkhead electrical compartment. This module constantly monitors the system for signals from other modules.

This module contains two programs: one for processing ladder logic and one for communicating with the J1939 network.



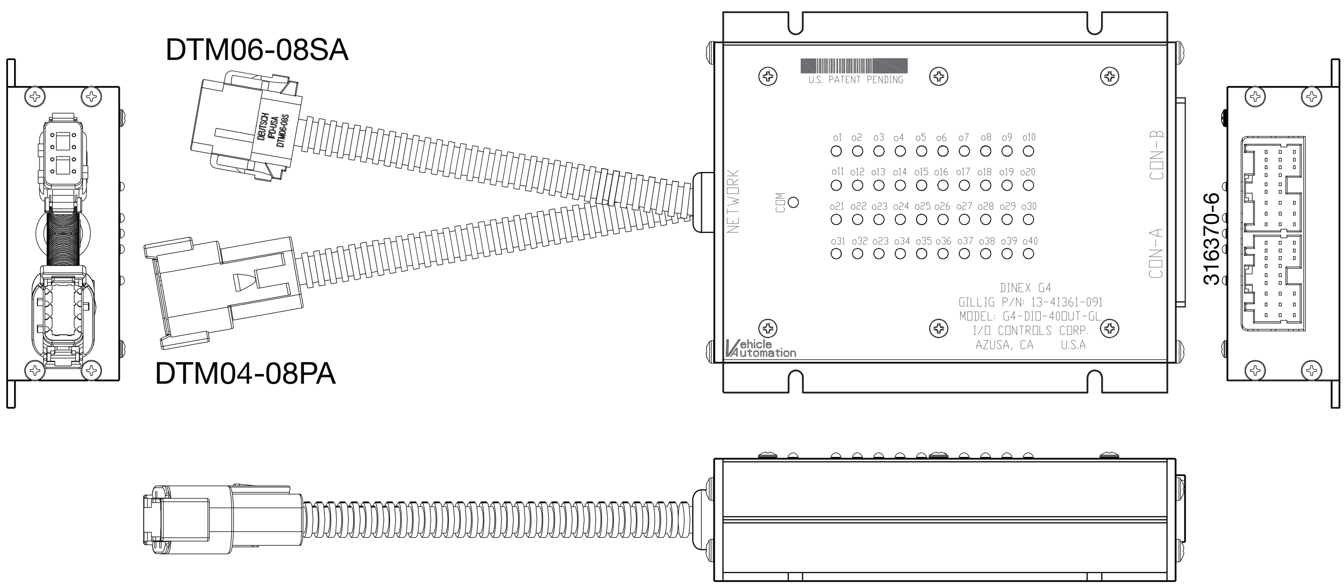
DT15-12PC (CON-A, GREEN)	
PIN#	FUNCTION
1	CAN_HI_B
2	CAN_LO_B
3	+12V, ISOLATED
4	GROUND, ISOLATED
5	SHIELD_B
6	N/C
7	PRIM_J1939_HI
8	PRIM_J1939_LO
9	PRIM_J1939_SHIELD
10	SEC_J1939_HI
11	SEC_J1939_LO
12	SEC_J1939_SHIELD

DT15-12PD (CON-B, BROWN)	
PIN#	FUNCTION
1	CAN_HI_A
2	CAN_LO_A
3	+12V, ISOLATED
4	GROUND, ISOLATED
5	SHIELD_A
6	DOWNLOAD_ENABLE
7	N/C
8	MASTER_SW_PMS
9	DA_PROG_PMS SETTING
10	DB_PROG_PMS SETTING
11	BATTERY, GROUND
12	BATTERY, +24V

Figure 9-22, G4-MBC-HUB Main Bus Controller

G4-DIO-40OUT-GL Module

This 40-output module (Figure 9-23) provides power signals to the Intelligent Transportation System (ITS), passenger counter, and camera system.



DTM04-08PA/DTM06-08SA		
PIN	COLOR	FUNCTION
1	YELLOW	CANH
2	GREEN	CANL
3	RED	+12V, ISOLATED
4	BLACK	GOUND, ISOLATED
5	NC	
6	NC	
7	NC	
8	BLUE	CAN SHIELD

CONNECTOR	316370-6 (WHITE) CON-A																							
PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
OUTPUT CHANNEL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

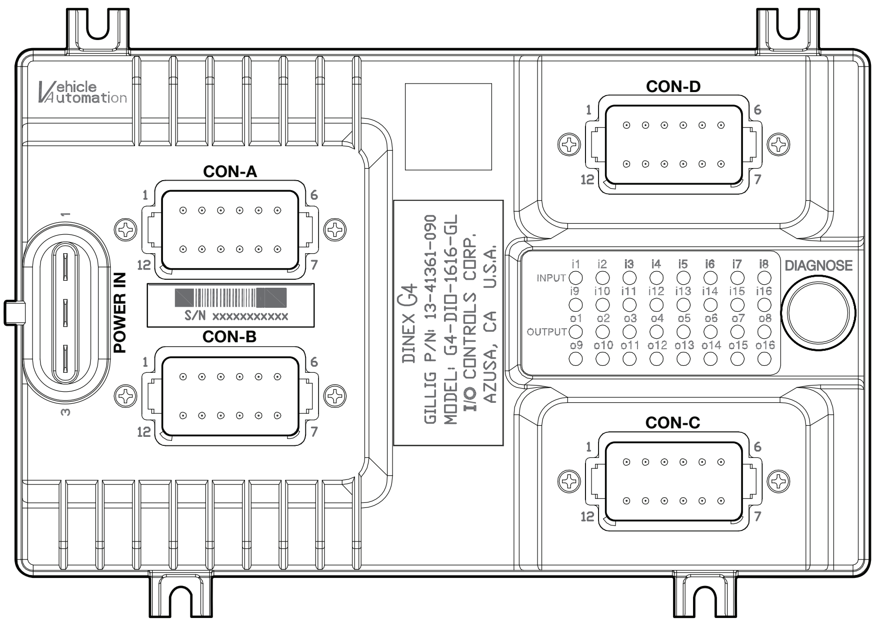
CONNECTOR	316370-6 (GREY) CON-B																							
PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
OUTPUT CHANNEL	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	COM1 OUTPUT 1-5		COM2 OUTPUT 6-13		COM3 OUTPUT 14-24		COM4 OUTPUT 25-40	

Figure 9-23, G4-DIO-40OUT-GL Module

G4-DIO-1616-GL Module

This digital 16-input/16-output module (Figure 9-24) receives commands from the G4-MBC-HUB module and performs various functions, depending upon where it is located—for example, this module can be used to control HVAC, headlights, panel lights, stop request lights, marker lights, farebox light, auxiliary heaters, and door controls.

DT15-12PA (CON-A, GREY)	
PIN#	FUNCTION
1	OUTPUT 5 (5.0A)
2	INPUT 1
3	OUTPUT 6 (5.0A)
4	INPUT 2
5	OUTPUT 1 (10.0A)
6	INPUT 3
7	OUTPUT 2 (10.0A)
8	INPUT 4
9	OUTPUT 7 (5.0A)
10	OUTPUT 8 (5.0A)
11	INPUT 5
12	OUTPUT 9 (5.0A)



DT15-12PB (CON-B, BLACK)	
PIN#	FUNCTION
1	OUTPUT 10 (5.0A)
2	INPUT 6
3	OUTPUT 11 (5.0A)
4	OUTPUT 12 (5.0A)
5	INPUT 7
6	OUTPUT 3 (10.0A)
7	INPUT 8
8	OUTPUT 4 (10.0A)
9	INPUT 9
10	OUTPUT 13 (5.0A)
11	INPUT 10
12	INPUT 11

DT15-12PC (CON-C, GREEN)	
PIN#	FUNCTION
1	OUTPUT 14H (0.12A)
2	OUTPUT 14L (0.12A)
3	OUTPUT 15 (SINK, 1.0A)
4	OUTPUT 16 (SINK, 1.0A)
5	OUTPUT 15-16 COM_GND
6	INPUT 13
7	INPUT 14
8	COM_1-6
9	COM_7-14
10	COM_GND
11	COM_POWER
12	INPUT 12

DT15-12PD (CON-D, BROWN)	
PIN#	FUNCTION
1	CAN_H
2	CAN_L
3	+12V, ISOLATED
4	GND, ISOLATED
5	CAN_SHIELD
6	INPUT 15_AN1
7	INPUT 16_AN2
8	ID_SELECT_GND
9	ID_SELECT_ADDR1
10	ID_SELECT_ADDR2
11	ID_SELECT_ADDR3
12	ID_SELECT_ADDR4

POWER IN	
PIN#	FUNCTION
1	BATTERY_POWER_A (FOR OUTPUT1,2,5,6,7,8,9)
2	BATTERY_GND
3	BATTERY_POWER_B (FOR OUTPUT3,4,10,11,12,13,)

Figure 9-24, Dedicated 16-Input/16-Output Module

Headlight Control Pulse-Width Modulation

Pulse-width modulation (PWM) is provided by the G4-DIO-1616-GL module. The task of the Headlight Control Pulse-Width Modulation module has now been assigned to output channels 1 and 2 on B1 and B2. Output channels 1 and 2 can be controlled by the application program to provide PWM or non-PWM output.

PWM output provides low voltage to outputs 1 on B1 and B2 for high beam and outputs 2 on B1 and B2 for low beam, significantly increasing bulb life. The voltage pulse width, instead of a constant 12 volts, is digitally modulated and programmable for a desired percentage of duty cycle.

DL-CM-007 Dinex Lighting Gateway Module (Optional)

This module (Figure 9-25) provides power to the interior lighting in buses equipped with I/O Controls LED interior lighting systems, and it communicates with the master module to turn individual lighting fixtures on and off according to conditions in the ladder logic. It controls curbside lighting fixtures and streetside lighting fixtures.

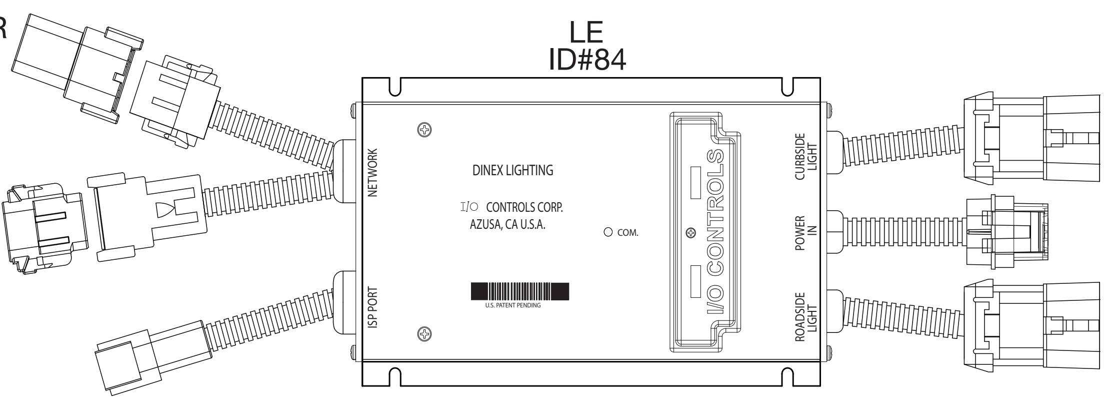


Figure 9-25, Lighting Gateway Module

G4-ATS-01 Automatic Test System (ATS) Module (Optional)

G4-ATS automatic test system (Figure 9-26) can be used for a variety of purposes. It functions as an input monitor display, an output emulator display, and as a display of previous test results. It can be used as a built-in self-test, which performs diagnostic functions. The G4-ATS can remember and display test results from three previous test runs. Consult your GILLIG Service representative before using this test system. Only trained personnel should use this equipment.

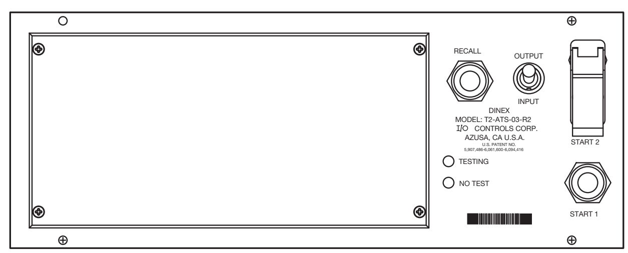


Figure 9-26, G4-ATS

Troubleshooting

Troubleshooting a multiplexed electrical system is usually fairly easy. Most problems can be identified by observing the LEDs on the multiplex modules. It may, on rare occasions, become necessary to reload the software into the master module.

To properly troubleshoot the electrical system, it is necessary to understand the relationship between various combinations of inputs and the programmed responses to those inputs. The I/O Dinex multiplex system can be programmed to require any number of conditions (on or off signals from bus switches or sensors) in any combination to produce a response. The response can simply turn on an output to a device, or it can be a series of timed events and/or multiple actions.

Diagnostic Mode

Service technicians have access to a Diagnostic Mode screen on the multi-function display. Available on this screen are bus network diagnostic information, logging/export data, and status monitoring of all I/O Multiplex modules. To get back to the Primary Screen, touch the "Main" button at the lower right of the screen.

Ladder Charts

The best way to understand the programming of the multiplex system is to study the diagram of the programming, which is known as a "ladder chart." The ladder chart can be found in the GILLIG *Electrical Schematics Manual*. Always make sure you are using the correct manual for your bus before attempting any electrical troubleshooting; check the bus/chassis numbers on the manual's front cover.

Ladder charts use logical symbols and connecting lines to show the relationships between the various inputs and outputs in the multiplex system. The three most commonly used symbols are:

Figure 9-27, "ON" input required

"ON" Input Condition Required

This symbol, which is made up of two vertical lines interrupting a horizontal line (see Figure 9-27), indicates that the input circuit number listed above the symbol must be **ON** to continue to the next step to the right of the symbol on the ladder chart. In the example here, the DAY RUN circuit at **B1-i01** must be on or active in order for the multiplex system to move on to the next condition or action in the ladder chart.

Figure 9-28, "OFF" input required

"OFF" Input Condition Required

This symbol, which looks like the "On Input Condition Required" symbol with a diagonal slash through it (see Figure 9-28), indicates that the input circuit number listed above the symbol must be **OFF** to continue to the next step to the right of the symbol on the ladder chart. In the example here, the STARTER ENGAGED circuit at **D1-in16** must be off or inactive in order for the multiplex system to move on to the next condition or action in the ladder chart.

Timed Action

This symbol, which looks like a "T" in between two vertical lines (see Figure 9-29), indicates that the timed function will affect whatever action is listed to the right of the box on the ladder chart. In some cases, there may be a delay before an action is taken; in others, an action may be taken for a specified amount of time, then stopped. In the example here, the RAISE output B4-o07 will be activated for 2.5 seconds, then turned off.

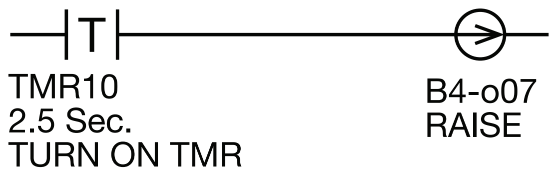


Figure 9-29, Timed Action Taken

Reading the Ladder Charts

Refer to Figure 9-30. Each circuit shown on the ladder charts starts with a single line on the left and ends with a single output on the right. The multiplex system checks for the required conditions, scanning from left to right. If a path can be completed (by meeting all the required conditions between the start of the circuit on the left and the output on the right), power is sent to the output. In most cases, there is more than one path that will activate the output; in these circuits, *any* completed path will activate the output.

For example, in Figure 9-30, there are two ways to send power to the roadside high beam headlamp at B2-o01 (the letter "o" stands for "output"). One way is for all the conditions on the upper path to be met; for this to happen, the STARTER MOTOR input at D1-in16 must be OFF, the NIGHT RUN input at B1-i01 must be ON, and B3-i05 must be on. *All* conditions on each rung must be met before the upper path can be completed and power sent to the headlights. Another way to send power to the roadside HIGH BEAM output is to complete the lower path, shown in Figure 9-30. To do this, the STARTER MOTOR input at D1-in16 must be OFF, or the EXT LIGHTS TEST FLAG must be ON.

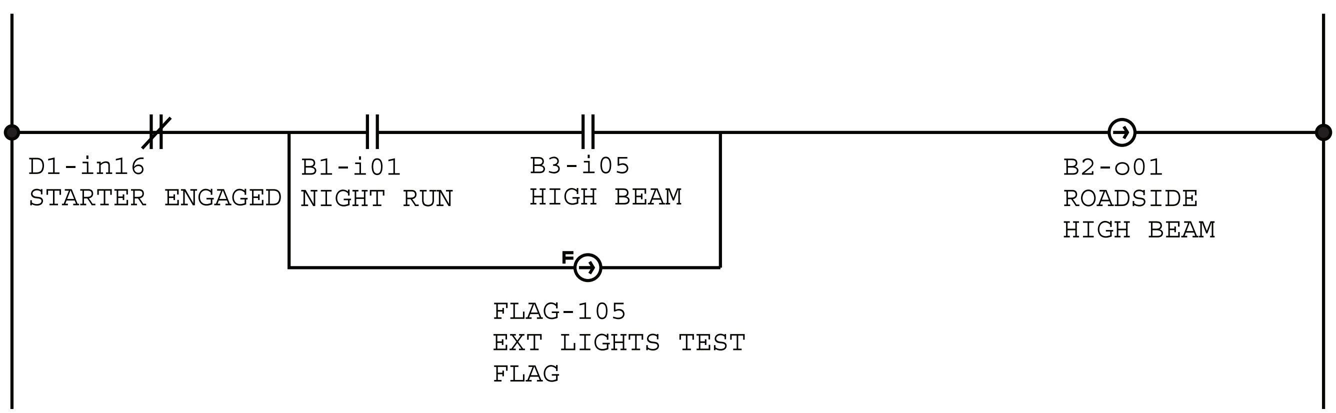


Figure 9-30, Streetside High Beam Headlight Ladder Chart

Module LEDs

The multiplex system modules have LED indicator lights to help you find problems. Each I/O point is optically isolated and smart fuse protected for double protection against voltage spikes, transients and short circuits. This optical isolation also provides electrical noise immunity. Observing the LEDs on the modules while referring to the ladder chart for your bus will enable you to solve most electrical problems on the bus.

Input Circuits

Input circuits have green LEDs. Refer to the input/output map for your bus to determine which circuit a particular LED is monitoring. Input circuits are always numbered **i1** through **i16** (Figure 9-31).

Output Circuits

Output circuits are monitored using the red LEDs. Refer to the input/output map for your bus to determine which circuit a particular LED is monitoring. Red LEDs are assigned a circuit number. When a red LED lights up, it indicates that the output circuit is on or active. Output circuits are always numbered **o1** through **o16** (Figure 9-31).

Diagnose

When the DIAGNOSE button is depressed for less than 10 seconds, the module ID# (Ref. Figure 9-33) and communication status is displayed. When the DIAGNOSE button is depressed for more than 10 seconds, the feedback and smart fuse information are displayed for output channels 1 through 14. Ref. Figure 9-32.

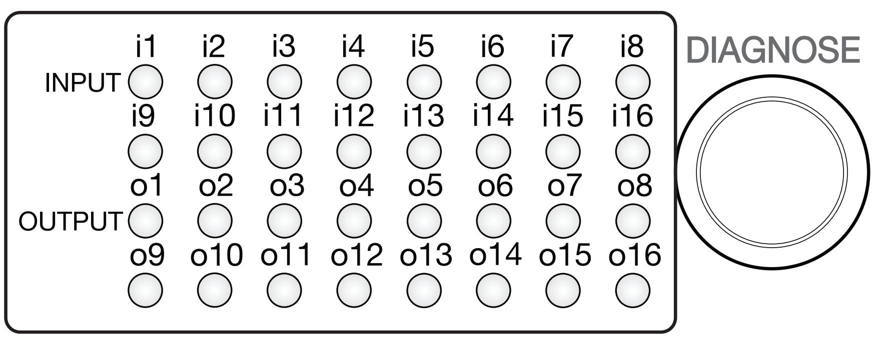


Figure 9-31, Input/Output Circuit LEDs

Diagnose Information for Less Than 10 Seconds	Diagnose Information After 10 Seconds
o09 = ID Select Address 1	Short Circuit = Flashes at a rate of 60 milliseconds
o10 = ID Select Address 2	Overload = Flashes at a rate of 400 milliseconds
o11 = ID Select Address 3	Open Load = Flashes at a rate of 800 milliseconds
o12 = ID Select Address 4	Load Normal = Remains off
o16 = ON(Active Communication), OFF(No Communication)	

Figure 9-32, Diagnose Information

Module ID Selection

Each module ID# is configured by the wire harness on CON-D. Every module will have a unique ID#.

Module ID Selection/Jump Table (Ref: CON D)	
ID	Jump Pins
64	8-9-10-11-12
65	8-10-11-12
66	8-9-11-12
67	8-11-12
68	8-9-10-12
69	8-10-12
70	8-9-12
71	8-12
72	8-9-10-11
73	8-10-11
74	8-9-11
75	8-11
76	8-9-10
77	8-10
78	8-9

Figure 9-33, Module ID Selection/Jump Table

DINEX Flash Codes

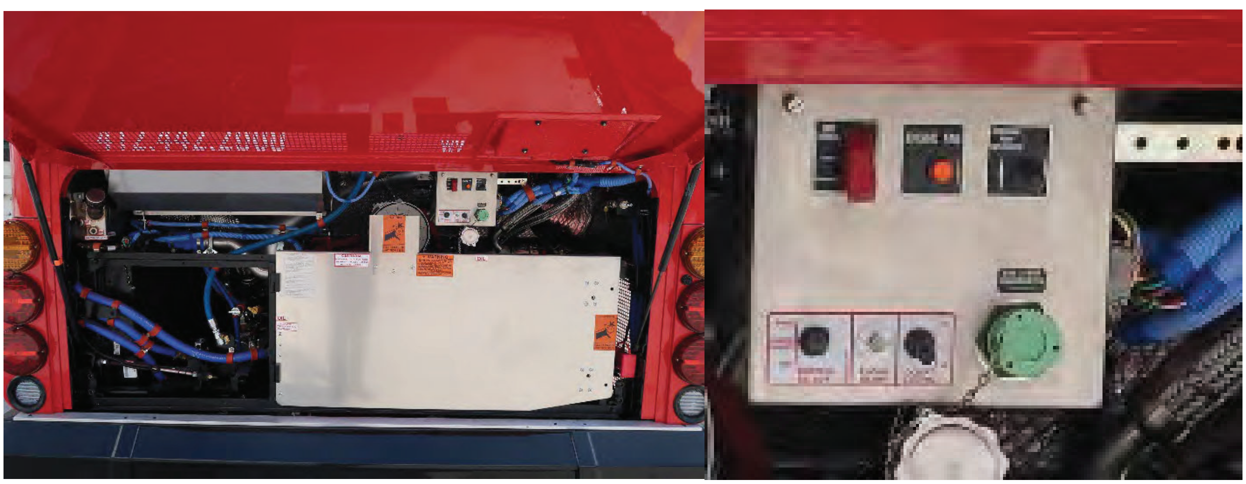
The COMM FAULT lamp on the MFD can display a flash code if there is any DINEX module communication failure. The Day Run, Night Run, Park, or Rear Run switch must be on to display these flash codes. The COMM FAULT lamp will light for a few seconds on initial power-up, and then turn off, indicating that the DINEX modules are communicating. On the MBC module there are twelve indicator lights used to indicate the status of twelve specified modules. The M1 to M12 light will be solid ON, if the module is communicating properly and solid OFF, if the module is not communicating. If the COMM FAULT lamp turns on after the initialization cycle, use the following flash codes to determine which module is failing. If a flash code appears that is not listed below, the wrong program may have been loaded or an incompatible tool may have been connected.

MBC Indicator	COMM FAULT	Module	IOC Module	GILLIG P/N
M1	1	B1 (ID# 64)	G4-DIO-1616-GL	13-41361-090
M2	2	B2 (ID# 65)	G4-DIO-1616-GL	13-41361-090
M3	3	B3 (ID# 66)	G4-DIO-1616-GL	13-41361-090
M4	4	B4 (ID# 67)	G4-DIO-1616-GL	13-41361-090
M5	5	B5 (ID# 68)	G4-DIO-1616-GL	13-41361-090
M6	6	C1 (ID# 69)	G4-DIO-1616-GL	13-41361-090
M7	7	D1 (ID# 70)	G4-DIO-1616-GL	13-41361-090
M8	8	D2 (ID# 71)	G4-DIO-1616-GL	13-41361-090
M9	9	D3 (ID# 72)	G4-DIO-1616-GL	13-41361-090
M10	10	R1 (ID# 88)	G4-DIO-40OUT-GL	13-41361-091
M11	-	A1 (ID# 93)	G4-48LED-04-GL	13-75839F003
M12	11	LE (ID# 84)	DL-CM2-007	13-41361-071
-	12	TM (ID# 80)	G4-TIMER-GL	Internal MBC
-	13	G1 (ID# 89)	G4-GW-J1939-4848-06	Internal MBC
-	14	G2 (ID# 90)	G4-GW-J1939-4848-06	Internal MBC
	15	G3 (ID# 91)	G4-GW-J1939-4848-06	Internal MBC
	16	G4 (ID# 92)	G4-GW-J1939-4848-06	Internal MBC
M11		A2 (ID# 86)	G4-MFD-02-GL2	19-68351-018
	17	R2 (ID# 87)	G4-GW-SYS-01	13-41361-095
	18	HL (ID# 81)	DL-HDM-90L-02	51-69995-001

CONTROLLER AREA NETWORK (CAN)

GILLIG provides two access points to the Controller Area Network (CAN). These are located in secure areas to prevent unauthorized personnel from accessing or tampering with connectors, while still being easy for maintenance personnel to connect to.

Interior location in forward air tank compartment by driver’s area


Exterior location in engine compartment on rear run box

Additional connectors can be provided upon request. These can be at the driver’s dash, driver’s side console, the electrical equipment cabinet or custom location upon request and approval.

A R A

The primary communications network on your bus is a “CAN backbone”—a controller area network. Controls such as the ECM (engine control module), ECU (transmission electronic control unit), ABS system ECU, and other vehicle computer control systems communicate through use of this SAE J1939 standard communication link.

This link receives operational information regarding the engine and other vehicle components, which is needed for proper bus systems control, and it transfers system operational data, to be utilized by vehicle systems to monitor, display, or use as input to determine the operating status of various systems. This communication link is also used as the basis for PC-based diagnostics programs.

Figure 9-29 shows the general layout of the J1939 system. Please refer to the “Communication Cable” section of the *Electrical Schematics Manual* for a more-detailed version of this schematic that is specific to your bus.

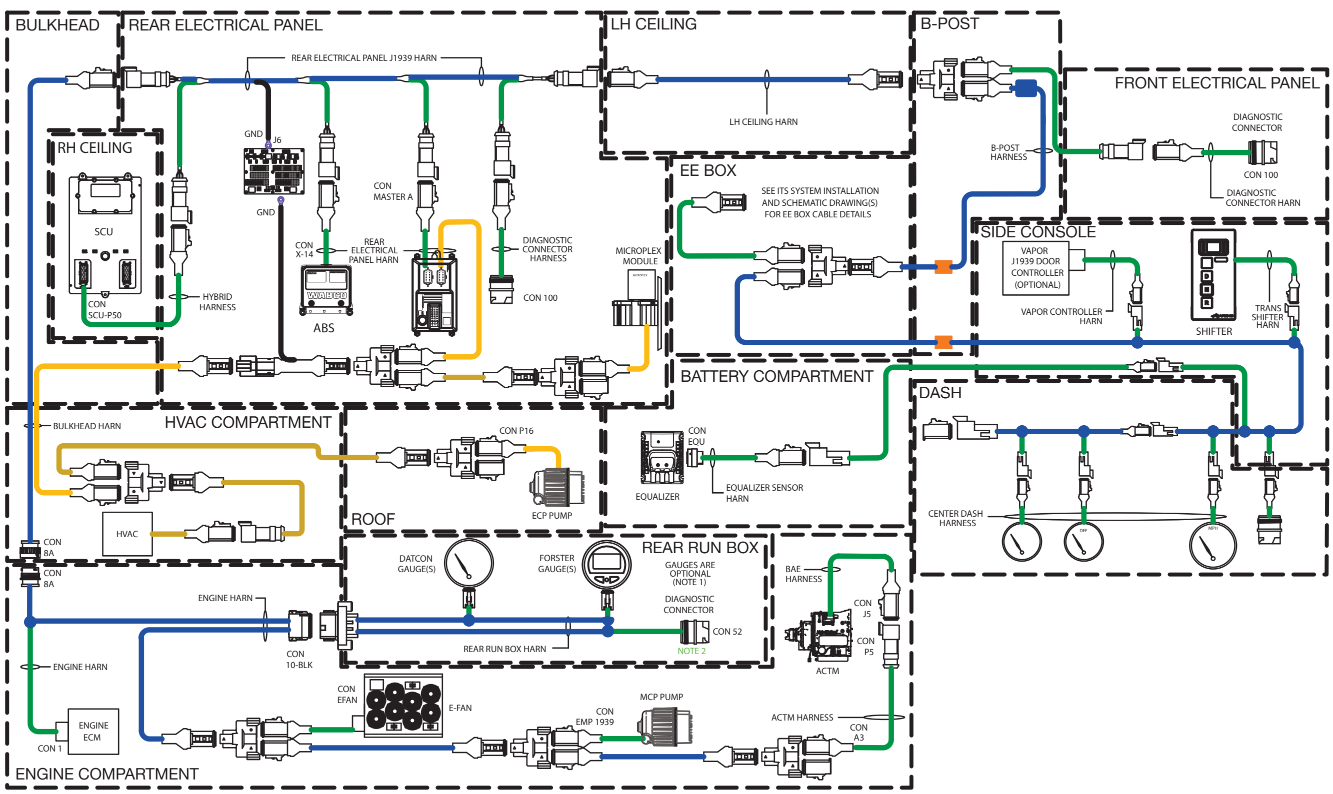
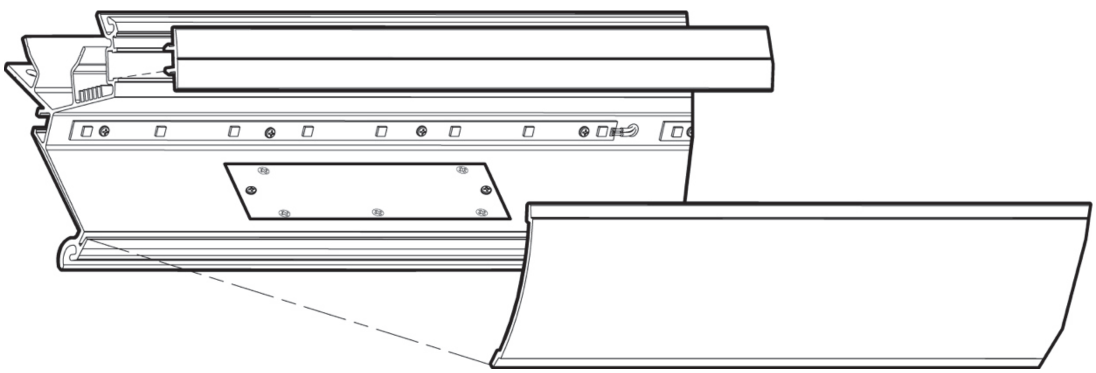


Figure 9-29, SAE J1939 Communications Network (Sample – see Electrical Schematics Manual for VIN-specific schematic)

Passenger Interior Lighting

GILLIG provides the I/O Controls based DINEX all LED interior lighting system in the passenger area. The LED lighting system is controlled by the I/O Controls multiplex electrical system. It requires no ballast, external power supply or regulator. It is programmable to control on/off or dimming on any one of the lighting fixtures based on operational conditions. The solid state, high power LEDs in this system are expected to maintain on average 60-70% of original output brightness after 60,000 hours of operation, and are covered by a 12 year warranty. The LED lighting has low power consumption as compared with fluorescent lamps and eliminates the disposal issues associated with fluorescent lamps.

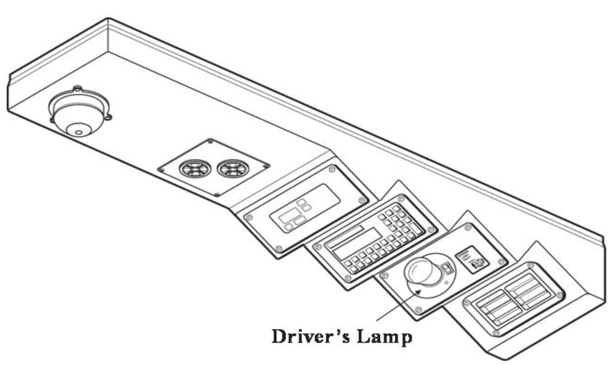


Dinex LED Interior Light

The lighting system has a built-in photo sensor which allows the lights to automatically adjust output capacity during the day to increase efficiency.

Driver's Lighting

The driver's lamp is located on the bottom of the main electrical panel closeout, above and to the left of the driver. **The lamp illuminates the steering wheel and dash area of the driver's compartment**. The lamp is controlled by a toggle switch convenient to the driver.



GILLIG Paint Appearance Standard

1. Purpose

1.1 The purpose of this document is to identify the steps required to inspect the exterior surface of a painted bus.

2. Scope

2.1 This standard describes the painted surface appearance requirements of exterior body panels. These requirements, with regard to appearance attributes and surface blemishes, are outlined in the following standards to ensure the paint finish of GILLIG buses will meet or exceed customer expectations.

3. Responsibilities

3.1 All exterior finished surfaces shall adhere to the appropriate ASTM standard for resistance to diesel fuel, gasoline and common cleaning agents. Use of any chemicals on painted surfaces shall be verified for acceptance with the paint manufacturer before use, approval of which shall be maintained by the paint department supervisor.

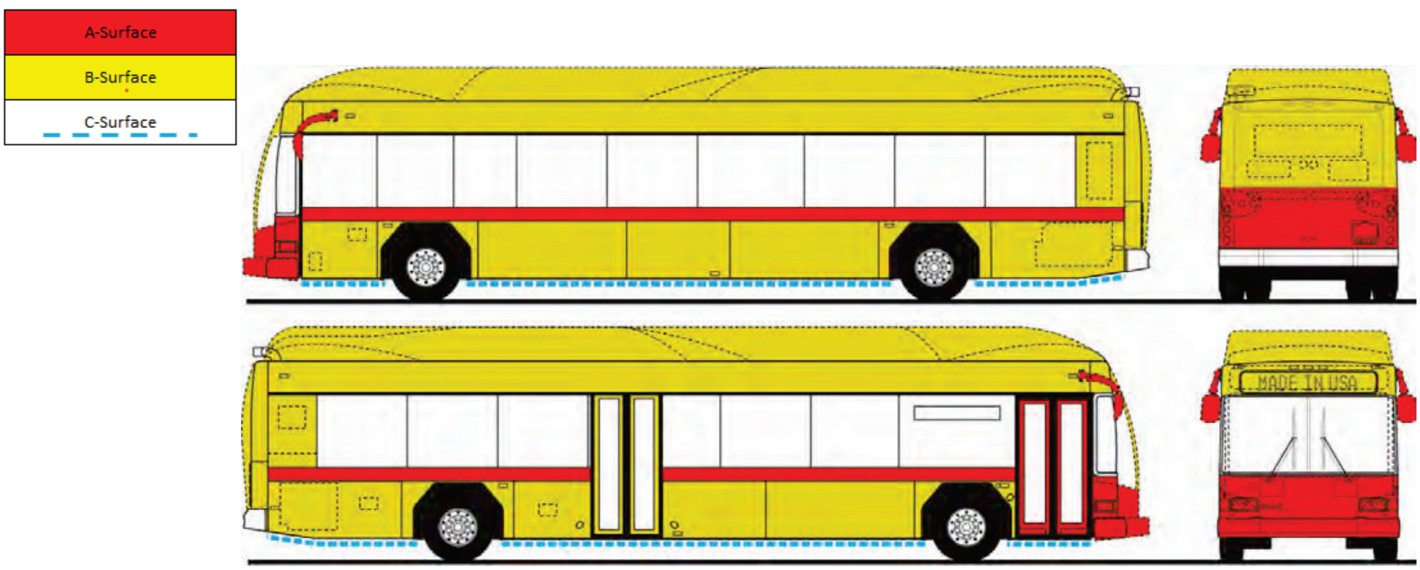
3.2 Proper adhesion between the basic surface and successive coats of the original paint shall be measured using ASTM D3359, Method B.

4. Procedure

4.1 **Appearance Zones - Exterior Body**

The body of a bus is divided into different appearance zones (A through C) to set the Appearance Quality Requirements of each zone separately.
The Appearance Quality Requirements are detailed in Section 4.2.

Zone	Description
A	Sides - Horizontal mid-rail extrusion along length of bus. Front - From bottom edge of windshield down. Rear - From the bottom edge of AC access door down.
B	Sides - From the bottom edge of the horizontal mid-rail extrusion down and from the top edge the horizontal mid-rail upward. Front - From the top of the windshield upward (including all roof cowlings). Rear - From the bottom of the AC access door upward (including all roof cowlings).
C	All surfaces of the lower bottom edge of skirt panels, interior side of all panels, and access doors.



		Surface Area (sqft)			Inspection Duration (min)		
Location	**Rate (sqft/min)**	**29'**	**35'**	**40'**	**29'**	**35'**	**40'**
Front	24	40	40	40	2	2	2
Curb Side	24	165	198	210	7	8	9
Rear	24	80	80	80	3	3	3
Street Side	24	180	213	220	8	9	9
				Total Inspection Time	19	22	23

Note: The vehicle must be viewed in a normal run operation condition and from ground level or equivalent. The use of flashlights is prohibited. Visual inspection is performed at a distance of 36" from painted surface.

4.2 Paint Audit Procedure

4.2.1 Quality Requirements for Appearance Attributes

4.2.1.1 Method of Taking readings

Visual inspection shall be completed in compliance with the above stated criteria. As defects are identified they will be marked/highlighted using a contrasting grease pen. After the inspection is completed, the results shall be tallied on either the Hard Card, or the In Process Inspection sheet (depending on where the inspection is completed).

All identified issues shall be reworked/reprocessed to achieve an acceptable level. Panel repair is an approved option if GILLIG determines a good repair can be achieved.

4.2.1.2 Orange Peel

Wavy appearance of the painted surfaces, poor flow, poor leveling, and pebbling.

Description: Uneven surface formation - much like that of the skin of an orange - which results from poor coalescence of atomized paint droplets. Paint droplets dry out before they can flow out and level smoothly together.

Method of Inspection: Optical evaluation utilizing a BYK Gardner Micro-Wave-Scan and associated software.

The scale used in the software is "Rating" from ACT Laboratories Inc. This scale rates orange peel from 1 to 10. 1 being a rough textured finish and 10 being a glass finish.

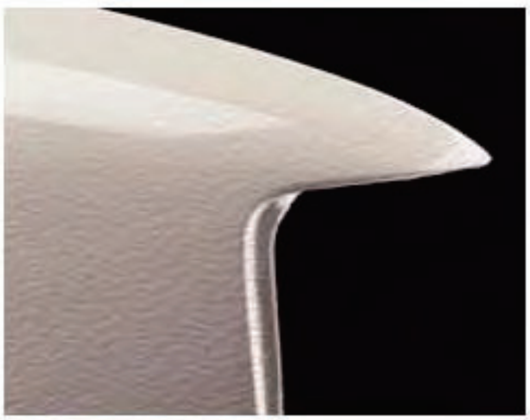
The micro-wave-scan evaluates structure size as well as the brilliance of the surface. Orange peel is rated from 1 to 10. 1 being the lowest and equivalent to the surface of an orange and 10 is the highest and equivalent to a glass surface. The industry average for this reading is a finish of 3.5 to 4. Use of the Micro-Wave-Scan is performed on a random sample basis or upon request. Measurements are taken on the bus mid-rail: front, middle, rear, and center of engine door.

Appearance Zone Requirements:

Table 2 - Orange Peel

Zone	Requirements
A	≥ 4.5
B	≥ 4.0
C	≥ 3.5

Note: Wet sand and polish is an acceptable repair method.



4.2.1.3 Gloss

Shininess of the painted surfaces.

Method of Inspection: Gloss meter (60°) as referenced in ASTM D523.

Optical evaluations utilizing a BYK Gardner Micro-Gloss 60° meter and associated software.

Note: Gloss measurements should not be taken on non-metallic or contoured surfaces due to resultant false or inaccurate readings.

Readings will only be taken as the bus exits the paint booth.

Appearance Zone Requirements:

Table 3 - Solids Gloss - Using BTK Gardener Micro-Gloss Meter

Zone	Requirements
A	80 units +
B	80 units +
C	80 units +

Note: Wet sand and polish is an acceptable repair method.

4.2.1.4 Uniformity

Appearance is consistent over entire bus, both within individual panels and between adjacent panels within a zone.

Axalta Coating Systems Approved Film Build Specification:

Single Stage - EX:

Axalta Coating System "Dry Film Thickness" specifications for the total primer/topcoat system for GILLIG is 3.0 mils minimum. The 3.0 mils for GILLIG has been approved by Axalta Coating System technical group.

* 920S primer "Dry Film Thickness" specification is 1.2 – 1.5 mils minimum.
* Imron Elite EX topcoat "Dry Film Thickness" specification is 1.8 – 2.2 mils minimum.

Axalta Coating System will continue to warranty units produced at GILLIG provided they meet minimum dry film thickness of 3.0 mils for single stage EX.

Basecoat/Clearcoat - EW/EB:

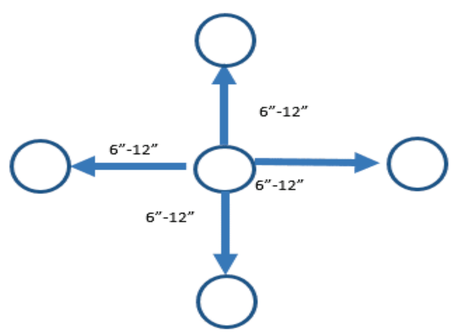
Axalta Coating System "Dry Film Thickness" specifications for the total primer/topcoat system for GILLIG is 4.0 mils minimum. The 4.0 mils for GILLIG has been approved by Axalta Coating System technical group.

* 920S primer "Dry Film Thickness" specification is 1.2 – 1.5 mils minimum.
* Imron Elite EW/EB topcoat "Dry Film Thickness" specification is 1.0 mils minimum.
* 8831S clearcoat "Dry Film Thickness" specification is 1.8 – 2.2 mils minimum.

Axalta Coating System will continue to warranty units produced at GILLIG provided they meet minimum dry film thickness of 4.0 mils for basecoat/clearcoat EW/EB.

GILLIG Film Build Measurement Process:

* If at any given point on the vehicle, total dry film thickness (DFT) is less than 3.0 mils for single stage or 4.0 mils for basecoat/clearcoat the following steps should be followed:
    * Measurement should be taken 6" – 12" inches above, below, and on each side of that low reading (see below diagram for reference).
    * If three (3) of the four (4) readings are within acceptable range for DFT, the area does not require paint repair for low film build and the current warranty will be honored.



4.2.1.5 Bubbles/Craters - Fish Eyes

Small round depressions in the paint film which may or may not expose the underlying surface.

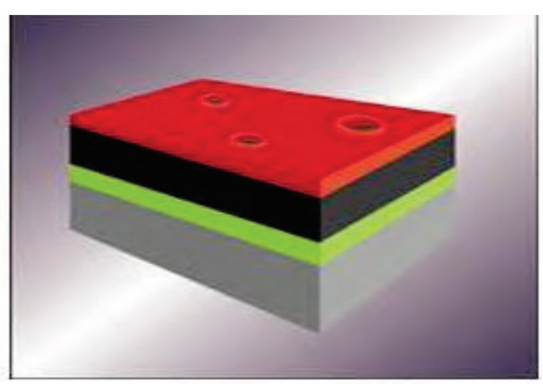
Method of Inspection:

Visual evaluation and comparison to zone table 4.

Table 4 - Bubbles/Craters

Zone	OK	Qty Per Panel Per	Max Size / Diameter	Description
A	No			
B	Yes	2 within 2 ft square (No Cluster)	0.059 in (1.5mm)	Primer Not Exposed
C	Yes	No More than 3 per panel	0.059 in (1.5mm)	Primer Not Exposed

Note: Wet sand and polish is an acceptable repair as long as the mil thickness is not compromised or repaint.



4.2.1.6 Dirt Inclusion

Foreign matter in, on, or under the paint film surface (i.e.: lint, fibers, sanding dust, etc...).

Method of Inspection:

Standard/Metric scale with visual evaluation and comparison to zone table 5.

Table 5 - Dirt in Paint

Zone	OK	Qty Per Panel Per Zone	Max Size / Diameter
A	Yes	No more than 2 spec. in 2 ft section but not in a cluster	0.059 in (1.5mm)
B	Yes	No more than 3 spec. in 2 ft section but not in a cluster	0.059 in (1.5mm)
C	Yes	No more than 5 spec. on any panel, should not be in a cluster	0.059 in (1.5mm)

Note: Wet sand and polish is an acceptable repair as long as the mil thickness is not compromised.

4.2.1.7 Ding

A localized depression or protrusion in the metal surface or substrate, which is visible after paint.

Method of Inspection:

Visual evaluation and comparison to zone table 6.

Table 6 - Ding in Paint Coating

Zone	OK	Description
A	No	
B	No	
C	Yes	Slight (less than 2 mm)

Note: Wet sand and polish is an acceptable repair as long as the mil thickness is not compromised or repaint.

4.2.1.8 Overspray/Dry Spray

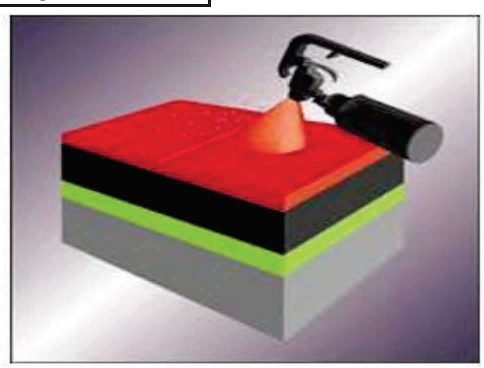
Rough or gritty texture on paint film surface.

Method of Inspection:

Visual evaluation and comparison to zone table 7.

Table 7 - Overspray/Dry Spray

Zone	OK	Description
A	No	
B	No	
C	Yes	Only on inside of flange



Note 1: Wet sand and polish is an acceptable repair.

Note 2: Acceptable on underside of chassis, engine compartment, and inside of wheel wells.

4.2.1.9 Solvent Pop

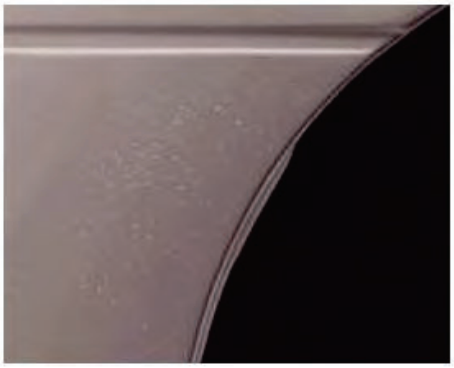
Small holes in a paint film usually caused by trapped solvent or porosity. Solvent boils are small, clustered, raised but unbroken bubbles in a paint film surface.

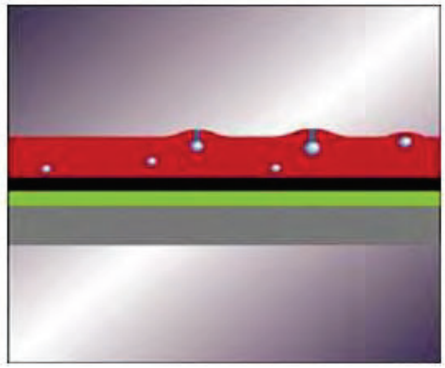
Method of Inspection:

Visual evaluation and comparison to zone table 8.

Table 8 - Solvent Pop

Zone	OK	Description
A	Yes	Pinhole type solvent pops, which are visible only when viewed at an angle or small random pops not visible from 3 ft away.
B	Yes	
C	Yes	





Note: Wet sand and polish is an acceptable repair as long as the mil thickness is not compromised or repaint.

4.2.1.10 Polish Marks

Visible swirl marks or hazy marks, which are caused by polishing techniques viewed in reflected or non-reflected lighting.

Method of Inspection:

Table 9 - Polish Marks

Zone	OK	Description
A	Yes	Provided the gloss meets the Paint Appearance Standards.
B	Yes	Provided the gloss meets the Paint Appearance Standards.
C	Yes	Provided the gloss meets the Paint Appearance Standards.

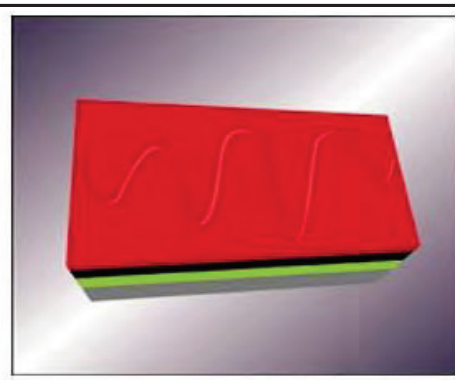
4.2.1.11 Sags and Runs

Method of Inspection:

Visual evaluation and comparison to zone table 10.

Table 10 - Sags and Runs

Zone	OK	Description
A	Yes	Slightly below punched/hole, rivets, and screws in panels.
B	Yes	Slightly below punched/hole, rivets, and screws in panels.
C	Yes	Slightly below punched/hole, rivets, and screws in panels.



Note: Wet sand and polish is an acceptable repair.

4.2.1.12 Scratches

Scratches on surface of paint film.

Method of Inspection:

Visual evaluation and comparison to zone table 11.

Table 11 - Scratches

Zone	OK	Length	Description
A	No		
B	Yes	Not >5 mm	On Non-Metallic
C	Yes	Not >5 mm	On Non-Metallic

Note: Touch-ups with a brush with primer and paint acceptable repairs.

4.2.1.13 Sand Marks

Cuts in the surface metal caused by poor sand technique or improper repair, only visible after paint.

Method of Inspection:

Visual evaluation and comparison to zone table 12.

Table 12 - Sand Marks after Paint

Zone	OK	Description
A	No	
B	No	
C	Yes	Minor

Note: Touch-ups with a brush with primer and paint acceptable repairs.

4.2.1.14 Pinholes

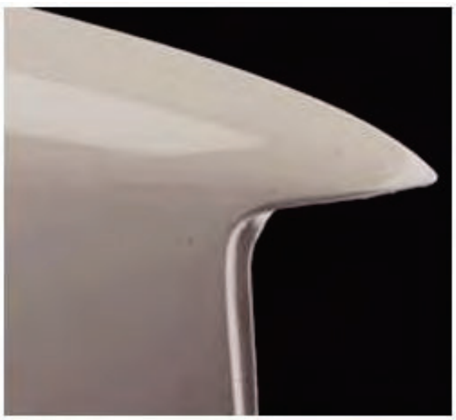
Small holes in a paint film, usually in the area of fiberglass gelcoat parts (i.e. porosity).

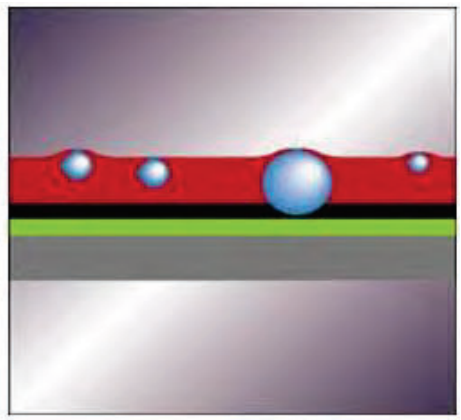
Method of Inspection:

Visual evaluation and comparison to zone table 13.

Table 13 - Pinholes

Zone	OK	Qty per	Description
A	No		
B	Yes	2	Not in a cluster 2 sqft area
C	Yes	2	Not in a cluster 2 sqft area





Note: Wet sand and polish is an acceptable repair as long as the mil thickness is not compromised or repaint.

4.2.1.15 Paint Chips

The absence of a small portion of the paint film.

Method of Inspection:

Visual evaluation and comparison to zone table 14.

Table 14 - Paint Chips

Zone	OK	Qty per	Description
A	No	0	Not Allowed
B			
C			

Note: Touch-ups with a brush on panel-edge is acceptable if no color change.

Attachment J
IFB6447

BUS TESTING CERTIFICATION

The undersigned bidder [Contractor/Manufacturer] certifies that the vehicle model or vehicle models offered in this bid submission complies with 49 CFR Part 665.

A copy of the test report (for each bid ITEM) prepared by the Federal Transit Administration's (FTA) Altoona, Pennsylvania Bus Testing Center is attached to this certification and is a true and correct copy of the test report as prepared by the facility.

The undersigned understands that misrepresenting the testing status of a vehicle acquired with Federal financial assistance may subject the undersigned to civil penalties as outlined in the U.S. Department of Transportation's regulation on Program Fraud Civil Remedies, 49 CFR Part 31. In addition, the undersigned understands that FTA may suspend or debar a manufacturer under the procedures in 49 CFR Part 29.

Name of Bidder/Company Name: GILLIG LLC

Type or print name: DEREK MAUNUS, PRESIDENT & CEO

Signature of authorized representative:

Signature of notary and SEAL: See attached.

Date of Signature: 10 / 06 / 2022

REFERENCE OUR ATTACHED CERTIFICATION.

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of ALAMEDA

Subscribed and sworn to (or affirmed) before me on this 6TH day of OCTOBER, 20 22, by DEREK MAUNUS, proved to me on the basis of satisfactory evidence to be the person(s) who appeared before me.

MIRUBENAT TAPIA
COMM. NO. 2319245
NOTARY PUBLIC - CALIFORNIA
ALAMEDA COUNTY
MY COMM. EXPIRES JAN. 19, 2024

(Seal) Signature

MIRUBENAT TAPIA
NOTARY PUBLIC

My commission number: 2319245

My commission expires: JANUARY 19, 2024

DESCRIPTION OF ATTACHED DOCUMENT

Type or Title of Document: BUS TESTING CERTIFICATION

Signer's Name: DEREK MAUNUS

Document Date: OCTOBER 6, 2022

GILLIG

ALTOONA TEST CERTIFICATION

This is to certify that the bus model proposed for your procurement complies with the bus testing regulations required by the Surface Transportation and Uniform Relocation Assistance Act of 1987 as defined in the Interim Final Rulemaking (IFR) by the FTA in the Federal Register 49 CFR Part 665, dated July 28, 1992 and the Final Rule in the Federal Register 49 CFR part 665, dated August 1, 2016.

This statement means that the proposed vehicle complies with one or more of the clauses below, as required by the above IFR:

- was in mass transportation service prior to September 30, 1988, or
- is the same vehicle model that has been previously tested in PTI (Altoona), and that
- any new component(s) has (have) been tested at PTI (Altoona), or
- the installation of any new component(s) did not result in significant structural modification to the vehicle; or
- the installation of the component(s) did not result in a significant change in the data obtained from previous testing of the vehicle model.
- is a new bus model or a bus produced with a major change in components or configuration and shall provide a copy of the final test report to the recipient prior to the recipient's final acceptance of the first vehicle.

GILLIG LLC

By: ______________________

DEREK MAUNUS

Title: PRESIDENT & CEO

Date: OCTOBER 6, 2022

GILLIG

ALTOONA TESTING

GILLIG LLC hereby certifies that the bus model proposed for your procurement complies with the bus testing regulations required by the Surface Transportation and Uniform Relocation Assistance Act of 1987 as defined in the Interim Final Rulemaking (IFR) by the FTA in the Federal Register 49 CFR Part 665, dated July 28, 1992 and the Final Rule in the Federal Register 49 CFR part 665, dated August 1, 2016.

GILLIG is pleased to have completed full Altoona testing on all our Low Floor platform buses (diesel, Hybrid, CNG, Battery Electric).

1. PTI-BT-R9922-06-00: 29' Low Floor Diesel (June 2000)
2. PTI-BT-R0410: 35'/40' Low Floor Diesel (December 2004)
3. PTI-BT-R0405: 35'/40' Low Floor Hybrid (October 2004)
4. PTI-BT-R1109: 29' Low Floor CNG (January 2012)
5. PTI-BT-R1203-P: 35'/40' Low Floor BAE Hybrid (July 2012)
6. LTI-BT-R1911: 35'/40' Low Floor CNG (March 2020)
7. LTI-BT-R2020-05: 35'/40' Low Floor BEB (June 2021)
8. LTI-BT-R2022-06-P 35'/40' Low Floor eGenFlex (August 2022)

A copy of the final test report(s) can be provided upon request.

Structural Analysis Validation - Completed

- Design Load Calculations
- Stress Calculations
- Finite Element Analysis
- Computer Simulations

Code and Regulation Compliance Validation

- Design Codes (interior lighting, driver's visibility, etc.)
- Design FMVSS Requirements

Component Application Analysis - Completed

- Component Selections
- Component Application Approvals
- Computer Simulations

Physical Validation Testing – Most Current Completion Date

- Optimization of Ride and Handling – 2011
- Vibration Tests – 2010
- Turning Radius Tests – 2011
- Turning Radius Test - 2020
- Engine Manufacturer Approvals
  - Cummins IQA Approvals 2007
  - Cummins IQA Approvals 2010
  - Cummins IQA Approvals 2013
  - Cummins IQA Approvals 2015 EMP Radiator only
  - Cummins IQA Approvals 2017 ISB BAE Hybrid
  - Cummins IQA Approval 2021 L9 Diesel
  - Cummins IQA Approval 2021 B67 Hybrid
  - Cummins IQA Approval 2021 40' Electric Bus
  - Cummins IQA includes engine/emission system installation approval, cooling system validation and compliance with electrical, AEB's.
- Strain Gauge Validation – 2005
- Loaded Road Dynamic Stress Test – 2006
- TRW Steering Geometry Test – 1998
- TRW Steering Geometry Test -2018
- TRW Steering Geometry Test - 2020
- Crashworthiness Test – 1998
- Crashworthiness Test -2018
- Crashworthiness Test - 2020
- Thermo King Performance Test T14 Unit– 2010
- Thermo King Performance Test T14 High Cooling Capacity -2015
- Thermo King Performance Test E Bus HVAC-2019
- Thermo King Performance Test E Bus HVAC -2020
- Accelerated Durability Test Road simulation/shaker test 40' CNG 2012.

TESTING & DESIGN OPERATING PROFILE VALIDATION

- Accelerated Durability Test Road simulation/shaker test 40' Electric Bus 2019
- Hot Weather on Road Testing (Death Valley) 40' Electric Gen 2.0 2019
- Hot Weather on Road Testing (Death Valley) 40' Electric Gen 2.5 2021
- Cold Weather Chamber and Cold Test Track Testing 40' Electric Bus 2020
- Cold Temperature Chamber testing 40' Electric bus 2021
- Vehicle Stability Testing 40' Electric Bus 2019
- Vehicle Stability Testing 40' Electric Bus 2020
- Vehicle ESC Testing 40' Electric 2019
- Vehicle Gradeability On Road Salt Lake City 40' Gen 2.0 Electric Bus 2019
- Vehicle Gradeability On Road Salt Lake City 40' Gen 2.5 Electric Bus 2021
- Altoona Style Durability Test Navistar Proving Grounds 40' Electric 2019
- Altoona Test 40' Diesel Bus Complete (ISM/Voith) – December 2004
- Altoona Test 40' Hybrid Bus Complete (ISB/EV40) – October 2004
- Altoona Test 29' Diesel Bus Complete (S40/B300) – June 2000
- Altoona Test 40' Hybrid Bus Complete (ISL/Voith Hybrid) – 2010
- Altoona Test 40' CNG Bus Complete (ISLG/B400R) – May 2011
- Altoona Test 29' CNG Bus Complete (ISLG/B400R) – January 2012
- Altoona Test 40' BAE Hybrid – July 2012
- Altoona Test 29' ISL – June 2010
- Altoona Test 40' CNG/Disc Brake – June 2013
- Altoona Test 40' Hybrid Bus (330 ISL/Allison Hybrid) - Feb 2019
- Altoona Test 40' Hybrid Bus (330L9/BAE Hybrid) – April 2018
- Altoona Test 29' Electric Bus – May 2018
- Altoona Test 40' Gen 2.0 Electric Bus - June 2021
- Altoona Test 40' CNG with Hendrickson Rear Suspension 2019
- Altoona Test 29' CNG with Hendrickson Rear Suspension 2021
- Altoona Test 40' Gen 2.5 Electric Bus - In Process

- FMVSS 121 Testing – Brakes
  - 2002 - 29 Ft. Low Floor Drum Brakes
  - 1999 - 29 Ft. Low Floor Drum Brake
  - 1998 - 40 Ft. Low Floor Drum Brake
  - 1997 - 40 Ft. Low Floor Drum Brake
  - 2011 - 40 Ft. Low Floor Drum Brake 27,000 Rear GAWR
  - 2013 - 40 Ft. Low Floor Meritor Disc Brakes
  - 2015 - 29' Low Floor Meritor Disc Brakes
  - 2016 - 29' Low Floor Drum Brake
  - 2019 - 40' Low Floor Meritor Disc Brakes Electric Bus @ 45,000 Lbs. GVWR
  - 2020 - 40' Low Floor Meritor Disc Brakes Electric Bus @ 47,180 Lbs. GVWR
  - 2022 - 40' Low Floor Meritor Disc Brakes Electric Bus @ 48,200 Lbs. - Planned 2022

- Transmission Installation Approval & Cooling Tests
  - Allison 2007, 2010, 2013
  - Voith 2007, 2010, 2013, 2020
  - ZF 2007, 2010, 2013,2018
  - ZF 2021 Ecolife/L9
- Hybrid Drive
  - ISL 330 hp Allision - 2018
  - L9 330 hp BAE - 2018
- Amerex Fire Suppression Installation Approval 2013
- Amerex Fire Suppression Installation Approval 40’ Electric Bus 2020
- Kidde Fire Suppression Installation Approval 2013
- Fogmaker Fire Suppression Installation Approval 2013
- Fire Trace Fire Suppression Installation Approval 2013
- Fire suppression installation approvals ongoing with new configurations

STURAA TEST

12 YEAR

500,000 MILE BUS

from

GILLIG CORPORATION

MODEL LOWFLOOR

DECEMBER 2004

PTI-BT-R0410

PENNSTATE

1855

The Pennsylvania Transportation Institute

201 Research Office Building (814) 865-1891
The Pennsylvania State University
University Park, PA 16802

Bus Testing and Research Center

2237 Old Rt 220 N. (814) 695-3404
Duncansville, PA 16635

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EXECUTIVE SUMMARY

The Gillig Corporation submitted a model Lowfloor, diesel-powered 36 seat (including the driver) 40-foot bus, for a 12 yr/500,000 mile STURAA test. The odometer reading at the time of delivery was 4,127 miles. Testing started on May 26, 2004 and was completed on December 3, 2004. The Check-In section of the report provides a description of the bus and specifies its major components.

The primary part of the test program is the Structural Durability Test, which also provides the information for the Maintainability and Reliability results. The Structural Durability Test was started on June 21, 2004 and was completed on November 5, 2004.

The interior of the bus is configured with seating for 36 passengers including the driver. Free floor space will accommodate 39 standing passengers resulting in a potential capacity of 75 persons. At 150 lbs per person, this load results in a measured gross vehicle weight of 37,950 lbs. The first segment of the Structural Durability Test was performed with the bus loaded to a GVW of 37,950 lbs. The middle segment was performed at a seated load weight of 32,540 lbs and the final segment was performed at a curb weight of 27,240 lbs. Durability driving resulted in unscheduled maintenance and failures that involved a variety of subsystems. A description of failures, and a complete and detailed listing of scheduled and unscheduled maintenance is provided in the Maintainability section of this report.

Accessibility, in general, was adequate. Components covered in Section 1.3 (Repair and/or Replacement of Selected Subsystems) along with all other components encountered during testing, were found to be readily accessible and no restrictions were noted.

The Reliability section compiles failures that occurred during Structural Durability Testing. Breakdowns are classified according to subsystems. The data in this section are arranged so that those subsystems with more frequent problems are apparent. The problems are also listed by class as defined in Section 2. The test bus encountered no Class 1 or Class 2 failures. Of the 24 reported failures, nine were Class 3 and 15 were Class 4.

The Safety Test, (a double-lane change, obstacle avoidance test) was safely performed in both right-hand and left-hand directions up to a maximum test speed of 45 mph. The performance of the bus is illustrated by a speed vs. time plot. Acceleration and gradeability test data are provided in Section 4, Performance. The average time to obtain 50 mph was 30.82 seconds.

The Shakedown Test produced a maximum final loaded deflection of 0.183 inches with a permanent set ranging between 0.001 to 0.006 inches under a distributed static load of 28,125 lbs. The Distortion Test was completed with all subsystems, doors and escape mechanisms operating properly. No water leakage was observed throughout the test. All subsystems operated properly.

The Static Towing Test was performed using a target load (towing force) of 32,688 lbs. All four front pulls were completed to the full test load with no damage or deformation observed. The Dynamic Towing Test was performed by means of a front-lift tow. The towing interface was accomplished using a hydraulic under-lift wrecker. The bus was towed without incident and no damage resulted from the test. The manufacturer does not recommend towing the bus from the rear, therefore, a rear test was not performed. The Jacking and Hoisting Tests were also performed without incident. The bus was found to be stable on the jack stands, and the minimum jacking clearance observed with a tire deflated was 5.1 inches.

A Fuel Economy Test was run on simulated central business district, arterial, and commuter courses. The results were 3.50 mpg, 4.41 mpg, and 7.40 mpg respectively; with an overall average of 4.43 mpg.

A series of Interior and Exterior Noise Tests was performed. These data are listed in Section 7.1 and 7.2 respectively.

ABBREVIATIONS

ABTC	-	Altoona Bus Test Center
A/C	-	air conditioner
ADB	-	advance design bus
ATA-MC	-	The Maintenance Council of the American Trucking Association
CBD	-	central business district
CW	-	curb weight (bus weight including maximum fuel, oil, and coolant; but without passengers or driver)
dB(A)	-	decibels with reference to 0.0002 microbar as measured on the "A" scale
DIR	-	test director
DR	-	bus driver
EPA	-	Environmental Protection Agency
FFS	-	free floor space (floor area available to standees, excluding ingress/egress areas, area under seats, area occupied by feet of seated passengers, and the vestibule area)
GVL	-	gross vehicle load (150 lb for every designed passenger seating position, for the driver, and for each 1.5 sq ft of free floor space)
GVW	-	gross vehicle weight (curb weight plus gross vehicle load)
GVWR	-	gross vehicle weight rating
MECH	-	bus mechanic
mpg	-	miles per gallon
mph	-	miles per hour
PM	-	Preventive maintenance
PSBRTF	-	Penn State Bus Research and Testing Facility
PTI	-	Pennsylvania Transportation Institute
rpm	-	revolutions per minute
SAE	-	Society of Automotive Engineers
SCH	-	test scheduler
SEC	-	secretary
SLW	-	seated load weight (curb weight plus 150 lb for every designed passenger seating position and for the driver)
STURAA	-	Surface Transportation and Uniform Relocation Assistance Act
TD	-	test driver
TECH	-	test technician
TM	-	track manager
TP	-	test personnel

TEST BUS CHECK-IN

I. OBJECTIVE

The objective of this task is to log in the test bus, assign a bus number, complete the vehicle data form, and perform a safety check.

II. TEST DESCRIPTION

The test consists of assigning a bus test number to the bus, cleaning the bus, completing the vehicle data form, obtaining any special information and tools from the manufacturer, determining a testing schedule, performing an initial safety check, and performing the manufacturer's recommended preventive maintenance. The bus manufacturer must certify that the bus meets all Federal regulations.

III. DISCUSSION

The check-in procedure is used to identify in detail the major components and configuration of the bus.

The test bus consists of a Gillig Corporation, model Lowfloor. The bus has a front door equipped with a Lift-U model LU6 03.-03 handicap ramp, located forward of the front axle and a rear door forward of the rear axle. Power is provided by a diesel-fueled, Cummins Motors model ISM 280 engine coupled to a Voith model A4VTOR2-8.5E transmission.

The measured curb weight is 8,300 lbs for the front axle and 18,940 lbs for the rear axle. These combined weights provide a total measured curb weight of 27,240 lbs. There are 36 seats including the driver and room for 39 standing passengers bringing the total passenger capacity to 75. Gross load is 150 lb x 75 = 11,250 lbs. At full capacity, the measured gross vehicle weight is 37,950 lbs.

VEHICLE DATA FORM

Bus Number: 0410	Arrival Date: 5-26-04
Bus Manufacturer: Gillig	Vehicle Identification Number (VIN): 15GGD211641076000
Model Number: Lowfloor	Date: 5-26-04
Personnel: T.S. & S.C.	

WEIGHT:

Individual Wheel Reactions:

Weights (lb)	Front Axle		Middle Axle		Rear Axle	
	Right	Left	Right	Left	Right	Left
CW	4,110	4,190	N/A	N/A	8,940	10,000
SLW	4,850	4,970	N/A	N/A	10,920	11,800
GVW	6,320	6,470	N/A	N/A	12,220	12,940

Total Weight Details:

Weight (lb)	CW	SLW	GVW	GAWR
Front Axle	8,300	9,820	12,790	14,600
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	18,940	22,720	25,160	25,000
Total	27,240	32,540	37,950	GVWR: 39,600

Dimensions:

Length (ft/in)	40 / 10.0
Width (in)	101.0
Height (in)	121.0 (exhaust pipe)
Front Overhang (in)	89.5
Rear Overhang (in)	122.0
Wheel Base (in)	278.5
Wheel Track (in)	Front: 85.7
	Rear: 77.7

Bus Number: 0410	Date: 5-26-04

CLEARANCES:

Lowest Point Outside Front Axle	Location: Skid plate	Clearance(in): 9.0
Lowest Point Outside Rear Axle	Location: Transmission coolant pipe	Clearance(in): 10.4
Lowest Point between Axles	Location: Frame	Clearance(in): 12.8
Ground Clearance at the center (in)	12.8	
Front Approach Angle (deg)	8.1	
Rear Approach Angle (deg)	9.1	
Ramp Clearance Angle (deg)	5.3	
Aisle Width (in)	Front – 17.5	Rear – 23.0
Inside Standing Height at Center Aisle (in)	Front – 94.6	Rear – 76.2

BODY DETAILS:

Body Structural Type	Monocoque		
Frame Material	Steel		
Body Material	Aluminum & fiberglass		
Floor Material	Plywood		
Roof Material	Aluminum & fiberglass		
Windows Type	□ Fixed	■ Movable	
Window Mfg./Model No.	Excel / AS3 M14 G DOT 573		
Number of Doors	_1_ Front	_1_ Rear	
Mfr. / Model No.	Gillig / Vapor controllers		
Dimension of Each Door (in)	Front – 32.6 x 77.0	Rear – 29.8 x 77.7	
Passenger Seat Type	□ Cantilever	■ Pedestal	□ Other (explain)
Mfr. / Model No.	American Seating / Metropolitan		
Driver Seat Type	■ Air	□ Spring	□ Other (explain)
Mfr. / Model No.	Recaro / Ergo AM80/72		
Number of Seats (including Driver)	36 (2 w/c positions with 4 seats folded away)		

Bus Number: 0410	Date: 5/26/04

BODY DETAILS (Contd..)

Free Floor Space (ft^2)	58.8
Height of Each Step at Normal Position (in)	Front 1. 15.2 2. N/A 3. N/A 4. N/A
	Middle 1. N/A 2. N/A 3. N/A 4. N/A
	Rear 1. 15.8 2. N/A 3. N/A 4. N/A
Step Elevation Change - Kneeling (in)	3.4

ENGINE

Type	■ C.I.	□ Alternate Fuel	
	□ S.I.	□ Other (explain)	
Mfr. / Model No.	Cummins Motors / ISM 280		
Location	□ Front	■ Rear	□ Other (explain)
Fuel Type	□ Gasoline	□ CNG	□ Methanol
	■ Diesel	□ LNG	□ Other (explain)
Fuel Tank Capacity (indicate units)	120 gals		
Fuel Induction Type	■ Injected	□ Carburetion	
Fuel Injector Mfr. / Model No.	Cummins Motors / ISM 280		
Carburetor Mfr. / Model No.	N/A		
Fuel Pump Mfr. / Model No.	Cummins Motors / ISM 280		
Alternator (Generator) Mfr. / Model No.	C.E.Nichoff & Co.		
Maximum Rated Output (Volts / Amps)	26 / 300		
Air Compressor Mfr. / Model No.	Cummins / 18.7		
Maximum Capacity (ft^3 / min)	18.7		
Starter Type	■ Electrical	□ Pneumatic	□ Other (explain)
Starter Mfr. / Model No.	Delco-Remy / 10479130		

Bus Number: 0410	Date: 5-26-04

TRANSMISSION

Transmission Type	□ Manual	■ Automatic	
Mfr. / Model No.	Voith / A4VT0R2-8.5 E		
Control Type	□ Mechanical	■ Electrical	□ Other
Torque Convertor Mfr. / Model No.	Voith / A4VT0R2-8.5 E		
Integral Retarder Mfr. / Model No.	Voith / A4VT0R2-8.5 E		

SUSPENSION

Number of Axles	2		
Front Axle Type	□ Independent	■ Beam Axle	
Mfr. / Model No.	Meritor / FH946 RK		
Axle Ratio (if driven)	N/A		
Suspension Type	■ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Koni / 902423		
Middle Axle Type	□ Independent	□ Beam Axle	
Mfr. / Model No.	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type	□ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	□ Independent	■ Beam Axle	
Mfr. / Model No.	Meritor / 71163WX		
Axle Ratio (if driven)	5.38		
Suspension Type	■ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	4		
Mfr. / Model No.	Koni / 902626		

Bus Number: 0410	Date: 5-26-04

WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Alcoa / 22.56 x 8.25
	Tire Mfr./ Model No.	Goodyear G159 / 12R 22.5
Rear	Wheel Mfr./ Model No.	Alcoa / 22.56 x 8.25
	Tire Mfr./ Model No.	Goodyear G159 / 12R 22.5

BRAKES

Front Axle Brakes Type	■ Cam	□ Disc	□ Other (explain)
Mfr. / Model No.	Meritor / 16.5x6 Cost plus		
Middle Axle Brakes Type	□ Cam	□ Disc	□ Other (explain)
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	■ Cam	□ Disc	□ Other (explain)
Mfr. / Model No.	Meritor / 14.5x10W		
Retarder Type	Integral hydraulic transmission		
Mfr. / Model No.	Voith / A4VT0R2-8.5 E		

HVAC

Heating System Type	□ Air	■ Water	□ Other
Capacity (Btu/hr)	94,000		
Mfr. / Model No.	Thermo King / T1		
Air Conditioner	■ Yes	□ No	
Location	Rear, above engine compartment		
Capacity (Btu/hr)	104,000		
A/C Compressor Mfr. / Model No.	Thermo King Corp. / X426		

STEERING

Steering Gear Box Type	Hydraulic gear
Mfr. / Model No.	TRW / Ross
Steering Wheel Diameter	20.0
Number of turns (lock to lock)	4.75

Bus Number: 0410	Date: 5-26-04

OTHERS

Wheel Chair Ramps	Location: Front door	Type: Hinged ramp
Wheel Chair Lifts	Location: N/A	Type: N/A
Mfr. / Model No.	Lift-U / LU6 03-03	
Emergency Exit	Location: Windows Doors Roof hatch	Number: 6 2 2

CAPACITIES

Fuel Tank Capacity (units)	120 gals
Engine Crankcase Capacity (gallons)	8.675
Transmission Capacity (gallons)	Dry: 7.4 Refill: 6.6
Differential Capacity (gallons)	5.5
Cooling System Capacity (quarts)	50
Power Steering Fluid Capacity (gallons)	3.6

VEHICLE DATA FORM

Bus Number: 0410	Date: 5-26-04

List all spare parts, tools and manuals delivered with the bus.

Part Number	Description	Qty.
G159 12R 22.5	Goodyear tires	6
FA. Voith 59.3355.10	Transmission filter	3
Donaldson P151097	Engine air filter	1
5298	Airbags	4
LF9001	Engine oil filter	1
102011	Engine fuel filter	1
Koni 902423	Shock	1
WF2071	Coolant	1
Koni 902626	Shock	1
Na	Radius rod (front)	2
Na	Radius rod (rear)	2

COMPONENT/SUBSYSTEM INSPECTION FORM

Bus Number: 0410	Date: 5-26-04

Subsystem	Checked	Comments
Air Conditioning Heating and Ventilation	√	
Body and Sheet Metal	√	
Frame	√	
Steering	√	
Suspension	√	
Interior/Seating	√	
Axles	√	
Brakes	√	
Tires/Wheels	√	
Exhaust	√	
Fuel System	√	Diesel
Power Plant	√	
Accessories	√	
Lift System	√	Hinged ramp.
Interior Fasteners	√	
Batteries	√	

CHECK - IN

GILLIG CORPORATION'S MODEL LOWFLOOR

1. MAINTAINABILITY

1.1 ACCESSIBILITY OF COMPONENTS AND SUBSYSTEMS

1.1-I. TEST OBJECTIVE

The objective of this test is to check the accessibility of components and subsystems.

1.1-II. TEST DESCRIPTION

Accessibility of components and subsystems is checked, and where accessibility is restricted the subsystem is noted along with the reason for the restriction.

1.1-III. DISCUSSION

Accessibility, in general, was adequate. Components covered in Section 1.3 (repair and/or replacement of selected subsystems), along with all other components encountered during testing, were found to be readily accessible and no restrictions were noted.

ACCESSIBILITY DATA FORM

Bus Number: 0410	Date: 12-3-04

Component	Checked	Comments
ENGINE :	√	
Oil Dipstick	√	
Oil Filler Hole	√	
Oil Drain Plug	√	
Oil Filter	√	
Fuel Filter	√	
Air Filter	√	
Belts	√	
Coolant Level	√	
Coolant Filler Hole	√	
Coolant Drain	√	
Spark / Glow Plugs	√	
Alternator	√	
Diagnostic Interface Connector	√	
TRANSMISSION :		
Fluid Dip-Stick	√	
Filler Hole	√	
Drain Plug	√	
SUSPENSION :		
Bushings	√	
Shock Absorbers	√	
Air Springs	√	
Leveling Valves	√	
Grease Fittings	√	

ACCESSIBILITY DATA FORM

Bus Number: 0410	Date: 12-3-04

Component	Checked	Comments
HVAC :		
A/C Compressor	√	
Filters	√	
Fans	√	
ELECTRICAL SYSTEM :		
Fuses	√	
Batteries	√	
Voltage regulator	√	
Voltage Convertors	√	
Lighting	√	
MISCELLANEOUS :		
Brakes	√	
Handicap Lifts/Ramps	√	
Instruments	√	
Axles	√	
Exhaust	√	
Fuel System	√	
OTHERS :		

1.2 SERVICING, PREVENTIVE MAINTENANCE, AND REPAIR AND MAINTENANCE DURING TESTING

1.2-I. TEST OBJECTIVE

The objective of this test is to collect maintenance data about the servicing, preventive maintenance, and repair.

1.2.-II. TEST DESCRIPTION

The test will be conducted by operating the NBM and collecting the following data on work order forms and a driver log.

1. Unscheduled Maintenance
    a. Bus number
    b. Date
    c. Mileage
    d. Description of malfunction
    e. Location of malfunction (e.g., in service or undergoing inspection)
    f. Repair action and parts used
    g. Man-hours required

2. Scheduled Maintenance
    a. Bus number
    b. Date
    c. Mileage
    d. Engine running time (if available)
    e. Results of scheduled inspections
    f. Description of malfunction (if any)
    g. Repair action and parts used (if any)
    h. Man-hours required

The buses will be operated in accelerated durability service. While typical items are given below, the specific service schedule will be that specified by the manufacturer.

A. Service
    1. Fueling
    2. Consumable checks
    3. Interior cleaning

B. Preventive Maintenance
    4. Brake adjustments
    5. Lubrication
    6. 3,000 mi (or equivalent) inspection

7. Oil and filter change inspection
8. Major inspection
9. Tune-up

C. Periodic Repairs
1. Brake reline
2. Transmission change
3. Engine change
4. Windshield wiper motor change
5. Stoplight bulb change
6. Towing operations
7. Hoisting operations

1.2-III. DISCUSSION

Servicing and preventive maintenance were performed at manufacturer-specified intervals. The following Scheduled Maintenance Form lists the mileage, items serviced, the service interval, and amount of time required to perform the maintenance. Table 1 is a list of the lubricating products used in servicing. Finally, the Unscheduled Maintenance List along with Unscheduled Maintenance-related photographs is included in Section 5.7, Structural Durability. This list supplies information related to failures that occurred during the durability portion of testing. The Unscheduled Maintenance List includes the date and mileage at which the malfunction occurred, a description of the malfunction and repair, and the time required to perform the repair.

SCHEDULED MAINTENANCE

Gillig #0410

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
07-01-04	1,194	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
07-16-04	1,555	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
07-23-04	1,993	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
08-04-04	2,585	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
08-13-04	3,305	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
08-19-04	3,759	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
08-26-04	4,808	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
09-01-04	5,551	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
09-08-04	6,651	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00

SCHEDULED MAINTENANCE

Gillig #0410

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
09-15-04	7,822	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
09-21-04	8,929	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
09-28-04	9,852	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
10-04-04	10,767	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
10-18-04	12,743	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
10-27-04	13,816	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
11-01-04	14,567	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
11-08-04	15,000	P.M. / Inspection Fuel Economy Prep.	Linkage, tie rods, universals/u-joints all lubed. Oil changed. Oil, fuel, and air filters changed. Transmission oil and filter changed.	8.00	8.00

Table 1. STANDARD LUBRICANTS

The following is a list of Texaco lubricant products used in bus testing conducted by the Penn State University Altoona Bus Testing Center:

ITEM	PRODUCT CODE	TEXACO DESCRIPTION
Engine oil	#2112	URSA Super Plus SAE 30
Transmission oil	#1866	Automatic Trans Fluid Mercon/Dexron II Multipurpose
Gear oil	#2316	Multigear Lubricant EP SAE 80W90
Wheel bearing & Chassis grease	#1935	Starplex II

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS

1.3-I. TEST OBJECTIVE

The objective of this test is to establish the time required to replace and/or repair selected subsystems.

1.3-II. TEST DESCRIPTION

The test will involve components that may be expected to fail or require replacement during the service life of the bus. In addition, any component that fails during the NBM testing is added to this list. Components to be included are:

1. Transmission
2. Alternator
3. Starter
4. Batteries
5. Windshield wiper motor

1.3-III. DISCUSSION

During the test, several additional components were removed for repair or replacement. Following is a list of components and total repair/replacement time.

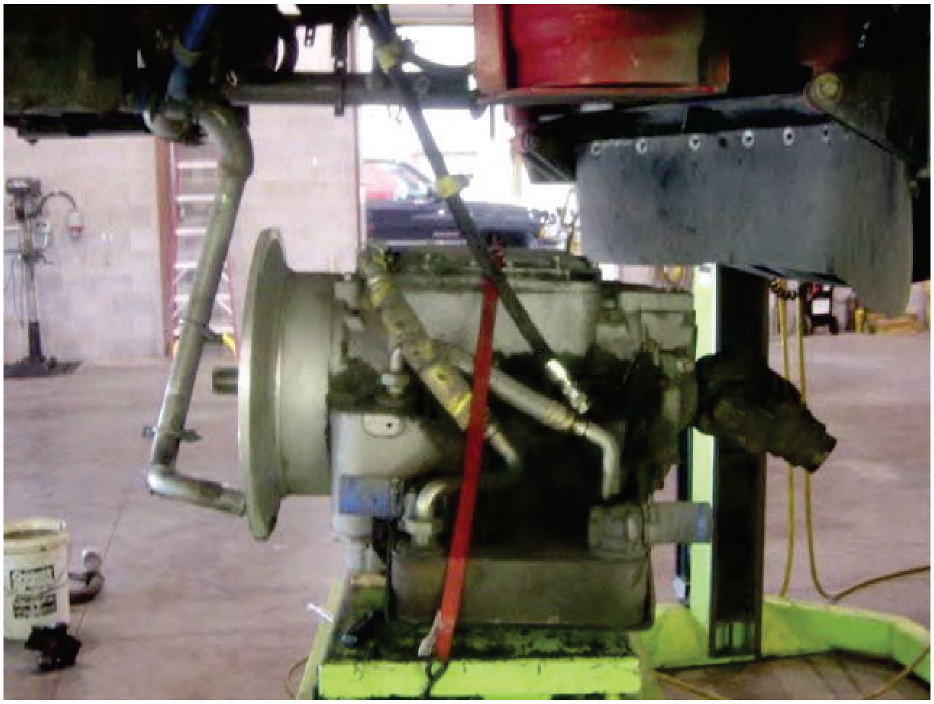
	MAN HOURS
Left front bump stop.	0.50
Left front slack adjuster snap ring & spacers.	0.50
A/C Belt.	0.50
Right front bump stop.	0.50
Left rear, front axle air bag.	1.00
Left front shock.	1.00
Hydraulic fluid reservoir.	2.00
Right front shock.	0.25

At the end of the test, the remaining items on the list were removed and replaced. The transmission assembly took 8.0 man-hours (two men 4.0 hrs) to remove and replace. The time required for repair/replacement of the four remaining components is given on the following Repair and/or Replacement Form.

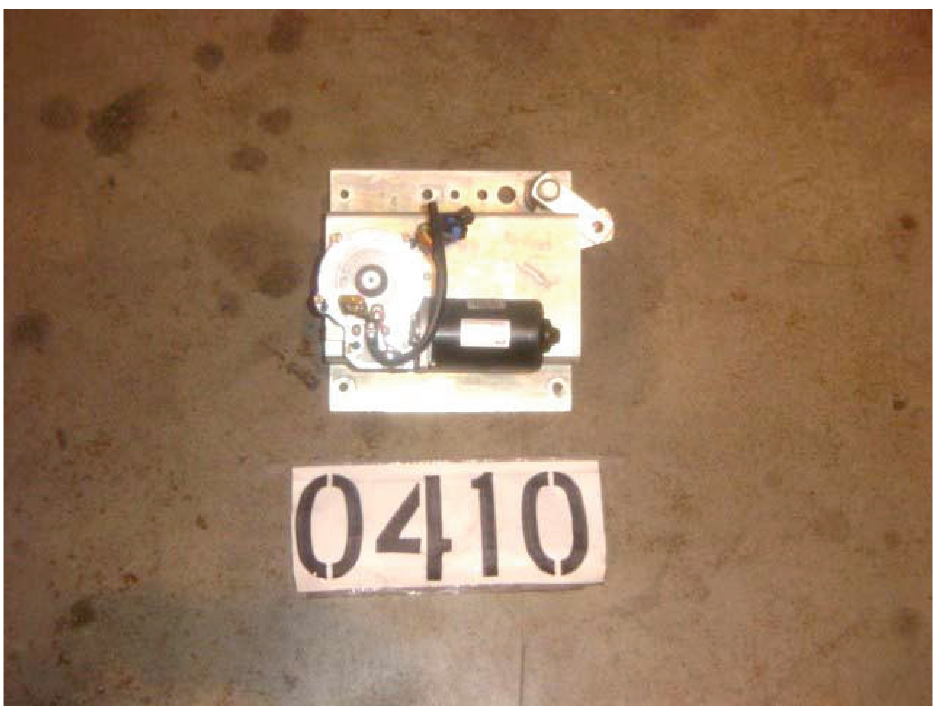
REPLACEMENT AND/OR REPAIR FORM

Subsystem	Replacement Time
Transmission	8.00 man hours
Wiper Motor	0.50 man hours
Starter	0.75 man hours
Alternator	0.75 man hours
Batteries	0.50 man hours

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS



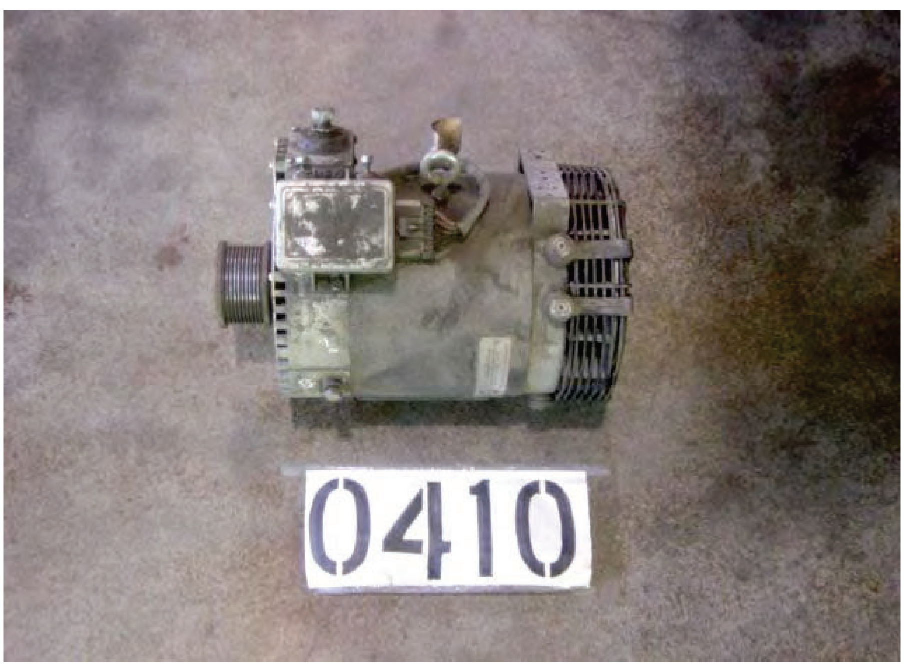
TRANSMISSION REMOVAL AND REPLACEMENT
(8.00 MAN HOURS)



WIPER MOTOR REMOVAL AND REPLACEMENT
(0.50 MAN HOURS)

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS CONT.

STARTER REMOVAL AND REPLACEMENT (0.75 MAN HOURS)



ALTERNATOR REMOVAL AND REPLACEMENT (0.75 MAN HOURS)

2. RELIABILITY - DOCUMENTATION OF BREAKDOWN AND REPAIR TIMES DURING TESTING

2-I. TEST OBJECTIVE

The objective of this test is to document unscheduled breakdowns, repairs, down time, and repair time that occur during testing.

2-II. TEST DESCRIPTION

Using the driver log and unscheduled work order forms, all significant breakdowns, repairs, man-hours to repair, and hours out of service are recorded on the Reliability Data Form.

CLASS OF FAILURES

Classes of failures are described below:

(a) Class 1: Physical Safety. A failure that could lead directly to passenger or driver injury and represents a severe crash situation.

(b) Class 2: Road Call. A failure resulting in an en route interruption of revenue service. Service is discontinued until the bus is replaced or repaired at the point of failure.

(c) Class 3: Bus Change. A failure that requires removal of the bus from service during its assignments. The bus is operable to a rendezvous point with a replacement bus.

(d) Class 4: Bad Order. A failure that does not require removal of the bus from service during its assignments but does degrade coach operation. The failure shall be reported by driver, inspector, or hostler.

2-III. DISCUSSION

A listing of breakdowns and unscheduled repairs is accumulated during the Structural Durability Test. The following Reliability Data Form lists all unscheduled repairs under classes as defined above. These classifications are somewhat subjective as the test is performed on a test track with careful inspections every two hours. However, even on the road, there is considerable latitude on deciding how to handle many failures.

The Unscheduled Repair List is also attached to provide a reference for the repairs that are included in the Reliability Data Forms.

The classification of repairs according to subsystem is intended to emphasize those systems which had persistent minor or more serious problems. There were no Class 1 or 2 failures. Of the nine Class 3 failures, seven involved the suspension system and one each to the brakes and engine/transmission. These, and the remaining 15 Class 4 failures are available for review in the Unscheduled Maintenance List, located in Section 5.7 Structural Durability.

RELIABILITY DATA FORMS

Bus Number: 0410	Date: 11/5/04
Personnel: Bob Reifsteck	

	Failure Type					
	Class 4 Bad Order	Class 3 Bus Change	Class 2 Road Call	Class 1 Physical Safety		
Subsystems	Mileage	Mileage	Mileage	Mileage	Man Hours	Down Time
Suspension	1,346				0.50	24.00
	1,483				0.50	8.00
	2,464				0.50	8.00
		2,534			0.50	8.00
	2,534				0.50	0.50
	2,708				0.50	8.00
	3,147				0.50	8.00
	3,363				0.50	8.00
		3,419			1.00	1.00
	3,836				0.50	8.00
	5,201				0.50	8.00
		5,288			1.00	8.00
		7,307			1.00	8.00
		9,974			1.00	10.00
		12,743			0.25	3.00
		12,743			1.00	48.00
Seats/Compartment	2,095				0.50	8.00
	5,500				0.25	0.25
	5,500				0.25	0.25

RELIABILITY DATA FORMS

Bus Number: 0410	Date: 11/5/04
Personnel: Bob Reifsteck	

Subsystems	Failure Type: Class 4 Bad Order — Mileage	Class 3 Bus Change — Mileage	Class 2 Road Call — Mileage	Class 1 Physical Safety — Mileage	Man Hours	Down Time
Air Conditioning	445				0.50	2.00
	729				1.00	4.00
Brakes		445			0.50	2.00
Engine/Transmission		12,487			2.00	2.00
Fuel System	729				0.50	8.00

3. SAFETY - A DOUBLE-LANE CHANGE (OBSTACLE AVOIDANCE)

3-I. TEST OBJECTIVE

The objective of this test is to determine handling and stability of the bus by measuring speed through a double lane change test.

3-II. TEST DESCRIPTION

The Safety Test is a vehicle handling and stability test. The bus will be operated at SLW on a smooth and level test track. The bus will be driven through a double lane change course at increasing speed until the test is considered unsafe or a speed of 45 mph is reached. The lane change course will be set up using pylons to mark off two 12 foot center to center lanes with two 100 foot lane change areas 100 feet apart. The bus will begin in one lane, change to the other lane in a 100 foot span, travel 100 feet, and return to the original lane in another 100 foot span. This procedure will be repeated, starting first in the right-hand and then in the left-hand lane.

3-III. DISCUSSION

The double-lane change was performed in both right-hand and left-hand directions. The bus was able to safely negotiate the test course in both the right-hand and left-hand directions up to the maximum test speed of 45 mph.

SAFETY DATA FORM

Bus Number: 0410	Date: 11-11-04
Personnel: R.C., T.S. & S.C.	

Temperature (°F): 56	Humidity (%): 45
Wind Direction: SW	Wind Speed (mph): 8
Barometric Pressure (in.Hg): 30.10	

SAFETY TEST: DOUBLE LANE CHANGE	
Maximum safe speed tested for double-lane change to left	45 mph
Maximum safe speed tested for double-lane change to right	45 mph
Comments of the position of the bus during the lane change: A safe profile was maintained through all portions of testing.	
Comments of the tire/ground contact patch: Tire/ground contact was maintained through all portions of testing.	

3. SAFETY

RIGHT - HAND APPROACH

LEFT - HAND APPROACH

4. PERFORMANCE - AN ACCELERATION, GRADEABILITY, AND TOP SPEED TEST

4-I. TEST OBJECTIVE

The objective of this test is to determine the acceleration, gradeability, and top speed capabilities of the bus.

4-II. TEST DESCRIPTION

In this test, the bus will be operated at SLW on the skid pad at the PSBRTF. The bus will be accelerated at full throttle from a standstill to a maximum "geared" or "safe" speed as determined by the test driver. The vehicle speed is measured using a Correvit non-contacting speed sensor. The times to reach speed between ten mile per hour increments are measured and recorded using a stopwatch with a lap timer. The time to speed data will be recorded on the Performance Data Form and later used to generate a speed vs time plot and gradeability calculations.

4-III. DISCUSSION

This test consists of three runs in both the clockwise and counterclockwise directions on the Test Track. Velocity versus time data is obtained for each run and results are averaged together to minimize any test variability which might be introduced by wind or other external factors. The test was performed up to a maximum speed of 50 mph. The fitted curve of velocity vs time is attached, followed by the calculated gradeability results. The average time to obtain 50 mph was 30.82 seconds.

PERFORMANCE DATA FORM

Bus Number: 0410	Date: 11-11-04
Personnel: R.C., T.S. & S.C.	

Temperature (°F): 56	Humidity (%): 45
Wind Direction: SW	Wind Speed (mph): 8
Barometric Pressure (in.Hg): 30.10	

Air Conditioning compressor-OFF	√_ Checked
Ventilation fans-ON HIGH	√_ Checked
Heater pump motor-Off	√_ Checked
Defroster-OFF	√_ Checked
Exterior and interior lights-ON	√_ Checked
Windows and doors-CLOSED	√_ Checked

ACCELERATION, GRADEABILITY, TOP SPEED

Counter Clockwise Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	4.86	5.05	4.65
20 mph	8.24	8.42	8.15
30 mph	12.33	12.71	12.36
40 mph	20.39	20.36	19.83
Top Test Speed(mph) 50	33.00	32.37	32.03

Clockwise Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	4.37	5.02	5.34
20 mph	7.71	8.34	8.62
30 mph	11.68	12.40	12.84
40 mph	18.27	18.99	19.81
Top Test Speed(mph) 50	28.35	29.02	30.16

0410.ACC

PERFORMANCE SUMMARY SHEET

BUS MANUFACTURER :Gillig
BUS MODEL :LowFloor

BUS NUMBER :0410
TEST DATE :11/11/04

TEST CONDITIONS :

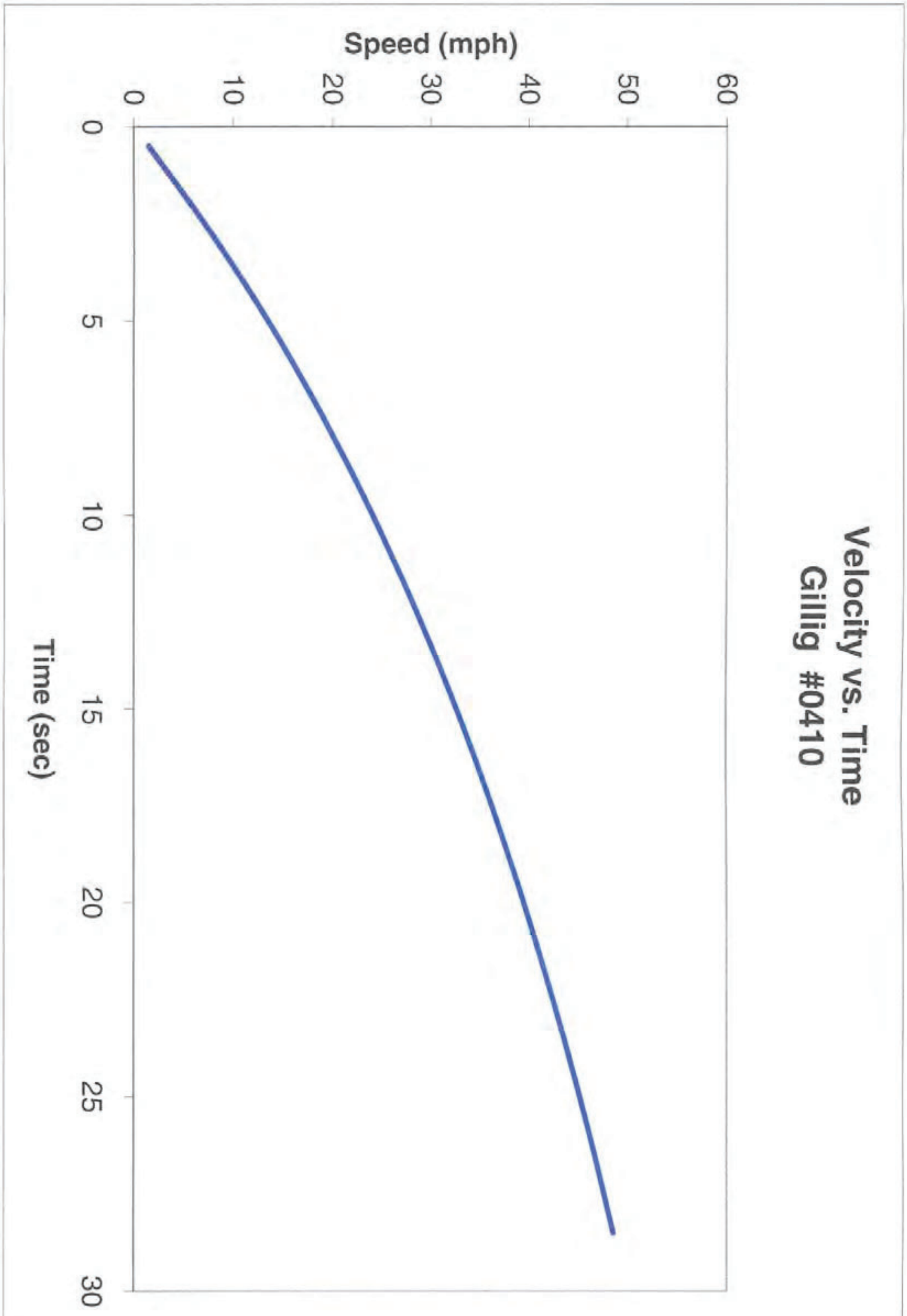
TEMPERATURE (DEG F)	: 56.0
WIND DIRECTION	: SW
WIND SPEED (MPH)	: 8.0
HUMIDITY (%)	: 45
BAROMETRIC PRESSURE (IN. HG)	: 30.1

VEHICLE SPEED	AVERAGE TIME (SEC)		
(MPH)	CCW DIRECTION	CW DIRECTION	TOTAL
10.0	4.85	4.91	4.88
20.0	8.27	8.22	8.25
30.0	12.47	12.31	12.39
40.0	20.19	19.02	19.61
50.0	32.47	29.18	30.82

TEST SUMMARY :

VEHICLE SPEED (MPH)	TIME (SEC)	ACCELERATION (FT/SEC^2)	MAX. GRADE (%)
1.0	.33	4.4	13.7
5.0	1.71	4.1	12.8
10.0	3.59	3.7	11.7
15.0	5.65	3.4	10.6
20.0	7.93	3.0	9.5
25.0	10.49	2.7	8.4
30.0	13.38	2.4	7.4
35.0	16.66	2.1	6.5
40.0	20.45	1.8	5.6
45.0	24.87	1.5	4.8
50.0	30.12	1.3	4.0

NOTE : Gradeability results were calculated from performance test data. Actual sustained gradeability performance for vehicles equipped with auto transmission may be lower than the values indicated here.



Velocity vs. Time
Gillig #0410
Speed (mph)
0
10
20
30
40
50
60
0
5
10
15
20
25
30
Time (sec)

5. STRUCTURAL INTEGRITY

5.1 STRUCTURAL STRENGTH AND DISTORTION TESTS - STRUCTURAL SHAKEDOWN TEST

5.1-I. DISCUSSION

The objective of this test is to determine certain static characteristics (e.g., bus floor deflection, permanent structural deformation, etc.) under static loading conditions.

5.1-II. TEST DESCRIPTION

In this test, the bus will be isolated from the suspension by blocking the vehicle under the suspension points. The bus will then be loaded and unloaded up to a maximum of three times with a distributed load equal to 2.5 times gross load. Gross load is 150 lb for every designed passenger seating position, for the driver, and for each 1.5 sq ft of free floor space. For a distributed load equal to 2.5 times gross load, place a 375-lb load on each seat and on every 1.5 sq ft of free floor space. The first loading and unloading sequence will "settle" the structure. Bus deflection will be measured at several locations during the loading sequences.

5.1-III. DISCUSSION

This test was performed based on a maximum passenger capacity of 75 people including the driver. The resulting test load is (75 x 375 lb) = 28,125 lb. The load is distributed evenly over the passenger space. Deflection data before and after each loading and unloading sequence is provided on the Structural Shakedown Data Form.

The unloaded height after each test becomes the original height for the next test. Some initial settling is expected due to undercoat compression, etc. After each loading cycle, the deflection of each reference point is determined. The bus is then unloaded and the residual (permanent) deflection is recorded. On the final test, the maximum loaded deflection was 0.183 inches at reference point 10. The maximum permanent deflection after the final loading sequence ranged from 0.001 inches at reference points 1, 6, and 7 to 0.006 inches at reference point 8.

STRUCTURAL SHAKEDOWN DATA FORM

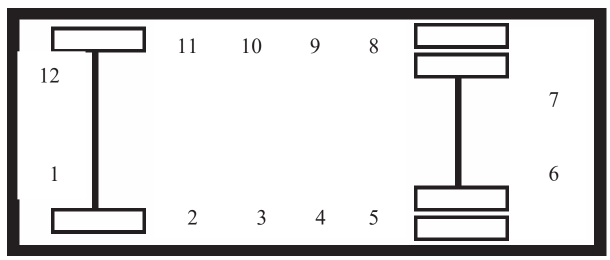
Bus Number: 0410	Date: 6-10-04
Personnel: D.L., M.H. T.S. & E.L.	Temperature (°F): 74
Loading Sequence: ■ 1 □ 2 □ 3 (check one) Test Load (lbs): 28,125	

Indicate Approximate Location of Each Reference Point

Right

Front of Bus

Left



Top View

Reference Point No.	A (in) Original Height	B (in) Loaded Height	B-A (in) Loaded Deflection	C (in) Unloaded Height	C-A (in) Permanent Deflection
1	0	.036	.036	.033	.033
2	0	.128	.128	.029	.029
3	0	.186	.186	.045	.045
4	0	.181	.181	.038	.038
5	0	.158	.158	.035	.035
6	0	.009	.009	.004	.004
7	0	.010	.010	.001	.001
8	0	.183	.183	.035	.035
9	0	.212	.212	.039	.039
10	0	.214	.214	.036	.036
11	0	.135	.135	.023	.023
12	0	.011	.011	.036	.036

STRUCTURAL SHAKEDOWN DATA FORM

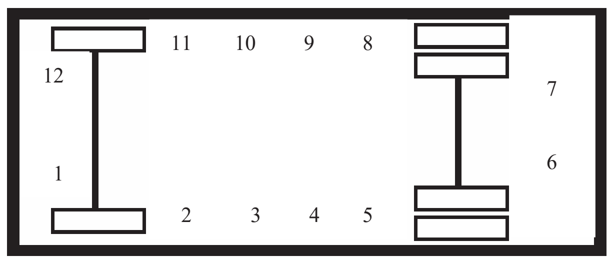
Bus Number: 0410	Date: 6-10-04
Personnel: D.L., M.H., T.S. & E.L.	Temperature (°F): 78
Loading Sequence: □ 1 ■ 2 □ 3 (check one) Test Load (lbs): 28,125	

Indicate Approximate Location of Each Reference Point

Right

Front
of
Bus

Left



Top View

Reference Point No.	A (in) Original Height	B (in) Loaded Height	B-A (in) Loaded Deflection	C (in) Unloaded Height	C-A (in) Permanent Deflection
1	.033	.045	.012	.034	.001
2	.029	.140	.111	.032	.003
3	.045	.204	.159	.050	.005
4	.038	.200	.162	.043	.005
5	.035	.175	.140	.040	.005
6	.004	.006	.002	.005	.001
7	.001	.000	-.001	.002	.001
8	.035	.185	.150	.041	.006
9	.039	.219	.180	.044	.005
10	.036	.219	.183	.041	.005
11	.023	.139	.116	.026	.003
12	.036	.012	-.024	.040	.004

5.1 STRUCTURAL SHAKEDOWN TEST

BUS LOADED TO 2.5 TIMES GVL
(28,125 LBS)

5.2 STRUCTURAL STRENGTH AND DISTORTION TESTS - STRUCTURAL DISTORTION

5.2-I. TEST OBJECTIVE

The objective of this test is to observe the operation of the bus subsystems when the bus is placed in a longitudinal twist simulating operation over a curb or through a pothole.

5.2-II. TEST DESCRIPTION

With the bus loaded to GVWR, each wheel of the bus will be raised (one at a time) to simulate operation over a curb and the following will be inspected:

1. Body
2. Windows
3. Doors
4. Roof vents
5. Special seating
6. Undercarriage
7. Engine
8. Service doors
9. Escape hatches
10. Steering mechanism

Each wheel will then be lowered (one at a time) to simulate operation through a pothole and the same items inspected.

5.2-III. DISCUSSION

The test sequence was repeated ten times. The first and last test is with all wheels level. The other eight tests are with each wheel 6 inches higher and 6 inches lower than the other three wheels.

All doors, windows, escape mechanisms, engine, steering and handicapped devices operated normally throughout the test. The undercarriage and body indicated no deficiencies. No water leakage was observed during the test. The results of this test are indicated on the following data forms.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0410	Date: 6-17-04
Personnel: T.S., M.H., E.L. & E.D.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	■ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0410	Date: 6-17-04
Personnel: T.S., M.H., E.L. & E.D.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	■ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0410	Date: 6-17-04
Personnel: T.S., M.H., E.L. & E.D.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	■ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0410	Date: 6-17-04
Personnel: T.S., M.H., E.L. & E.D.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	■ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Bus Number: 0410	Date: 6-17-04
Personnel: T.S., M.H., E.L. & E.D.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	■ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0410	Date: 6-17-04
Personnel: T.S., M.H., E.L. & E.D.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	■ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Bus Number: 0410	Date: 6-17-04
Personnel: T.S., M.H., E.L. & E.D.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	■ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0410	Date: 6-17-04
Personnel: T.S., M.H., E.L. & E.D.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	■ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0410	Date: 6-17-04
Personnel: T.S., M.H., E.L. & E.D.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	■ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0410	Date: 6-17-04
Personnel: T.S., M.H., E.L. & E.D.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	□ before	■ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

5.2 STRUCTURAL DISTORTION TEST

RIGHT FRONT WHEEL SIX INCHES HIGHER

RIGHT REAR WHEEL SIX INCHES LOWER

5.3 STRUCTURAL STRENGTH AND DISTORTION TESTS - STATIC TOWING TEST

5.3-I. TEST OBJECTIVE

The objective of this test is to determine the characteristics of the bus towing mechanisms under static loading conditions.

5.3-II. TEST DESCRIPTION

Utilizing a load-distributing yoke, a hydraulic cylinder is used to apply a static tension load equal to 1.2 times the bus curb weight. The load will be applied to both the front and rear, if applicable, towing fixtures at an angle of 20 degrees with the longitudinal axis of the bus, first to one side then the other in the horizontal plane, and then upward and downward in the vertical plane. Any permanent deformation or damage to the tow eyes or adjoining structure will be recorded.

5.3-III. DISCUSSION

The load-distributing yoke was incorporated as the interface between the Static Tow apparatus and the test bus tow hook/eyes. The test was performed to the full target test weight of 32,688 lbs (1.2 x 27,240 lbs CW). All four front pulls were completed with no damage or deformation observed. The manufacturer does not recommend towing from the rear, therefore, no rear test was performed.

STATIC TOWING TEST DATA FORM

Bus Number: 0410	Date: 11-23-04
Personnel: R.C., T.S., M.H. & S.C.	Temperature (°F): 49

Inspect right front tow eye and adjoining structure.
Comments: No damage or deformation observed.
Check the torque/welds of all bolts attaching tow eye and surrounding structure.
Comments: Welds verified.
Inspect left tow eye and adjoining structure.
Comments: No damage or deformation observed.
Check the torque/welds of all bolts attaching tow eye and surrounding structure.
Comments: Welds verified.
Inspect right rear tow eye and adjoining structure.
Comments: N/A
Check the torque of all bolts attaching tow eye and surrounding structure.
Comments: N/A
Inspect left rear tow eye and adjoining structure.
Comments: N/A
Check the torque of all bolts attaching tow eye and surrounding structure.
Comments: N/A
General comments of any other structure deformation or failure: All four front pulls were completed to the full target test load of 32,688 lbs (1.2 x 27,240 lbs) with no damage or deformation observed. The manufacturer does not recommend rear towing, therefore, a rear test was not performed.

5.3 STATIC TOWING TEST

FRONT 20° UPWARD PULL

FRONT 20° DOWNWARD PULL

5.3 STATIC TOWING TEST CONT.

FRONT 20° LEFT PULL

FRONT 20° RIGHT PULL

5.4 STRUCTURAL STRENGTH AND DISTORTION TESTS - DYNAMIC TOWING TEST

5.4-I. TEST OBJECTIVE

The objective of this test is to verify the integrity of the towing fixtures and determine the feasibility of towing the bus under manufacturer specified procedures.

5.4-II. TEST DESCRIPTION

This test requires the bus be towed at curb weight using the specified equipment and instructions provided by the manufacturer and a heavy-duty wrecker. The bus will be towed for 5 miles at a speed of 20 mph for each recommended towing configuration. After releasing the bus from the wrecker, the bus will be visually inspected for any structural damage or permanent deformation. All doors, windows and passenger escape mechanisms will be inspected for proper operation.

5.4-III. DISCUSSION

The bus was towed using a heavy-duty wrecker. The towing interface was accomplished by incorporating a hydraulic under lift. A front lift tow was performed. Rear towing is not recommended. No problems, deformation, or damage was noted during testing.

DYNAMIC TOWING TEST DATA FORM

Bus Number: 0410	Date: 12-2-04
Personnel: S.C. & M.H.	

Temperature (°F): 41	Humidity (%): 60
Wind Direction: Calm	Wind Speed (mph): Calm
Barometric Pressure (in.Hg): 30.12	

Inspect tow equipment-bus interface.

Comments: A safe and adequate connection was made between the tow equipment and the bus.

Inspect tow equipment-wrecker interface.

Comments: A safe and adequate connection was made between the tow equipment and the wrecker.

Towing Comments: A front lift tow was performed incorporating a hydraulic under lift wrecker.

Description and location of any structural damage: None noted.

General Comments: The manufacturer does not recommend towing from the rear; therefore, a rear tow was not performed.

5.4 DYNAMIC TOWING TEST

TOWING INTERFACE

TEST BUS IN TOW

5.5 STRUCTURAL STRENGTH AND DISTORTION TESTS – JACKING TEST

5.5-I. TEST OBJECTIVE

The objective of this test is to inspect for damage due to the deflated tire, and determine the feasibility of jacking the bus with a portable hydraulic jack to a height sufficient to replace a deflated tire.

5.5-II. TEST DESCRIPTION

With the bus at curb weight, the tire(s) at one corner of the bus are replaced with deflated tire(s) of the appropriate type. A portable hydraulic floor jack is then positioned in a manner and location specified by the manufacturer and used to raise the bus to a height sufficient to provide 3-in clearance between the floor and an inflated tire. The deflated tire(s) are replaced with the original tire(s) and the hack is lowered. Any structural damage or permanent deformation is recorded on the test data sheet. This procedure is repeated for each corner of the bus.

5.5-III. DISCUSSION

The jack used for this test has a minimum height of 8.75 inches. During the deflated portion of the test, the jacking point clearances ranged from 5.1 inches to 24.0 inches. No deformation or damage was observed during testing. A complete listing of jacking point clearances is provided in the Jacking Test Data Form.

JACKING CLEARANCE SUMMARY

Condition	Frame Point Clearance
Front axle – one tire flat	8.2”
Rear axle – one tire flat	23.9”
Rear axle – two tires flat	21.7”

JACKING TEST DATA FORM

Bus Number: 0410	Date: 6-8-04
Personnel: S.C.	Temperature (°F): 70

Record any permanent deformation or damage to bus as well as any difficulty encountered during jacking procedure.

Deflated Tire	Jacking Pad Clearance Body/Frame (in)	Jacking Pad Clearance Axle/Suspension (in)	Comments
Right front	11.4 " I 8.2 " D	8.6 " I 5.3 " D	
Left front	11.3 " I 8.2 " D	8.6 " I 5.1 " D	
Right rear—outside	27.0 " I 24.0 " D	10.3 " I 9.5 " D	
Right rear—both	27.0 " I 21.8 " D	10.3 " I 8.1 " D	
Left rear—outside	26.8 " I 23.9 " D	10.3 " I 9.6 " D	
Left rear—both	26.8 " I 21.7 " D	10.3 " I 8.0 " D	
Right middle or tag—outside	NA	NA	
Right middle or tag—both	NA	NA	
Left middle or tag—outside	NA	NA	
Left middle or tag—both	NA	NA	

Additional comments of any deformation or difficulty during jacking:
none

5.6 STRUCTURAL STRENGTH AND DISTORTION TESTS - HOISTING TEST

5.6-I. TEST OBJECTIVE

The objective of this test is to determine possible damage or deformation caused by the jack/stands.

5.6-II. TEST DESCRIPTION

With the bus at curb weight, the front end of the bus is raised to a height sufficient to allow manufacturer-specified placement of jack stands under the axles or jacking pads independent of the hoist system. The bus will be checked for stability on the jack stands and for any damage to the jacking pads or bulkheads. The procedure is repeated for the rear end of the bus. The procedure is then repeated for the front and rear simultaneously.

5.6-III. DISCUSSION

The test was conducted using four posts of a six-post electric lift and standard 19 inch jack stands. The bus was hoisted from the front wheel, rear wheel, and then the front and rear wheels simultaneously and placed on jack stands.

The bus easily accommodated the placement of the vehicle lifts and jack stands and the procedure was performed without any instability noted.

HOISTING TEST DATA FORM

Bus Number: 0410	Date: 6-8-04
Personnel: S.C.	Temperature (°F): 75

Comments of any structural damage to the jacking pads or axles while both the front wheels are supported by the jack stands:

None noted.

Comments of any structural damage to the jacking pads or axles while both the rear wheels are supported by the jack stands:

None noted.

Comments of any structural damage to the jacking pads or axles while both the front and rear wheels are supported by the jack stands:

None noted.

5.7 STRUCTURAL DURABILITY TEST

5.7-I. TEST OBJECTIVE

The objective of this test is to perform an accelerated durability test that approximates up to 25 percent of the service life of the vehicle.

5.7-II. TEST DESCRIPTION

The test vehicle is driven a total of 15,000 miles; approximately 12,500 miles on the PSBRTF Durability Test Track and approximately 2,500 miscellaneous other miles. The test will be conducted with the bus operated under three different loading conditions. The first segment will consist of approximately 6,250 miles with the bus operated at GVW. The second segment will consist of approximately 2,500 miles with the bus operated at SLW. The remainder of the test, approximately 6,250 miles, will be conducted with the bus loaded to CW. If GVW exceeds the axle design weights, then the load will be adjusted to the axle design weights and the change will be recorded. All subsystems are run during these tests in their normal operating modes. All recommended manufacturers servicing is to be followed and noted on the vehicle maintainability log. Servicing items accelerated by the durability tests will be compressed by 10:1; all others will be done on a 1:1 mi/mi basis. Unscheduled breakdowns and repairs are recorded on the same log as are any unusual occurrences as noted by the driver. Once a week the test vehicle shall be washed down and thoroughly inspected for any signs of failure.

5.7-III. DISCUSSION

The Structural Durability Test was started on June 21, 2004 and was conducted until November 5, 2004. The first 6,250 miles were performed at a GVW of 37,950 lbs. and completed on September 8, 2004. The next 2,500 mile SLW segment was performed at 32,540 lbs and completed on September 22, 2004, and the final 6,250 mile segment was performed at a CW of 27,240 lbs and completed on November 5, 2004.

The following mileage summary presents the accumulation of miles during the Structural Durability Test. The driving schedule is included, showing the operating duty cycle. A detailed plan view of the Test Track Facility and Durability Test Track are attached for reference. Also, a durability element profile detail shows all the measurements of the different conditions. Finally, photographs illustrating some of the failures that were encountered during the Structural Durability Test are included.

GILLIG - TEST BUS #0410
MILEAGE DRIVEN/RECORDED FROM DRIVERS' LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
06/21/04 TO 06/27/04	511.00	75.00	586.00
06/28/04 TO 07/04/04	485.00	175.00	660.00
07/05/04 TO 07/11/04	95.00	5.00	100.00
07/12/04 TO 07/18/04	158.00	112.00	270.00
07/19/04 TO 07/25/04	358.00	121.00	479.00
07/26/04 TO 08/01/04	419.00	20.00	439.00
08/02/04 TO 08/08/04	184.00	109.00	293.00
08/09/04 TO 08/15/04	409.00	127.00	536.00
08/16/04 TO 08/22/04	504.00	127.00	631.00
08/23/04 TO 08/29/04	1155.00	52.00	1207.00
08/30/04 TO 09/05/04	790.00	130.00	920.00
09/06/04 TO 09/12/04	701.00	485.00	1186.00
09/13/04 TO 09/19/04	1118.00	51.00	1169.00
09/20/04 TO 09/26/04	920.00	187.00	1107.00
09/27/04 TO 10/03/04	994.00	49.00	1043.00
10/04/04 TO 10/10/04	1162.00	154.00	1316.00
10/11/04 TO 10/17/04	625.00	29.00	654.00

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
10/18/04 TO 10/24/04	403.00	123.00	526.00
10/25/04 TO 10/31/04	1196.00	156.00	1352.00
11/01/04 TO 11/07/04	304.00	222.00	526.00
TOTAL	12491.00	2509.00	15000.00

Table 4. Driving Schedule for Bus Operation on the Durability Test Track.

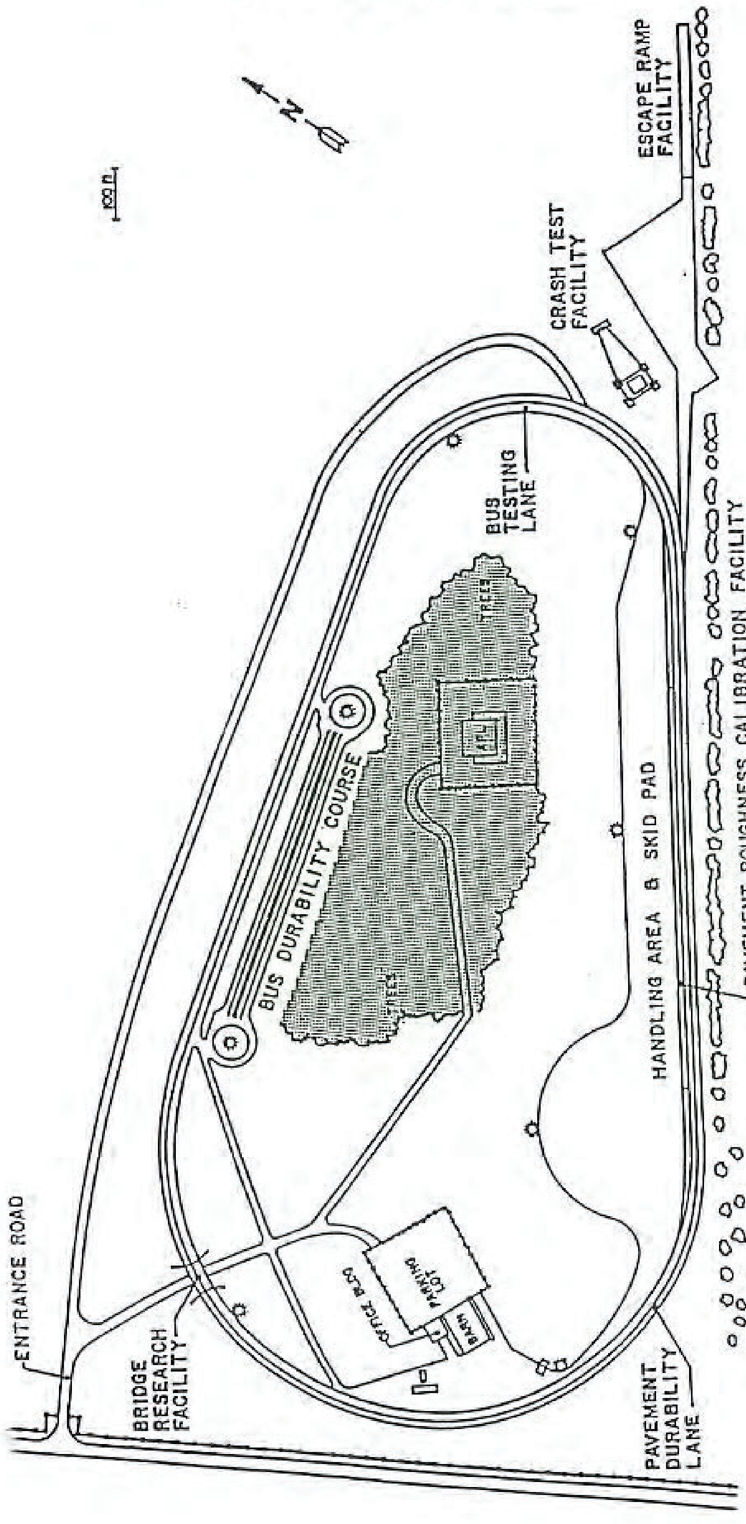
STANDARD OPERATING SCHEDULE

Monday through Friday

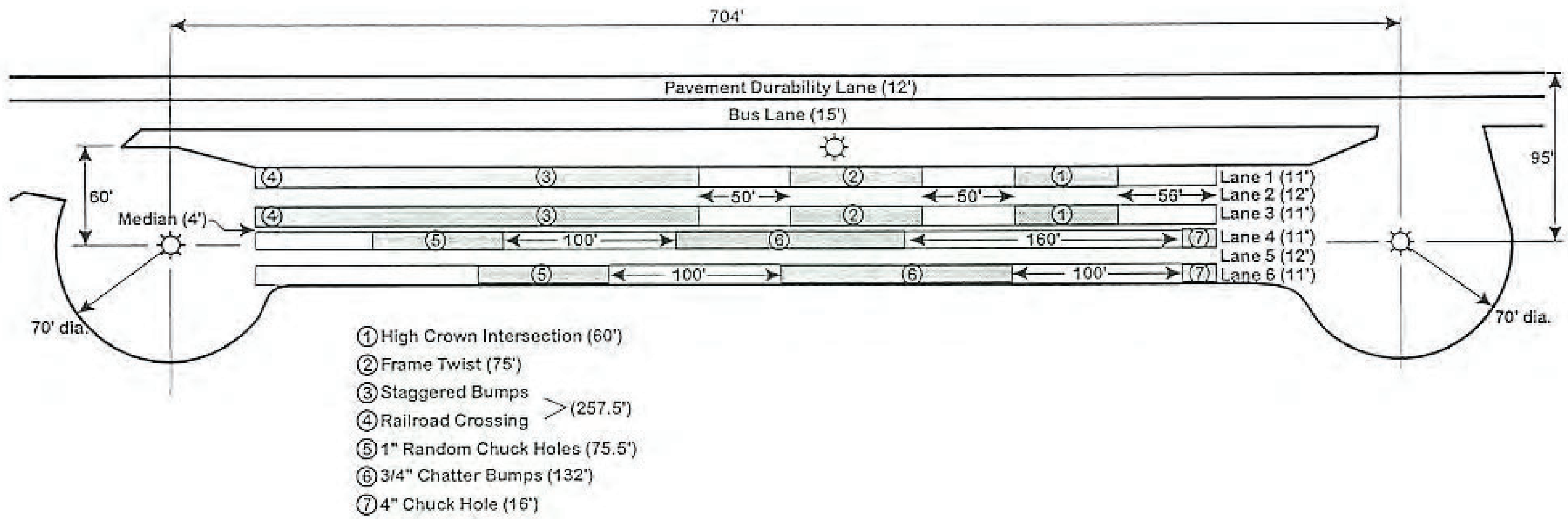
	HOUR	ACTION
Shift 1	midnight	D
	1:40 am	C
	1:50 am	B
	2:00 am	D
	3:35 am	C
	3:45 am	B
	4:05 am	D
	5:40 am	C
	5:50 am	B
	6:00 am	D
	7:40 am	C
	7:50 am	F
Shift 2	8:00 am	D
	9:40 am	C
	9:50 am	B
	10:00 am	D
	11:35 am	C
	11:45 am	B
	12:05 pm	D
	1:40 pm	C
	1:50 pm	B
	2:00 pm	D
	3:40 pm	C
	3:50 pm	F
Shift 3	4:00 pm	D
	5:40 pm	C
	5:50 pm	B
	6:00 pm	D
	7:40 pm	C
	7:50 pm	B
	8:05 pm	D
	9:40 pm	C
	9:50 pm	B
	10:00 pm	D
	11:40 pm	C
	11:50 pm	F

B—Break
C—Cycle all systems five times, visual inspection, driver's log entries
D—Drive bus as specified by procedure
F—Fuel bus, complete driver's log shift entries

"PLAN VIEW OF PENN STATE BUS TESTING AND RESEARCH FACILITY"



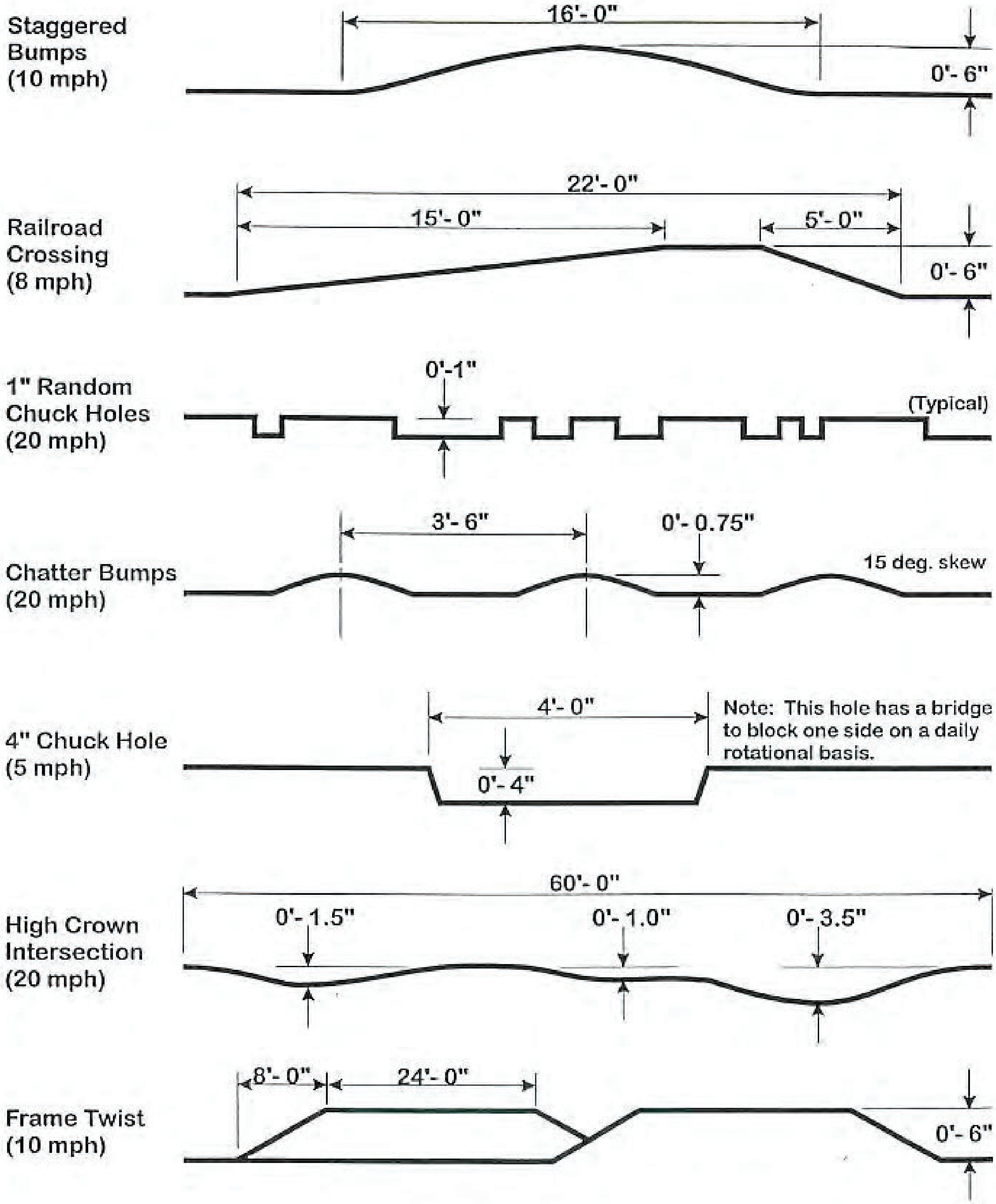
BUS TESTING AND RESEARCH TEST TRACK
UNIVERSITY PARK, PA



Plan View

Vehicle Durability Test Track

The Pennsylvania Transportation Institute
Penn State



Durability Element Profiles

The Pennsylvania Transportation Institute
Penn State

UNSCHEDULED MAINTENANCE

Gillig 0410

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
06/25/04	445	The snap ring and spacers are missing from the front left slack adjuster. Part found on the test track undamaged.	Snap ring and spacers installed in slack adjuster.	2.00	0.50
06/25/04	445	The A/C belt came off.	Undamaged A/C belt reinstalled.	2.00	0.50
06/29/04	729	Fuel is splashing out of the filler cap.	Hinged rubber cap replaced with a lock-on metal cap.	8.00	0.50
06/29/04	729	The A/C belt is riding half way off the pulleys.	A/C compressor repositioned and belt reinstalled.	4.00	1.00
07/13/04	1,346	The left front bump stop is broken.	Left front bump stop replaced.	24.00	0.50
07/15/04	1,483	The right front bump stop is broken.	Right front bump stop replaced.	8.00	0.50
07/26/04	2,095	The driver's seat will not hold air.	Leaking air supply line repaired.	8.00	0.50
07/28/04	2,464	The right front bump stop is broken.	Right front bump stop replaced.	8.00	0.50

(Page 2 of 3)

UNSCHEDULED MAINTENANCE

Gillig 0410

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
07/30/04	2,534	The front leveling valve link is disconnected.	Front leveling valve link reconnected.	8.00	0.50
08/04/04	2,534	Both front bump stops are broken.	Both front bump stops replaced.	0.50	0.50
08/06/04	2,708	The right front bump stop is broken.	Right front bump stop replaced.	8.00	0.50
08/12/04	3,147	The right front bump stop is broken.	Right front bump stop replaced.	8.00	0.50
08/16/04	3,363	The right front bump stop is broken.	Right front bump stop replaced.	8.00	0.50
08/17/04	3,419	The left rear, front axle air bag has failed.	Air bag replaced.	1.00	1.00
08/20/04	3,836	The left front bump stop is broken.	Left front bump stop replaced.	8.00	0.50
08/30/04	5,201	The right front bump stop is broken.	Right front bump stop replaced.	8.00	0.50
08/31/04	5,288	The left front, front axle air bag is leaking air.	Air bag replaced.	8.00	1.00

(Page 3 of 3)
UNSCHEDULED MAINTENANCE
Gillig 0410

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
09/01/04	5,500	The 3rd seat on the right side has a broken frame.	Seat removed.	0.25	0.25
09/01/04	5,500	The slide tracks on the battery tray are loose.	Screws tightened.	0.25	0.25
09/13/04	7,307	The “T” fitting for the left front, front axle air bag is leaking air.	“T” fitting replaced.	8.00	1.00
09/29/04	9,974	The left front shock is broken.	Left front shock replaced.	10.00	1.00
10/14/04	12,487	The hydraulic fluid reservoir is cracked at the inlet hose connection.	New reservoir installed.	2.00	2.00
10/20/04	12,743	The right front shock is worn and leaking oil.	Right front shock replaced.	3.00	0.25
10/20/04	12,743	The H-beam anchor point is cracked.	Crack welded/repaired.	48.00	1.00

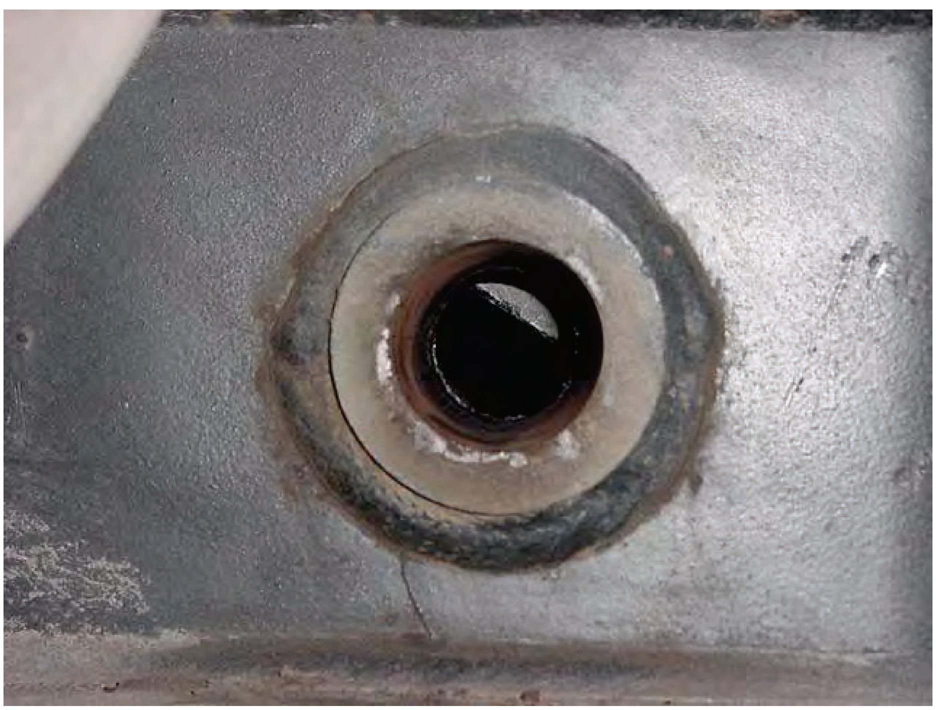
UNSCHEDULED MAINTENANCE

BROKEN SEAT FRAME
(5,500 TEST MILES)

BROKEN LEFT FRONT SHOCK
(9,974 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.

CRACKED HYDRAULIC RESERVOIR
(12,487 TEST MILES)



CRACKED H-BEAM ANCHOR POINT
(12,743 TEST MILES)

6. FUEL ECONOMY TEST - A FUEL CONSUMPTION TEST USING AN APPROPRIATE OPERATING CYCLE

6-I. TEST OBJECTIVE

The objective of this test is to provide accurate comparable fuel consumption data on transit buses produced by different manufacturers. This fuel economy test bears no relation to the calculations done by the Environmental Protection Agency (EPA) to determine levels for the Corporate Average Fuel Economy Program. EPA's calculations are based on tests conducted under laboratory conditions intended to simulate city and highway driving. This fuel economy test, as designated here, is a measurement of the fuel expended by a vehicle traveling a specified test loop under specified operating conditions. The results of this test will not represent actual mileage but will provide data that can be used by recipients to compare buses tested by this procedure.

6-II. TEST DESCRIPTION

This test requires operation of the bus over a course based on the Transit Coach Operating Duty Cycle (ADB Cycle) at seated load weight using a procedure based on the Fuel Economy Measurement Test (Engineering Type) For Trucks and Buses: SAE 1376 July 82. The procedure has been modified by elimination of the control vehicle and by modifications as described below. The inherent uncertainty and expense of utilizing a control vehicle over the operating life of the facility is impractical.

The fuel economy test will be performed as soon as possible (weather permitting) after the completion of the GVW portion of the structural durability test. It will be conducted on the bus test lane at the Penn State Test Facility. Signs are erected at carefully measured points which delineate the test course. A test run will comprise 3 CBD phases, 2 Arterial phases, and 1 Commuter phase. An electronic fuel measuring system will indicate the amount of fuel consumed during each phase of the test. The test runs will be repeated until there are at least two runs in both the clockwise and counterclockwise directions in which the fuel consumed for each run is within $\pm$ 4 percent of the average total fuel used over the 4 runs. A 20-minute idle consumption test is performed just prior to and immediately after the driven portion of the fuel economy test. The amount of fuel consumed while operating at normal/low idle is recorded on the Fuel Economy Data Form. This set of four valid runs along with idle consumption data comprise a valid test.

The test procedure is the ADB cycle with the following four modifications:

1. The ADB cycle is structured as a set number of miles in a fixed time in the following order: CBD, Arterial, CBD, Arterial, CBD, Commuter. A separate idle fuel consumption measurement is performed at the beginning and end of the fuel economy test. This phase sequence permits the reporting of fuel consumption for each of these phases separately, making the data more useful to bus manufacturers and transit properties.

2. The operating profile for testing purposes shall consist of simulated transit type service at seated load weight. The three test phases (figure 6-1) are: a central business district (CBD) phase of 2 miles with 7 stops per mile and a top speed of 20 mph; an arterial phase of 2 miles with 2 stops per mile and a top speed of 40 mph; and a commuter phase of 4 miles with 1 stop and a maximum speed of 40 mph. At each designated stop the bus will remain stationary for seven seconds. During this time, the passenger doors shall be opened and closed.

3. The individual ADB phases remain unaltered with the exception that 1 mile has been changed to 1 lap on the Penn State Test Track track. One lap is equal to 5,042 feet. This change is accommodated by adjusting the cruise distance and time.

4. The acceleration profile, for practical purposes and to achieve better repeatability, has been changed to "full throttle acceleration to cruise speed".

Several changes were made to the Fuel Economy Measurement Test (Engineering Type) For Trucks and Buses: SAE 1376 July 82:

1. Sections 1.1, and 1.2 only apply to diesel, gasoline, methanol, and any other fuel in the liquid state (excluding cryogenic fuels).

1.1 SAE 1376 July 82 requires the use of at least a 16-gal fuel tank. Such a fuel tank when full would weigh approximately 160 lb. It is judged that a 12-gal tank weighing approximately 120 lb will be sufficient for this test and much easier for the technician and test personnel to handle.

1.2 SAE 1376 July 82 mentions the use of a mechanical scale or a flowmeter system. This test procedure uses a load cell readout combination that provides an accuracy of 0.5 percent in weight and permits on-board weighing of the gravimetric tanks at the end of each phase. This modification permits the determination of a fuel economy value for each phase as well as the overall cycle.

2. Section 2.1 applies to compressed natural gas (CNG), liquified natural gas (LNG), cryogenic fuels, and other fuels in the vapor state.

2.1 A laminar type flowmeter will be used to determine the fuel consumption. The pressure and temperature across the flow element will be monitored by the flow computer. The flow computer will use this data to calculate the gas flow rate. The flow computer will also display the flow rate (scfm) as well as the total fuel used (scf). The total fuel used (scf) for each phase will be recorded on the Fuel Economy Data Form.

3. Use both Sections 1 and 2 for dual fuel systems.

FUEL ECONOMY CALCULATION PROCEDURE

A. For diesel, gasoline, methanol and fuels in the liquid state.

The reported fuel economy is based on the following: measured test quantities--distance traveled (miles) and fuel consumed (pounds); standard reference values--density of water at 60°F (8.3373 lbs/gal) and volumetric heating value of standard fuel; and test fuel specific gravity (unitless) and volumetric heating value (BTU/gal). These combine to give a fuel economy in miles per gallon (mpg) which is corrected to a standard gallon of fuel referenced to water at 60°F. This eliminates fluctuations in fuel economy due to fluctuations in fuel quality. This calculation has been programmed into a computer and the data processing is performed automatically.

The fuel economy correction consists of three steps:

1.) Divide the number of miles of the phase by the number of pounds of fuel consumed

phase	miles per phase	total miles per run
CBD	1.9097	5.7291
ART	1.9097	3.8193
COM	3.8193	3.8193

$$\mathbf{FEo_{mi/lb}} = \text{Observed fuel economy} = \frac{\text{miles}}{\text{lb of fuel}}$$

2.) Convert the observed fuel economy to miles per gallon [mpg] by multiplying by the specific gravity of the test fuel Gs (referred to water) at 60°F and multiply by the density of water at 60°F

$$\mathbf{FEo_{mpg} = FEc_{mi/lb}} \times Gs \times Gw$$

where **Gs** = Specific gravity of test fuel at 60°F (referred to water)
Gw = 8.3373 lb/gal

3.) Correct to a standard gallon of fuel by dividing by the volumetric heating value of the test fuel (H) and multiplying by the volumetric heating value of standard reference fuel (Q). Both heating values must have the same units.

$$\mathbf{FEc = FEo_{mpg}} \times \frac{Q}{H}$$

where

H = Volumetric heating value of test fuel [BTU/gal]
Q = Volumetric heating value of standard reference fuel

Combining steps 1-3 yields

$$\Longrightarrow \; FEc = \frac{miles}{lbs} \times (Gs \times Gw) \times \frac{Q}{H}$$

4.) Covert the fuel economy from mpg to an energy equivalent of miles per BTU. Since the number would be extremely small in magnitude, the energy equivalent will be represented as miles/BTUx10^6.

Eq = Energy equivalent of converting mpg to mile/BTUx10^6.

$$Eq = ((mpg)/(H)) \times 10^6$$

B. CNG, LNG, cryogenic and other fuels in the vapor state.

The reported fuel economy is based on the following: measured test quantities--distance traveled (miles) and fuel consumed (scf); density of test fuel, and volumetric heating value (BTU/lb) of test fuel at standard conditions (P=14.73 psia and T=60 °F).

These combine to give a fuel economy in miles per lb. The energy equivalent (mile/BTUx10^6) will also be provided so that the results can be compared to buses that use other fuels.

1.) Divide the number of miles of the phase by the number of standard cubic feet (scf) of fuel consumed.

phase	miles per phase	total miles per run
CBD	1.9097	5.7291
ART	1.9097	3.8193
COM	3.8193	3.8193

$$\mathbf{FEo_{mi/scf}} = \text{Observed fuel economy} = \frac{\text{miles}}{\text{scf of fuel}}$$

2.) Convert the observed fuel economy to miles per lb by dividing FEo by the density of the test fuel at standard conditions (Lb/ft^3).

Note: The density of test fuel must be determined at standard conditions as described above. If the density is not defined at the above standard conditions, then a correction will be needed before the fuel economy can be calculated.

$$\mathbf{FEo_{mi/lb}} = FEo / Gm$$

where Gm = Density of test fuel at standard conditions

3.) Convert the observed fuel economy (FEomi/lb) to an energy equivalent of (miles/BTUx10^6) by dividing the observed fuel economy (FEomi/lb) by the heating value of the test fuel at standard conditions.

$$Eq = ((FEomi/lb)/H)x10^6$$

where

Eq = Energy equivalent of miles/lb to mile/BTUx10^6
H = Volumetric heating value of test fuel at standard conditions

6-III. DISCUSSION

This is a comparative test of fuel economy using diesel fuel with a heating value of 20,214.0 btu/lb. The driving cycle consists of Central Business District (CBD), Arterial (ART), and Commuter (COM) phases as described in 6-II. The fuel consumption for each driving cycle and for idle is measured separately. The results are corrected to a reference fuel with a volumetric heating value of 127,700.0 btu/gal.

An extensive pretest maintenance check is made including the replacement of all lubrication fluids. The details of the pretest maintenance are given in the first three Pretest Maintenance Forms. The fourth sheet shows the Pretest Inspection. The next sheet shows the correction calculation for the test fuel. The next four Fuel Economy Forms provide the data from the four test runs. Finally, the summary sheet provides the average fuel consumption. The overall average is based on total fuel and total mileage for each phase. The overall average fuel consumption values were; CBD – 3.50 mpg, ART – 4.41 mpg, and COM – 7.40 mpg. Average fuel consumption at idle was 7.88 lb/hr (1.26 gph).

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 0410	Date: 11-4-04	SLW (lbs): 32,540
Personnel: E.D., E.L. & S.C.		

FUEL SYSTEM	OK	Date	Initials
Install fuel measurement system	√	11/4/04	S.C.
Replace fuel filter	√	11/4/04	S.C.
Check for fuel leaks	√	11/4/04	S.C.
Specify fuel type (refer to fuel analysis)	Diesel		
Remarks: none			
BRAKES/TIRES	OK	Date	Initials
Inspect hoses	√	11/4/04	E.D.
Inspect brakes	√	11/4/04	E.D.
Relube wheel bearings	√	11/4/04	E.D.
Check tire inflation pressures (mfg. specs.)	√	11/4/04	E.D.
Remarks: none			
COOLING SYSTEM	OK	Date	Initials
Check hoses and connections	√	11/4/04	T.S.
Check system for coolant leaks	√	11/4/04	T.S.
Remarks: none			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM (page 2)

Bus Number: 0410	Date: 11-4-04
Personnel: E.D., T.S. & S.C.	

ELECTRICAL SYSTEMS	OK	Date	Initials
Check battery	√	11/4/04	S.C.
Inspect wiring	√	11/4/04	S.C.
Inspect terminals	√	11/4/04	S.C.
Check lighting	√	11/4/04	S.C.
Remarks: none			
DRIVE SYSTEM	OK	Date	Initials
Drain transmission fluid	√	11/4/04	T.S.
Replace filter/gasket	√	11/4/04	T.S.
Check hoses and connections	√	11/4/04	T.S.
Replace transmission fluid	√	11/4/04	T.S.
Check for fluid leaks	√	11/4/04	T.S.
Remarks: none			
LUBRICATION	OK	Date	Initials
Drain crankcase oil	√	11/4/04	E.D.
Replace filters	√	11/4/04	E.D.
Replace crankcase oil	√	11/4/04	E.D.
Check for oil leaks	√	11/4/04	E.D.
Check oil level	√	11/4/04	E.D.
Lube all chassis grease fittings	√	11/4/04	E.D.
Lube universal joints	√	11/4/04	E.D.
Replace differential lube including axles	√	11/4/04	E.D.
Remarks: none			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM (page 3)

Bus Number: 0410	Date: 11-4-04
Personnel: E.D., T.S. & S.C.	

EXHAUST/EMISSION SYSTEM	OK	Date	Initials
Check for exhaust leaks	√	11/4/04	S.C.
Remarks: none			

ENGINE	OK	Date	Initials
Replace air filter	√	11/4/04	T.S.
Inspect air compressor and air system	√	11/4/04	T.S.
Inspect vacuum system, if applicable	√	11/4/04	T.S.
Check and adjust all drive belts	√	11/4/04	T.S.
Check cold start assist, if applicable	√	11/4/04	T.S.
Remarks: none			

STEERING SYSTEM	OK	Date	Initials
Check power steering hoses and connectors	√	11/4/04	S.C.
Service fluid level	√	11/4/04	S.C.
Check power steering operation	√	11/4/04	S.C.
Remarks: none			

	OK	Date	Initials
Ballast bus to seated load weight	√	11/4/04	S.C.

TEST DRIVE	OK	Date	Initials
Check brake operation	√	11/4/04	S.C.
Check transmission operation	√	11/4/04	S.C.
Remarks: none			

FUEL ECONOMY PRE-TEST INSPECTION FORM

Bus Number: 0410	Date: 11-9-04
Personnel: S.C.	

PRE WARM-UP	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	S.C.
Cold tire pressure (psi): Front 120 Middle N/A Rear 120	S.C.
Tire wear:	S.C.
Engine oil level	S.C.
Engine coolant level	S.C.
Interior and exterior lights on, evaporator fan on	S.C.
Fuel economy instrumentation installed and working properly.	S.C.
Fuel line -- no leaks or kinks	S.C.
Speed measuring system installed on bus. Speed indicator installed in front of bus and accessible to TECH and Driver.	S.C.
Bus is loaded to SLW	S.C.
WARM-UP	**If OK, Initial**
Bus driven for at least one hour warm-up	S.C.
No extensive or black smoke from exhaust	S.C.
POST WARM-UP	**If OK, Initial**
Warm tire pressure (psi): Front 121 Middle N/A Rear 122	S.C.
Environmental conditions Average wind speed <12 mph and maximum gusts <15 mph Ambient temperature between 30°F(-1C°) and 90°F(32°C) Track surface is dry Track is free of extraneous material and clear of interfering traffic	S.C.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0410	Manufacturer: Gillig	Date: 11/8/04
Run Number: 1	Personnel: R.C., T.S. & S.C.	
Test Direction: □CW or ■CCW	Temperature (°F): 43	Humidity (%): 39
SLW (lbs): 32,540	Wind Speed (mph) & Direction: 10 / NW	Barometric Pressure (in.Hg): 30.18

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Load Cell Reading (lb)		Fuel Used (lbs)
	Start	Finish		Start	Start	Finish	
CBD #1	0	8:51	8:51	37.0	87.85	84.10	3.75
ART #1	0	4:06	4:06	37.5	84.10	81.30	2.80
CBD #2	0	8:45	8:45	38.6	81.30	78.20	3.10
ART #2	0	4:05	4:05	39.8	78.20	75.80	2.40
CBD #3	0	8:49	8:49	42.0	75.80	72.50	3.30
COMMUTER	0	6:06	6:06	42.4	72.50	69.10	3.40
							Total Fuel = 18.75 lbs

20 minute idle : Total Fuel Used = 2.65 lbs

Heating Value = 20,214.0 BTU/LB

Comments: none

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0410	Manufacturer: Gillig	Date: 11-8-04
Run Number: 2	Personnel: R.C., T.S. & S.C.	
Test Direction: ■CW or □CCW	Temperature (°F): 43	Humidity (%): 39
SLW (lbs): 32,540	Wind Speed (mph) & Direction: 10 / W	Barometric Pressure (in.Hg): 30.21

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Load Cell Reading (lb)		Fuel Used (lbs)
	Start	Finish		Start	Start	Finish	
CBD #1	0	8:47	8:47	42.8	65.75	62.45	3.30
ART #1	0	4:05	4:05	43.0	62.45	59.70	2.75
CBD #2	0	8:45	8:45	43.1	59.70	56.05	3.65
ART #2	0	4:03	4:03	43.1	56.05	53.15	2.90
CBD #3	0	8:48	8:48	43.4	53.15	49.95	3.20
COMMUTER	0	6:03	6:03	43.3	49.95	46.80	3.15
							Total Fuel = 18.95 lbs

20 minute idle : Total Fuel Used = N/A lbs

Heating Value = 20,214.0 BTU/LB

Comments: none

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0410	Manufacturer: Gillig	Date: 11-9-04
Run Number: 3	Personnel: R.C., T.S. & S.C.	
Test Direction: □CW or ■CCW	Temperature (°F): 360	Humidity (%): 55
SLW (lbs): 32,540	Wind Speed (mph) & Direction:10/NNW	Barometric Pressure (in.Hg): 30.45

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Load Cell Reading (lb)		Fuel Used (lbs)
	Start	Finish		Start	Start	Finish	
CBD #1	0	8:57	8:57	35.3	89.35	85.90	3.45
ART #1	0	4:05	4:05	36.0	85.90	82.90	3.00
CBD #2	0	8:48	8:48	36.7	82.90	79.20	3.70
ART #2	0	4:03	4:03	37.5	79.20	76.70	2.50
CBD #3	0	8:51	8:51	39.2	76.70	73.10	3.60
COMMUTER	0	6:03	6:03	41.1	73.10	69.95	3.15
							Total Fuel = 19.40 lbs

20 minute idle : Total Fuel Used = N/A lbs

Heating Value = 20,214.0 BTU/LB

Comments: none

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0410	Manufacturer: Gillig	Date: 11-9-04
Run Number: 4	Personnel: R.C., T.S. & S.C.	
Test Direction: ■CW or □CCW	Temperature (°F): 38	Humidity (%): 55
SLW (lbs): 32,540	Wind Speed (mph) & Direction:10/NNW	Barometric Pressure (in.Hg): 30.45

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Load Cell Reading (lb)		Fuel Used (lbs)
	Start	Finish		Start	Start	Finish	
CBD #1	0	8:48	8:48	41.5	69.95	66.50	3.45
ART #1	0	4:03	4:03	41.9	66.50	63.80	2.70
CBD #2	0	8:47	8:47	42.8	63.80	60.70	3.10
ART #2	0	4:03	4:03	42.8	60.70	58.00	2.70
CBD #3	0	8:47	8:47	42.9	58.00	54.55	3.45
COMMUTER	0	6:04	6:04	42.9	54.55	51.30	3.25
							Total Fuel = 18.65 lbs

20 minute idle : Total Fuel Used = 2.6 lbs

Heating Value = 20,214.0 BTU/LB

Comments: none

0410.FUL
FUEL ECONOMY SUMMARY SHEET

BUS MANUFACTURER :Gillig   BUS NUMBER :0410
BUS MODEL :LowFloor   TEST DATE :11/8/04

FUEL TYPE : DIESEL
SP. GRAVITY : .8095
HEATING VALUE : 20214.00 BTU/Lb
Standard Conditions : 60 deg F and 14.7 psi
Density of Water : 8.3373 lb/gallon at 60 deg F

CYCLE	TOTAL FUEL USED (Lb)	TOTAL MILES	FUEL ECONOMY M/Lb(Measured)	FUEL ECONOMY MPG(Corrected)
Run # :1, CCW				
CBD	10.15	5.73	.56	3.54
ART	5.20	3.82	.73	4.60
COM	3.40	3.82	1.12	7.04
TOTAL	18.75	13.37	.71	4.47
Run # :2, CW				
CBD	10.15	5.73	.56	3.54
ART	5.65	3.82	.68	4.24
COM	3.15	3.82	1.21	7.60
TOTAL	18.95	13.37	.71	4.42
Run # :3, CCW				
CBD	10.75	5.73	.53	3.34
ART	5.50	3.82	.69	4.35
COM	3.15	3.82	1.21	7.60
TOTAL	19.40	13.37	.69	4.32
Run # :4, CW				
CBD	10.00	5.73	.57	3.59
ART	5.40	3.82	.71	4.43
COM	3.25	3.82	1.18	7.37
TOTAL	18.65	13.37	.72	4.49

IDLE CONSUMPTION

First 20 Minutes Data : 2.65 Lb   Last 20 Minutes Data : 2.60 Lb
Average Idle Consumption : 7.88 Lb/Hr

RUN CONSISTENCY: % Difference from overall average of total fuel used

Run 1 : 1.0   Run 2 : -.1   Run 3 : -2.4   Run 4 : 1.5

SUMMARY

Average Idle Consumption : 1.26 G/Hr
Average CBD Phase Consumption : 3.50 MPG
Average Arterial Phase Consumption : 4.41 MPG
Average Commuter Phase Consumption : 7.40 MPG
Overall Average Fuel Consumption : 4.43 MPG
Overall Average Fuel Consumption : 32.44 Miles/ Million BTU

7. NOISE

7.1 INTERIOR NOISE AND VIBRATION TESTS

7.1-I. TEST OBJECTIVE

The objective of these tests is to measure and record interior noise levels and check for audible vibration under various operating conditions.

7.1-II. TEST DESCRIPTION

During this series of tests, the interior noise level will be measured at several locations with the bus operating under the following three conditions:

1. With the bus stationary, a white noise generating system shall provide a uniform sound pressure level equal to 80 dB(A) on the left, exterior side of the bus. The engine and all accessories will be switched off and all openings including doors and windows will be closed. This test will be performed at the ABTC.

2. The bus accelerating at full throttle from a standing start to 35 mph on a level pavement. All openings will be closed and all accessories will be operating during the test. This test will be performed on the track at the Test Track Facility.

3. The bus will be operated at various speeds from 0 to 55 mph with and without the air conditioning and accessories on. Any audible vibration or rattles will be noted. This test will be performed on the test segment between the Test Track and the Bus Testing Center.

All tests will be performed in an area free from extraneous sound-making sources or reflecting surfaces. The ambient sound level as well as the surrounding weather conditions will be recorded in the test data.

7.1-III. DISCUSSION

This test is performed in three parts. The first part exposes the exterior of the vehicle to 80.0 dB(A) on the left side of the bus and the noise transmitted to the interior is measured. The overall average of the six measurements was 60.8 dB(A); ranging from 59.4 dB(A) at the rear passenger seats to 63.2 dB(A) at he driver's seat. The interior ambient noise level for this test was 41.9 dB(A).

The second test measures interior noise during acceleration from 0 to 35 mph. This noise level ranged from 72.5 dB(A) at the front passenger seats to 76.1 dB(A) at the rear passenger seats. The overall average was 74.2 dB(A). The interior ambient noise level for this test was 34.2 dB(A).

The third part of the test is to listen for resonant vibrations, rattles, and other noise sources while operating over the road. No vibrations or rattles were noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 1: 80 dB(A) Stationary White Noise

Bus Number: 0410	Date: 5-26-04
Personnel: T.S. & S.C.	
Temperature (°F): 73	Humidity (%): 86
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.14	
Initial Sound Level Meter Calibration: ■ checked by: S.C.	
Interior Ambient Noise Level dB(A): 41.9	Exterior Ambient Noise Level dB(A): 47.1
Microphone Height During Testing (in): 48.0	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	63.2
Front Passenger Seats	61.0
In Line with Front Speaker	60.9
In Line with Middle Speaker	60.7
In Line with Rear Speaker	59.5
Rear Passenger Seats	59.4

Final Sound Level Meter Calibration: ■ checked by: S.C.

Comments: All readings taken in the center aisle.

INTERIOR NOISE TEST DATA FORM
Test Condition 2: 0 to 35 mph Acceleration Test

Bus Number: 0410	Date: 11-11-04
Personnel: T.S. & R.C.	
Temperature (°F): 56	Humidity (%): 45
Wind Speed (mph): 8	Wind Direction: SW
Barometric Pressure (in.Hg): 30.10	
Initial Sound Level Meter Calibration: ■ checked by: S.C.	
Interior Ambient Noise Level dB(A): 34.2	Exterior Ambient Noise Level dB(A): 40.3
Microphone Height During Testing (in): 48.0	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	75.3
Front Passenger Seats	72.5
Middle Passenger Seats	72.8
Rear Passenger Seats	76.1

Final Sound Level Meter Calibration: ■ checked by: S.C.

Comments: All readings taken in the center aisle.

INTERIOR NOISE TEST DATA FORM
Test Condition 3: Audible Vibration Test

Bus Number: 0410	Date: 11-11-04
Personnel: T.S. & R.C.	
Temperature (°F): 56	Humidity (%): 45
Wind Speed (mph): 8	Wind Direction: SW
Barometric Pressure (in.Hg): 30.10	

Describe the following possible sources of noise and give the relative location on the bus.

Source of Noise	Location
Engine and Accessories	None noted.
Windows and Doors	None noted.
Seats and Wheel Chair lifts	None noted.

Comment on any other vibration or noise source which may have occurred
that is not described above: none noted

7.1 INTERIOR NOISE TEST

TEST BUS SET-UP FOR 80 dB(A)
INTERIOR NOISE TEST

7.2 EXTERIOR NOISE TESTS

7.2-I. TEST OBJECTIVE

The objective of this test is to record exterior noise levels when a bus is operated under various conditions.

7.2-II. TEST DESCRIPTION

In the exterior noise tests, the bus will be operated at a SLW in three different conditions using a smooth, straight and level roadway:

1. Accelerating at full throttle from a constant speed at or below 35 mph and just prior to transmission up shift.
2. Accelerating at full throttle from standstill.
3. Stationary, with the engine at low idle, high idle, and wide open throttle.

In addition, the buses will be tested with and without the air conditioning and all accessories operating. The exterior noise levels will be recorded.

The test site is at the PSBRTF and the test procedures will be in accordance with SAE Standards SAE J366b, Exterior Sound Level for Heavy Trucks and Buses. The test site is an open space free of large reflecting surfaces. A noise meter placed at a specified location outside the bus will measure the noise level.

During the test, special attention should be paid to:

1. The test site characteristics regarding parked vehicles, signboards, buildings, or other sound-reflecting surfaces
2. Proper usage of all test equipment including set-up and calibration
3. The ambient sound level

7.2-III. DISCUSSION

The Exterior Noise Test determines the noise level generated by the vehicle under different driving conditions and at stationary low and high idle, with and without air conditioning and accessories operating. The test site is a large, level, bituminous paved area with no reflecting surfaces nearby.

With an exterior ambient noise level of 41.8 dB(A), the average test result obtained while accelerating from a constant speed was 71.4 dB(A) on the right side and 72.6 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 42.5 dB(A), the average of the results obtained were 71.0 dB(A) on the right side and 71.6 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 62.6 dB(A) at low idle, 64.3 dB(A) at high idle, and 74.8 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 0.9 dB(A) higher at low idle, 1.3 dB(A) higher at high idle, and 1.2 dB(A) higher at wide open throttle. The exterior ambient noise level measured during this test was 42.4 dB(A).

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed

Bus Number: 0410	Date: 11-11-04
Personnel: T.S. & R.C.	
Temperature (°F): 56	Humidity (%): 45
Wind Speed (mph): 8	Wind Direction: SW
Barometric Pressure (in.Hg): 30.10	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■ checked by: S.C.	
Initial Sound Level Meter Calibration: ■ checked by: S.C.	
Exterior Ambient Noise Level dB(A): 41.8	

Accelerating from Constant Speed Curb (Right) Side		Accelerating from Constant Speed Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	71.6	1	71.9
2	70.7	2	72.2
3	71.1	3	72.0
4	71.1	4	72.7
5	71.0	5	72.4
Average of two highest actual noise levels = 71.4 dB(A)		Average of two highest actual noise levels = 72.6 dB(A)	

Final Sound Level Meter Calibration Check: ■ checked by: S.C.

Comments: None

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill

Bus Number: 0410	Date: 11-11-04
Personnel: R.C. & T.S.	
Temperature (°F): 56	Humidity (%): 45
Wind Speed (mph): 8	Wind Direction: SW
Barometric Pressure (in.Hg): 30.10	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■ checked by: S.C.	
Initial Sound Level Meter Calibration: ■ checked by: S.C.	
Exterior Ambient Noise Level dB(A): 42.5	

Accelerating from Standstill Curb (Right) Side		Accelerating from Standstill Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	71.2	1	71.8
2	70.3	2	70.5
3	70.6	3	71.3
4	70.8	4	70.9
5	70.8	5	70.4
Average of two highest actual noise levels = 71.0 dB(A)		Average of two highest actual noise levels = 71.6 dB(A)	

Final Sound Level Meter Calibration Check: ■ checked by: S.C.

Comments: None

EXTERIOR NOISE TEST DATA FORM
Stationary

Bus Number: 0410	Date: 11-11-04
Personnel: T.S. & R.C.	
Temperature (°F): 56	Humidity (%): 45
Wind Speed (mph): 8	Wind Direction: SW
Barometric Pressure (in.Hg): 30.10	

Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■ checked by: S.C.

Initial Sound Level Meter Calibration: ■ checked by: S.C.

Exterior Ambient Noise Level dB(A): 42.4

Accessories and Air Conditioning ON

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	700	62.3	62.0
High Idle	998	63.5	65.0
Wide Open Throttle	2,335	73.7	75.8

Accessories and Air Conditioning OFF

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	702	64.0.	62.9
High Idle	1,001	66.5	64.6
Wide Open Throttle	2,333	74.7	76.2

Final Sound Level Meter Calibration Check: ■ checked by: S.C.

Comments: None

7.2 EXTERIOR NOISE TEST

TEST BUS UNDERGOING
EXTERIOR NOISE TESTING

FEDERAL TRANSIT BUS TEST

Performed for the Federal Transit Administration U.S. DOT
In accordance with 49 CFR, Part 665

Manufacturer: GILLIG, LLC
Model: 40 FOOT LOW FLOOR L9N CNG

Tested in Service-Life Category
12 Year / 500,000 Miles

March 2020

Report Number: LTI-BT-R1911

The Thomas D. Larson
Pennsylvania Transportation Institute
201 Transportation Research Building
The Pennsylvania State University
University Park, PA 16802
(814) 865-1891

Bus Testing and Research Center
2237 Plank Road
Duncansville, PA 16635
(814) 695-3404

PennState
College of Engineering

LTI BUS RESEARCH
AND TESTING CENTER

FEDERAL TRANSIT BUS TEST

Performed for the Federal Transit Administration, U.S. DOT
1200 New Jersey Avenue, SE
Washington, DC 20590

In accordance with 49 CFR Part, 665

Manufacturer: GILLIG, LLC
Manufacturer's address: 451 DISCOVERY DRIVE
LIVERMORE, CA 94551

Model: 40 Foot Low Floor L9N CNG

Tested in Service-Life Category
12 Year / 500,000 Miles

Report Number: LTI-BT-R1911

ACCREDITED
Mechanical Testing Certificate 3172.01

David Klinikowski	Director, Bus Research and Testing Center	02/11/2021
Quality Authorization	*Title*	*Date*

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EXECUTIVE SUMMARY

TEST HIGHLIGHTS

The information in this report pertains only to this specific bus, as received from the manufacturer for testing. Any modifications made by manufacturer during testing are recorded in this report.

The Check-In section of the report provides a description of the bus and specifies its major components. The following table gives the salient specifications.

Manufacturer	Gillig, LLC
Model	40 Foot Low Floor L9N
Chassis Make/Model	Gillig, LLC / L9N
Chassis Modified	No
Length	40 Foot 8 Inches
Fuel	CNG
Service Life	12-Year / 500,000 mile test
Number of Seats (including driver)	39 or 33 and 2 wheelchairs
Manufacturer-Designated Standing Passenger Capacity	33
Gross Vehicle Weight used for testing	41,500
Gross Vehicle Weight Rating	41,600
Mileage at Delivery	3,177
Test Start Date	June 27, 2019
Test Completion Date	December 10, 2019

The measured curb weight was 10,520 lb. for the front axle and 20,150 lb. for the rear axle. These combined weights provided a total measured curb weight of 30,670 lb. There are 39 seats including the driver and free floor space for 34 standing passengers bringing the potential total passenger capacity to 73. A placard shows the maximum number of standing passengers as 33. Six seats can fold away to accommodate 2 wheelchairs. Therefore, the gross load represents 39 seated passengers (including driver), and 33 standees, for a total of 72 passengers. Gross load is calculated as 72 x 150 = 10,800 lb. At full declared capacity, the measured gross vehicle weight was 41,500 lb.

BUS TESTING BACKGROUND

On August 1, 2016, FTA announced a final rule for bus testing for improving the process of ensuring the safety and reliability of new transit buses. The rule satisfies requirements in MAP-21 to establish minimum performance standards, a standardized scoring system, and a pass-fail threshold based on the score.

FTA's Bus Testing Program (often referred to as "Altoona Testing" due to the location of the main testing center) tests new transit bus models for:

- Maintainability
- Reliability

- Safety
- Performance (including Braking Performance)
- Structural Integrity (including Structural Durability)
- Fuel Economy (Energy Efficiency and Range, for electric buses)
- Noise
- Emissions

Bus models that fail to meet one or more minimum performance standards will "fail" their test and thus be ineligible for purchase with FTA funds until the failures are resolved and validated through further testing. FTA will use this authority to make sure defects are corrected before a bus model can be acquired with FTA funding.

In each application to FTA for the purchase or lease of any new bus model, or any bus model with a major change in configuration or components to be acquired or leased with funds obligated by the FTA, the recipient shall certify that it has received the appropriate full Bus Testing Report and any applicable partial testing report(s) before final acceptance of the first vehicle. In dealing with a bus manufacturer or dealer, the recipient shall be responsible for determining whether a vehicle to be acquired requires full testing or partial testing or has already satisfied the requirements of this part. A bus manufacturer or recipient may request guidance from FTA in making these determinations.

The purpose of the testing is intended set a "Pass/Fail" standard and grade the performance of the buses in order to provide performance information to the transit authorities that can be used in their purchase or lease decisions. The intent of this report is to provide the grantee a relative measure of the performance of a particular model of transit bus against a standard of performance. The passing of this test should ensure a vehicle has a high probability of meeting its service life in the category it was tested.

The data included in this test report and other applicable reports should be reviewed to choose the most suitable bus for a grantee's operation. A higher scoring bus is not necessarily the best bus for a given application. For example, a bus with a powerful engine may score well because of its performance and gradeability, but another bus with a smaller and more fuel-efficient engine could be a better choice for applications in mostly flat areas. It is the responsibility of the grantee to ensure the proper test report or applicable partial report is in their possession and has been thoroughly reviewed.

The score sheet for the subject vehicle of this test report is provided below. **This bus passed the Altoona test, with an aggregate score of 85.7.**

Gillig Bus# 1911

Test category		Standard	Base Pts.	Bonus Pts.	Range	Range	Test Data	Score	FAIL
1. Maintainability	Unscheduled maint.	< 125 hours	2	14	0	125	9	14.99	
2. Reliability	# Class 2 failures	< 2 Uncorrected	2	6	0	2	0	8.00	
3. Safety	Hazards	No uncorrected Class 1	10	0	P	F	P	10.00	
	Stability	Lane change, 45 mph?	2.5	0	P	F	P	2.50	
		< 158 feet at 45mph	0.5	2	80	158	105.2	1.85	
	Braking	Holds Lane, Split coeffient	2.5	0	P	F	P	2.50	
		Parking brake, 20% grade	2.5	0	P	F	P	2.50	
4. Performance	Acceleration 0-30 mph	less than 30 sec	1.5	0	P	F	P	1.50	
	Gradeability 2.5%	more than 40 mph	1.5	0	P	F	P	1.50	
	Gradeability 10%	more than 10 mph	2	0	P	F	P	2.00	
5. Structural Integrity	Distortion	Exits are operational	1	0	P	F	P	1.00	
	Static Towing	No significant deformation	1	0	P	F	p	0.00	
	Dynamic Towing	Towable with std. wrecker	1	0	P	F	P	1.00	
	Jacking	Liftable with std. jack	1	0	P	F	P	1.00	
	Hoisting	Stable on jacks	1	0	P	F	P	1.00	
	Durability-Structural	No uncorrected failures	13	0	P	F	P	13.00	
	Durability-Powertrain	No uncorrected failures	12	0	P	F	P	12.00	
6. Fuel Economy	Liquid fuels	1-13mpg	1	6	1	13	NA	0.00	
	CNG	10-50 scf/mi			10	50	39.2	2.62	
	Hydrogen	15-98 cf/mi			15	98	NA	0.00	
	Electric	1-3 kWh/mi			1	3	NA	0.00	
7. Noise	Int. Noise (0-35 mph)	less than 80 db	0.5	3	30	80	76.8	0.69	
	Ext. Noise (0-35 mph)	less than 83 db	0.5	3	50	83	74.2	1.30	
8. Emissions	CO_2	0-4000 g/mi	1	4	0	4000	2104	2.90	
	CO	0-20 g/mi		0.4	0	20	4	0.32	
	Total hydrocarbon	0-3 g/mi		0.4	0	3	0.24	0.37	
	NMHC	0-3 g/mi		0.4	0	3	0.02	0.40	
	Nitrogen oxides	0-3 g/mi		0.4	0	2	0.03	0.39	
	Particulates	0-0.1 g/m		0.4	0	0.1	0	0.40	
Total			60	40				85.7	

Note: The use of the scoring system is not mandatory for procurement. It is only necessary that the bus being procured has received a passing score.

ABBREVIATIONS AND ACRONYMS

ABS - anti-skid braking system

ABTC - Altoona Bus Test Center

A/C - air conditioner, or air conditioning

AC - alternating current

ADA - American Disability Act

CDCTS - chassis dynamometer test control system

CVS - constant volume sampling

CW - curb weight (bus weight including maximum fuel, oil, and coolant; but without passengers or driver)

dB(A) - decibels with reference to 0.0002 microbar as measured on the "A" scale

DC - direct current

DIR - test director

DR - bus driver

EPA - Environmental Protection Agency

GAWR – gross axle weight rating

GVL - gross vehicle load (150 lb. for every designed passenger seating position, for the driver, and for each 1.5 sq ft of free floor space)

GVW - gross vehicle weight (curb weight plus gross vehicle load)

GVWR - gross vehicle weight rating

HD-UDDS – Heavy Duty-Urban Dynamometer Driving Schedule

LTI - Larson Transportation Institute

mpg - miles per gallon

mph - miles per hour

PM - Preventive maintenance

PSTT - Penn State Test Track

rpm - revolutions per minute

SAE - Society of Automotive Engineers

SCF - Standard cubic foot

SCH - test scheduler

SA - staff assistant

SLW - seated load weight (curb weight plus 150 lb. for every designed passenger seating position and for the driver)

TD - test driver

TECH - test technician

TM - track manager

TP - test personnel

Wh - Watt hour

TEST BUS CHECK-IN

I. OBJECTIVE

The objective of this task is to log in the test bus, assign a bus number, complete the vehicle data form, and perform a safety check.

II. TEST DESCRIPTION

The test consisted of assigning a bus test number to the bus, cleaning the bus, completing the vehicle data form, obtaining any special information and tools from the manufacturer, determining a testing schedule, performing an initial safety check, and performing the manufacturer's recommended preventive maintenance. The bus manufacturer certified that the bus meets all Federal regulations.

III. DISCUSSION

The check-in procedure is used to identify in detail the major components and configuration of the bus.

The test bus consisted of a Gillig, LLC , model 40 Foot Low Floor L9N. The bus has a front passenger door forward of the front axle, and is equipped with an ADA accessible lift system, and a main passenger door forward of the rear axle. Power is provided by a CNG-fueled, Cummins / L9N 280 engine coupled to a Voith / D864.6 transmission.

The measured curb weight was 10,520 lb. for the front axle and 20,150 lb. for the rear axle. These combined weights provided a total measured curb weight of 30,670 lb. There are 39 seats including the driver and free floor space for 34 standing passengers bringing the potential total passenger capacity to 73. A placard shows the maximum number of standing passengers as 33. Six seats can fold away to accommodate 2 wheelchairs. Therefore, the gross load represents 39 seated passengers (including driver), and 33 standees, for a total of 72 passengers. Gross load is calculated as 72 x 150 = 10,800 lb. At full declared capacity, the measured gross vehicle weight was 41,500 lb

VEHICLE DATA FORM

Bus Number: 1911	Date of Check-In: 06/27/19
Bus Manufacturer: Gillig, LLC	Vehicle Identification Number (VIN): 15GGD3117K3190045
Model Number: L9N	Chassis Mfr./Mod.#: Gillig, LLC / L9N
Personnel: T.S.,S.R. & E.D.	Starting Odometer Reading: 3,177

WEIGHT:

Individual Wheel Reactions:

Weights (lb.)	Front Axle		Middle Axle		Rear Axle	
	Curb	Street	Curb	Street	Curb	Street
CW	5,250	5,270	N/A	N/A	9,500	10,650
SLW	6,230	6,230	N/A	N/A	11,410	12,960
GVW	7,270	7,250	N/A	N/A	12,720	14,260

Total Weight Details:

Weight (lb.)	CW	SLW	GVW	GAWR
Front Axle	10,520	12,460	14,520	14,600
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	20,150	24,370	26,980	27,000
Total	30,670	36,830	41,500	GVWR: 41,600 Specified by Manufacturer

Dimensions:

Length (ft/in)	40 / 8
Width (in)	100 ¾
Height (in)	124
Front Overhang (in)	88 ¼
Rear Overhang (in)	121 ¼
Wheel Base (in)	278 ½
Wheel Track (in)	Front: 85.2
	Middle: N/A
	Rear: 76.9

VEHICLE DATA FORM

Bus Number: 1911	Date: 06/27/19

CLEARANCES:

Lowest Point Outside Front Axle	Location: Skid Plate	Clearance(in): 8.5
Lowest Point Outside Rear Axle	Location: Coolant Pipe	Clearance(in): 11.8
Lowest Point between Axles	Location: Frame	Clearance(in): 13.8
Ground Clearance at the center (in)	13.8	
Front Approach Angle (deg)*	8.0	
Rear Approach Angle (deg)*	10.0	
Ramp Clearance Angle (deg)	5.6	
Aisle Width (in)	Front- 23	Rear- 22.6
Inside Standing Height at Center Aisle (in)	Front- 95.2	Rear-76.4

*measurements used to calculate approach and departure angles are taken from the center-line of the axles.

BODY DETAILS:

Body Structural Type	Semi-Monocoque		
Frame Material	Steel		
Body Material	Aluminum		
Floor Material	Plywood		
Roof Material	Composite		
Windows Type	■ Fixed- Bottom	■ Movable-Top	
Window Mfg./Model No.	Arow / AS3 M-3 DOT 1060		
Number of Doors	_1_ Front	_1_ Rear	
Mfr. / Model No.	Front - Vapor AmeriView / 51750578-00 Rear – Vapor Ameriview / 51750621-00		
Dimension of Each Door (in)	Front- 75.3 H x 31.9 W Rear- 78 H x 29.7 W		
Passenger Seat Type	■Cantilever-Front	■ Pedestal-Rear	☐ Other (explain)
Driver Seat Type	■ Air	☐ Spring	☐ Other (explain)
Mfr. / Model No.	USSC / 9000 CX Series		
Number of Seats (including Driver)	39 or 33 + 2 w/c		

Bus Number: 1911	Date: 06/27/19

BODY DETAILS (Contd.)

Free Floor Space (ft^2)	56.8
Height of Each Step at Normal Position (in)	Front 1.15.4 2. N/A 3. N/A 4. N/A
	Middle 1. 16.6 2. N/A 3. N/A 4. N/A
	Rear 1. N/A 2. N/A 3. N/A 4. N/A
Step Elevation Change - Kneeling (in)	Front- 3.4 Middle-1.3

ENGINE

Type	☐ C.I.	☐ Alternate Fuel	
	■ S.I.	☐ Other (explain)	
Mfr. / Model No.	Cummins / L9N 280		
Location	☐ Front	■ Rear	☐ Other (explain)
Fuel Type	☐ Gasoline	■ CNG	☐ Methanol
	☐ Diesel	☐ LNG	☐ Other (explain)
Alternator (Generator) Mfr./Model No.	C.E. Niehoff & Co. / C803D		
Maximum Rated Output (Volts / Amps)	28 volts / 525 amps		
Air Compressor Mfr. / Model No.	Wabco / 4938827		
Maximum Capacity (ft^3 / min)	Minimum 179L/min @1000kPa, 30.4CFM		
Starter Type	■ Electrical	☐ Pneumatic	☐ Other (explain)
Starter Mfr. / Model No.	Delco Remy / 24V-42MT-450		

Bus Number: 1911	Date: 06/27/19

TRANSMISSION

Transmission Type	☐ Manual	■ Automatic	☐ Load Sensing Adaptive
Mfr. / Model No.	Voith / D864.6		
Control Type	☐ Mechanical	■ Electrical	☐ Other
Integral Retarder Mfr. / Model No.	☐ Yes	■ No	

SUSPENSION

Number of Axles	2		
Front Axle Type	☐ Independent	■ Beam Axle	
Mfr. / Model No.	Meritor / FH946KX46		
Axle Ratio (if driven)	N/A		
Suspension Type	■ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Koni / 99B 3202SP1Merit		
Middle Axle Type N/A	☐ Independent	☐ Beam Axle	
Mfr. / Model No.	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type	☐ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	☐ Independent	■ Beam Axle	
Mfr. / Model No.	Meritor / 79163KX13-538		
Axle Ratio (if driven)	5.38		
Suspension Type	■ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	4		
Mfr. / Model No.	Koni / 1173703000		

VEHICLE DATA FORM

Bus Number: 1911	Date: 06/27/19

WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Accuride / 22.5 x 8.25
	Tire Mfr./ Model No.	Goodyear Metro Miler / B305 85R 22.5
Rear	Wheel Mfr./ Model No.	Accuride / 22.5 x 8.25
	Tire Mfr./ Model No.	Goodyear Metro Miler / B305 85R 22.5

BRAKES

Front Axle Brakes Type	☐ Cam	■ Disc	☐ Other (explain)
Mfr. / Model No.	Meritor / EX225H3 disc		
Middle Axle Brakes Type	☐ Cam	☐ Disc	■ N/A
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	☐ Cam	■ Disc	☐ Other (explain)
Mfr. / Model No.	Meritor / EX225H3 disc		

HVAC

Heating System Type	☐ Air	■ Water	☐ Other
Capacity (Btu/hr)	98,000		
Mfr. / Model No.	ThermoKing / X426		
Air Conditioner	■ Yes	☐ No	
Location	Rear		
Capacity (Btu/hr)	86,000		
A/C Compressor Mfr. / Model No.	Thermo King / X426		

STEERING

Steering Gear Box Type	Hydraulic Gear		
Mfr. / Model No.	ZF/TRW TAS65 / TAS65171B		
Steering Wheel Diameter	20”		
Number of turns (lock to lock)	4 ½		
Control Type	☐ Electric	■ Hydraulic	☐ Other (explain)

Bus Number: 1911	Date: 06/27/19

OTHERS

Wheel Chair Ramps	Location: Front	Type: Fold-Out
Wheel Chair Lifts	Location: N/A	Type: N/A
Mfr. / Model No.	Lift-U / LU18-02-09	
Emergency Exit	Location: Windows Doors Roof Hatch	Number: 5 2 1

CAPACITIES

Fuel Tank Capacity (gallons)	3600 psig @ 70˚ F (Liquid Capacity-2418 litres)
Engine Crankcase Capacity (quarts)	23
Transmission Capacity (quarts)	33 qrts initial fill / 25-26 quarts service
Differential Capacity (litres)	18.8-20.8
Cooling System Capacity (gallons)	15
Power Steering Fluid Capacity (quarts)	14

VEHICLE DATA FORM

Page 7 of 7

Bus Number: 1911	Date: 06/27/19

List all spare parts, tools and manuals delivered with the bus.

Part Number	Description	Qty.
N/A	N/A	N/A

COMPONENT/SUBSYSTEM INSPECTION FORM

Page 1 of 1

Bus Number: 1911	Date: 06/27/19

Subsystem	Checked	Initials	Comments
Air Conditioning Heating and Ventilation	✓	E.D.	None noted
Body and Sheet Metal	✓	E.D.	None noted
Frame	✓	E.D.	None noted
Steering	✓	E.D.	None noted
Suspension	✓	E.D.	None noted
Interior/Seating	✓	E.D.	None noted
Axles	✓	E.D.	None noted
Brakes	✓	E.D.	None noted
Tires/Wheels	✓	E.D.	None noted
Exhaust	✓	E.D.	None noted
Fuel System	✓	E.D.	None noted
Power Plant	✓	E.D.	None noted
Accessories	✓	E.D.	None noted
ADA Accessible Lift System	N/A	E.D.	None noted
ADA Accessible Ramp System	✓	E.D.	None noted
Interior Fasteners	✓	E.D.	None noted
Batteries	✓	E.D.	None noted

CHECK - IN

GILLIG, LLC
40-FOOT LOW FLOOR LN9 CNG

CHECK - IN CONT.

ROOFTOP CNG TANKS

OPERATOR'S AREA

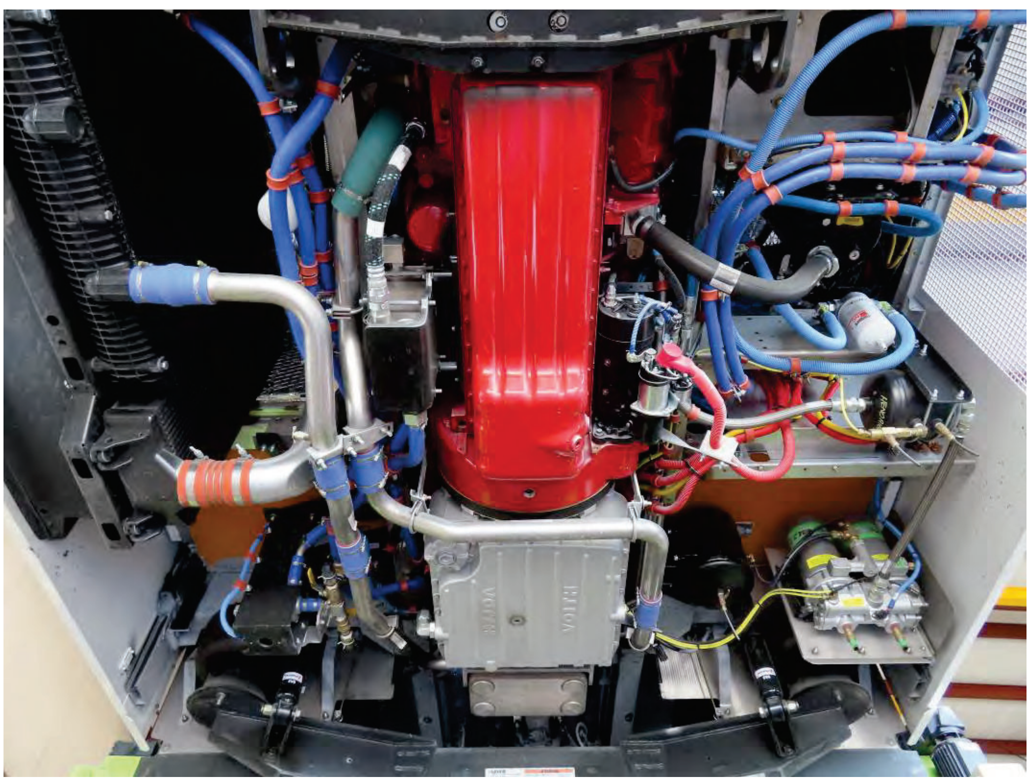
CHECK - IN CONT.

INTERIOR FROM FRONT

VIN TAG

CHECK - IN CONT.

PLACARD SHOWING MAXIMUM PASSENGERS



ENGINE COMPARTMENT

1. MAINTAINABILITY

1.1 ACCESSIBILITY OF COMPONENTS AND SUBSYSTEMS

1.1-I. TEST OBJECTIVE

The objective of this test is to check the accessibility of components and subsystems.

1.1-II. TEST DESCRIPTION

Accessibility of components and subsystems was checked, and where accessibility was restricted the subsystem was noted along with the reason for the restriction.

1.1-III. DISCUSSION

Accessibility, in general, was adequate. Components covered in Section 1.3 (repair and/or replacement of selected subsystems), along with all other components encountered during testing, were found to be readily accessible and no restrictions were noted.

ACCESSIBILITY DATA FORM

Page 1 of 2

Bus Number: 1911	Date: 12/10/19

Component	Checked	Comments
ENGINE :		
Oil Dipstick	✓	N/A
Oil Filler Hole	✓	N/A
Oil Drain Plug	✓	N/A
Oil Filter	✓	N/A
Fuel Filter	✓	N/A
Air Filter	✓	Difficult to change due to placement behind AC compressor & over hydraulic tank.
Belts	✓	N/A
Coolant Level	✓	N/A
Coolant Filler Hole	✓	N/A
Coolant Drain	✓	N/A
Spark / Glow Plugs	✓	N/A
Alternator	✓	N/A
Diagnostic Interface Connector	✓	N/A
TRANSMISSION :		
Fluid Dip-Stick	✓	N/A
Filler Hole	✓	N/A
Drain Plug	✓	N/A
SUSPENSION :		
Bushings	✓	N/A
Shock Absorbers	✓	N/A
Air Springs	✓	N/A
Leveling Valves	✓	N/A
Grease Fittings	✓	N/A

ACCESSIBILITY DATA FORM

Bus Number: 1911	Date: 12/10/19

Component	Checked	Comments
HVAC :		
A/C Compressor	✓	N/A
Filters	✓	N/A
Fans	✓	N/A
ELECTRICAL SYSTEM :		
Fuses	✓	N/A
Batteries	✓	N/A
Voltage regulator	✓	On alternator
Voltage Converters	✓	N/A
Lighting	✓	N/A
MISCELLANEOUS :		
Brakes	✓	N/A
ADA Accessible Lifts/Ramps	✓	N/A
Instruments	✓	N/A
Axles	✓	N/A
Exhaust	✓	N/A
Fuel System	✓	CNG tanks on the roof
OTHERS :		

1.2 SERVICING, PREVENTIVE MAINTENANCE, AND REPAIR AND MAINTENANCE DURING TESTING

1.2-I. TEST OBJECTIVE

The objective of this test is to collect maintenance data about the servicing, preventive maintenance, and repair.

1.2.-II. TEST DESCRIPTION

The test was conducted by operating the bus and collecting the following data on work order forms and a driver log.

1. Scheduled Maintenance
   a. Bus number
   b. Date
   c. Mileage
   d. Results of scheduled inspections
   e. Description of malfunction (if any)
   f. Repair action and parts used (if any)
   g. Man-hours required

2. Unscheduled Maintenance
   a. Bus number
   b. Date
   c. Mileage
   d. Description of malfunction
   e. Place and time of malfunction (e.g., in service or undergoing inspection)
   f. Repair action and parts used
   g. Man-hours required

The bus was operated in accelerated durability service. While typical items are given below, the specific service schedule was that specified by the manufacturer.

A. Service
   1. Fueling
   2. Consumable checks
   3. Interior cleaning

B. Preventive Maintenance
   1. Brake adjustments
   2. Lubrication
   3. 3,000 mi (or manufacturer recommended) inspection

4. Oil and filter change inspection
5. Major inspection
6. Tune-up

C. Periodic Repairs
1. Brake reline*
2. Transmission change
3. Engine change*
4. Windshield wiper motor change
5. Stoplight bulb change*
6. Towing operations
7. Hoisting operations

*These items are attended to if found necessary, while the others in the list are removed/replaced/tested for all buses undergoing a full test.

1.2-III. DISCUSSION

Servicing and preventive maintenance were performed at manufacturer-specified intervals. The following Scheduled Maintenance Form lists the mileage, items serviced, the service interval, and amount of time required to perform the maintenance.

The Unscheduled Maintenance List along with related photographs is included in Section 5.7, Structural Durability. This list supplies information related to failures that occurred during the durability portion of testing. The Unscheduled Maintenance List includes the date and mileage at which the malfunction was detected, a description of the malfunction and repair, and the time required to perform the repair.

(Page 1 of 2)
SCHEDULED MAINTENANCE
Gillig, LLC # 1911

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	LABOR HOURS
07/17/19	948	P.M./Inspection	Steering linkage lubed. Tie rods, universals/u-joints all checked. Inspected frame, body and suspension.	4.00	4.00
08/02/19	1851	P.M./Inspection	Steering linkage lubed. Tie rods, universals/u-joints all checked. Inspected frame, body and suspension.	4.00	4.00
08/12/19	2798	P.M./Inspection	Steering linkage lubed. Tie rods, universals/u-joints all checked. Inspected frame, body and suspension.	4.00	4.00
08/22/19	3796	P.M./Inspection	Steering linkage lubed. Tie rods, universals/u-joints all checked. Inspected frame, body and suspension.	4.00	4.00
09/05/19	5245	P.M./Inspection	Steering linkage lubed. Tie rods, universals/u-joints all checked. Inspected frame, body and suspension.	4.00	4.00
09/11/19	5940	P.M./Inspection	Steering linkage lubed. Tie rods, universals/u-joints all checked. Inspected frame, body and suspension.	4.00	4.00
09/25/19	7751	P.M./Inspection	Steering linkage lubed. Tie rods, universals/u-joints all checked. Inspected frame, body and suspension.	4.00	4.00

SCHEDULED MAINTENANCE

Gillig, LLC # 1911

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	LABOR HOURS
10/04/19	9558	P.M./Inspection	Steering linkage lubed. Tie rods, universals/u-joints all checked. Inspected frame, body and suspension.	4.00	4.00
10/15/19	10,583	P.M./Inspection	Steering linkage lubed. Tie rods, universals/u-joints all checked. Inspected frame, body and suspension.	4.00	4.00
10/22/19	11,491	P.M./Inspection	Steering linkage lubed. Tie rods, universals/u-joints all checked. Inspected frame, body and suspension.	4.00	4.00
11/05/19	12,904	P.M./Inspection	Steering linkage lubed. Tie rods, universals/u-joints all checked. Inspected frame, body and suspension.	4.00	4.00
11/20/19	14,985	P.M./Inspection Fuel Economy	Steering linkage lubed. Tie rods, universals/u-joints all checked. Inspected frame, body and suspension. Oil changed. Oil, fuel, and air filters changed. Transmission oil and filter changed.	8.00	8.00

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS

1.3-I. TEST OBJECTIVE

The objective of this test is to establish the time required to replace and/or repair selected subsystems.

1.3-II. TEST DESCRIPTION

The test involved components that may be expected to fail or require replacement during the service life of the bus. In addition, any component that failed during testing of the bus was added to this list. Components to be included are:

1. Transmission
2. Alternator
3. Starter
4. Batteries
5. Windshield wiper motors

1.3-III. DISCUSSION

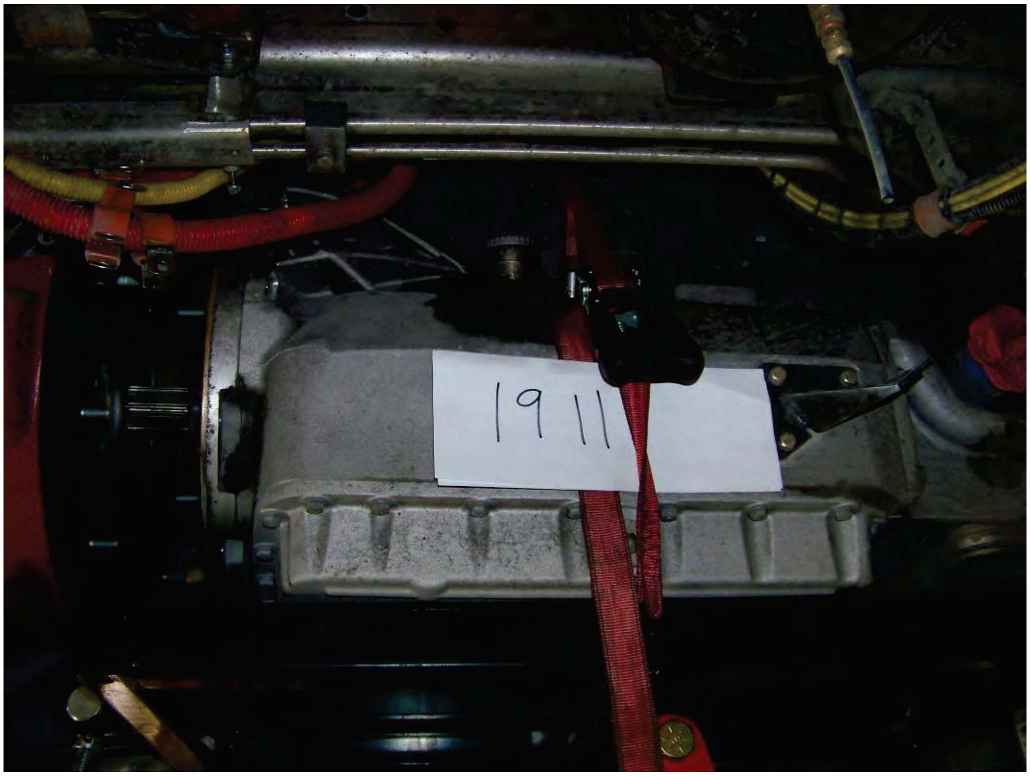
At the end of the test, the items on the list were removed and replaced. The transmission assembly took 6.00 labor-hours (3 persons @ 2.00 hrs) to remove and replace. The time required for repair/replacement of the other four components is given on the following Repair and/or Replacement Form.

REPLACEMENT AND/OR REPAIR FORM

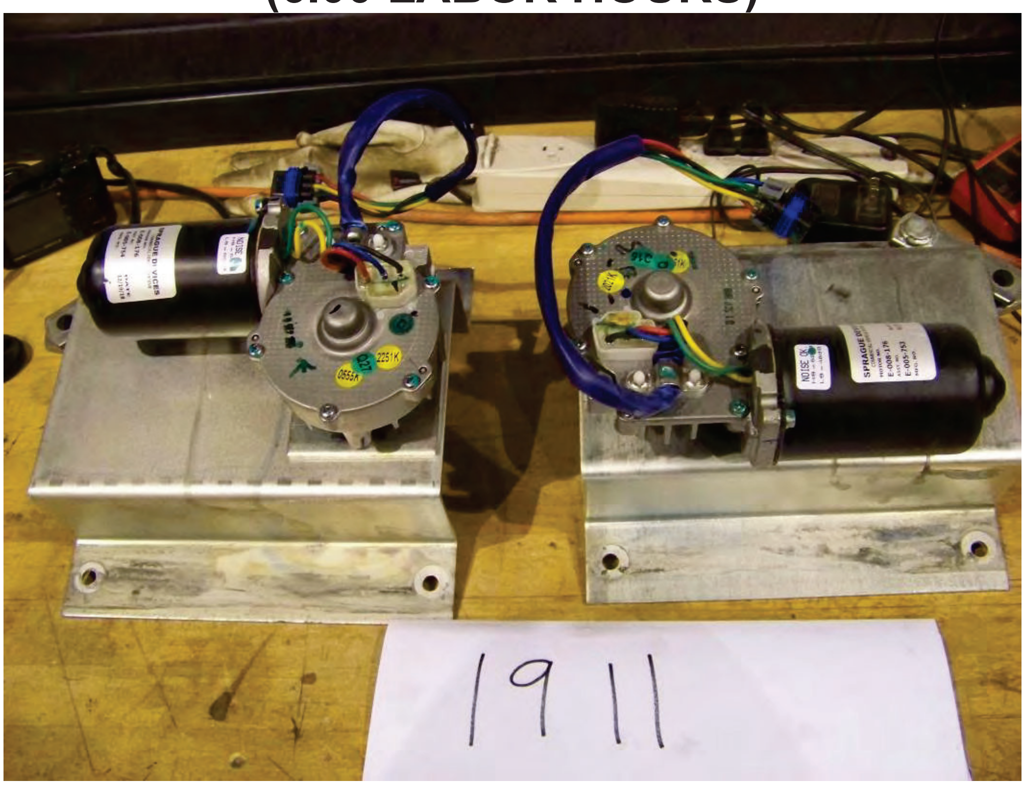
Subsystem	Replacement Time
Transmission	6.00 labor hours
(2) Wiper Motors	2.00 labor hours
Starter	1.00 labor hour
Alternator	2.00 labor hours
Batteries	1.00 labor hour

During the test, additional components were removed for repair or replacement and the details are available in Section 5.7 in Unscheduled Maintenance.

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS



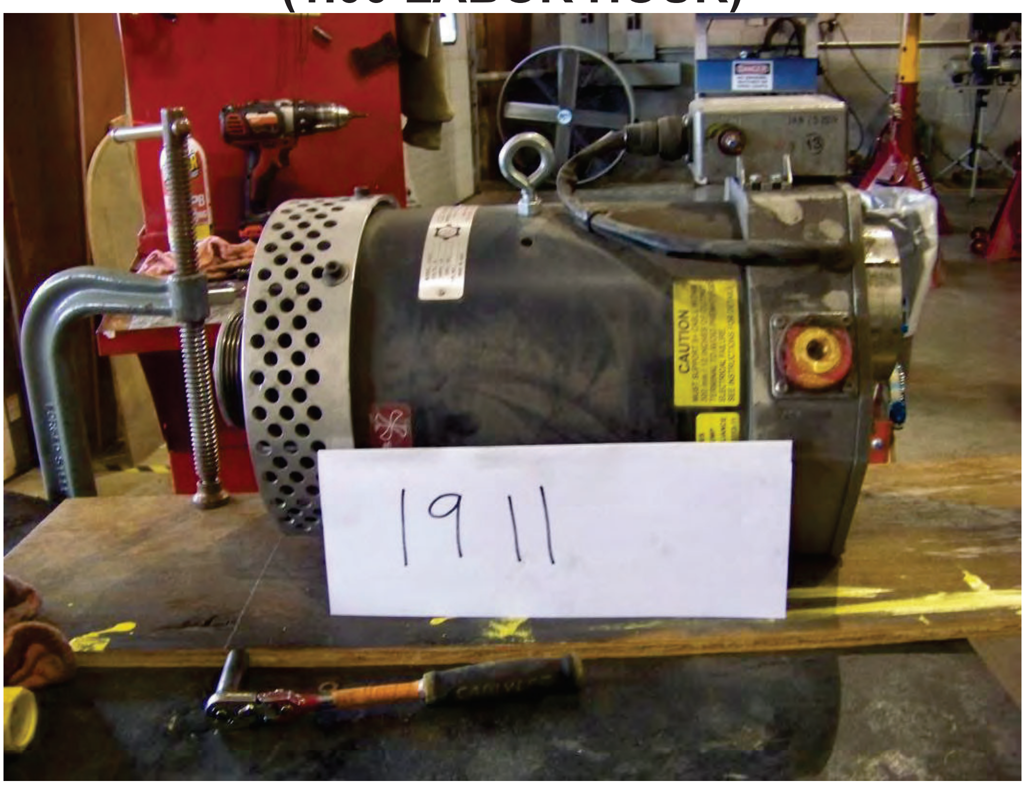
TRANSMISSION REMOVAL AND REPLACEMENT (6.00 LABOR HOURS)



WIPER MOTORS REMOVAL AND REPLACEMENT (2.00 LABOR HOURS)

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS CONT.

STARTER REMOVAL AND REPLACEMENT
(1.00 LABOR HOUR)



ALTERNATOR REMOVAL AND REPLACEMENT
(2.00 LABOR HOURS)

2. RELIABILITY - DOCUMENTATION OF BREAKDOWN AND REPAIR TIMES DURING TESTING

2-I. TEST OBJECTIVE

The objective of this test is to document unscheduled breakdowns, repairs, down time, and repair time that occur during testing.

2-II. TEST DESCRIPTION

Using the driver log and unscheduled work order forms, all significant breakdowns, repairs, labor-hours to repair, and hours out of service were recorded on the Reliability Data Form.

CLASS OF FAILURES

Classes of failures are described below:

(a) Class 1: Physical Safety. A failure that could lead directly to Injury, a crash and/or significant physical damage.

(b) Class 2: Road Call. A failure resulting in an en-route interruption of revenue service. Service is discontinued until the bus is replaced or repaired at the point of failure.

(c) Class 3: Bus Change. A failure that requires removal of the bus from service during its assignments. The bus is operable to a rendezvous point with a replacement bus.

(d) Class 4: Bad Order. A failure that does not require removal of the bus from service during its assignments but does degrade coach operation. The failure shall be reported by driver, inspector, or hostler.

2-III. DISCUSSION

A listing of breakdowns and unscheduled repairs was accumulated during the Structural Durability Test. The following Reliability Data Form lists all unscheduled repairs under classes as defined above.

The classification of repairs according to subsystem is intended to emphasize those systems which had persistent minor or more serious problems. There was a total of 4 failures, 1 involved the HVAC system and the other 3 involved the suspension of the bus. All four of the failures were listed as Class 4. These failures are available for review in the Unscheduled Maintenance List, located in Section 5.7 Structural Durability.

This bus passed the Structural and Powertrain Durability sections of the test.

RELIABILITY DATA FORMS

Bus Number : 1911	Date: 01/15/2020
Personnel: S.I.	

Failure Type			
Class 4 Bad Order	Class 3 Bus Change	Class 2 Road Call	Class 1 Physical Safety

Subsystems	Mileage	Mileage	Mileage	Mileage	Labor Hours	Down Time
HVAC	9,558				2.00	2.00
Suspension	10,976				4.00	4.00
	11,491				1.00	1.00
	11,491				2.00	2.00

3.1 SAFETY - A DOUBLE-LANE CHANGE (OBSTACLE AVOIDANCE)

3.1-I. TEST OBJECTIVE

The objective of this test is to determine handling and stability of the bus by measuring speed through a double lane change test.

3.1-II. TEST DESCRIPTION

The Safety Test consisted of an obstacle avoidance maneuver to evaluate the handling and stability of the bus. The test was conducted at the LTI test track on the vehicle dynamics pad. The bus was driven through a double-lane change course at increasing speeds until the test was determined to be unsafe or a speed of 45 mph is reached. The test is determined unsafe if vehicle handling becomes unstable or if any of the tires lose contact with the pavement.

The layout of the test course was defined by placing pylons along painted guidelines that delineated the course. The guidelines marked off two 12 foot center-to-center lanes. Each lane had two 100 foot long gates with a spacing distance of 100 feet between them. The bus entered the test course in one lane, crossed over to the other lane within the 100 foot gate, traveled for 100 feet, and then returned back into the original lane within the next 100 foot gate. This maneuver was repeated from 20 mph with speed increasing in increments of 5 mph. The test was performed starting from both the right and left lanes.

A test run is considered valid if the bus is able to perform the maneuver at a constant speed without deviating from the test course or striking pylons. If the bus is not able to successfully complete the maneuver due to vehicle instability, the test will be terminated. The highest speed at which the maneuver can be successfully performed up to a maximum speed of 45 mph is recorded on the Safety Data Form.

3.1-III. DISCUSSION

The double-lane change was performed in both right-hand and left-hand directions. The bus was able to safely negotiate the test course in both the right-hand and left-hand directions up to the maximum test speed of 45 mph, and therefore, passed this portion of the test.

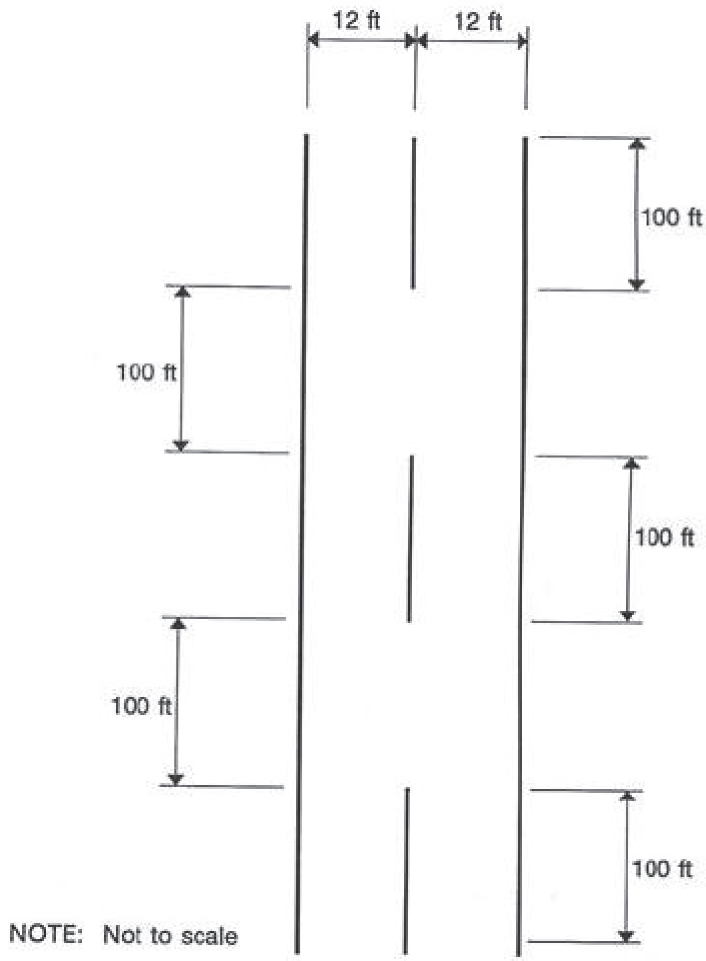


Figure 3.1. Double lane change test course

SAFETY DATA FORM

Page 1 of 1

Bus Number: 1911	Date: 09-13-19
Personnel: T.S., S.R. & M.H.	

Temperature (°F): 63	Humidity (%): 69
Wind Direction: SE	Wind Speed (mph): 6
Barometric Pressure (in.Hg): 30.34	

SAFETY TEST: DOUBLE LANE CHANGE	
Maximum safe speed tested for double-lane change to left	45 mph
Maximum safe speed tested for double-lane change to right	45 mph
Comments of the position of the bus during the lane change:	
The bus maintained a safe position throughout the test.	
Comments of the tire/ground contact patch:	
The bus maintained contact with the ground throughout the test.	

3.1 SAFETY

RIGHT - HAND APPROACH

LEFT - HAND APPROACH

3.2 Safety - Braking

3.2 I. TEST OBJECTIVE

The objective of this test is to provide, for comparison purposes, braking performance data on transit buses produced by different manufacturers.

3.2 II. TEST DESCRIPTION

The testing was conducted at the LTI Test Track skid pad area. Brake tests were conducted after completion of the GVW portion of the vehicle durability test. At this point in testing the brakes have been subjected to a large number of braking snubs and will be considered well burnished. Testing was performed when the bus was fully loaded at its GVW. All tires on each bus were representative of the tires on the production model vehicle and inflated to the bus manufacturer's specified pressures.

The brake testing procedure is comprised of three phases:

1. Stopping distance tests

   i. Dry surface (high-friction, Skid Number within the range of 70-76)
   ii. Wet surface (low-friction, Skid Number within the range of 30-36)

2. Stability tests
3. Parking brake test

3.2-III. DISCUSSION

The results of the Stopping Distance phase of the Brake Test are available in table 3.2-2. There was no deviation from the test lane during the performance of the Stopping Distance phase. The bus passed this portion of the test.

During the Stability phase of Brake Testing the test bus experienced no deviation from the test lane during both approaches to the Split Friction Road surface.

The Parking Brake phase was completed with the test bus maintaining the parked position for the full five minute period with no slip or roll observed in both the uphill and downhill positions.

This bus passed all three phases of the Safety –Braking Test.

Table 3.2-1. Braking Test Data Forms

Page 1 of 3

Bus Number: 1911	Date: 07-19-19
Personnel: S.R., E.D. & E.L.	
Amb. Temperature (°F): 84	Wind Speed (mph): 9
Wind Direction: SW	Pavement Temp (°F) Start: 96 End: 98

TIRE INFLATION PRESSURE (psi):				
Tire Type: Goodyear Metro Miler Front: 305 / 85R / 22.5			Tire Type: Goodyear Metro Miler Rear: 305 / 85R / 22.5	
	Left Tire(s)		Right Tire(s)	
Front	110		110	
	Inner	Outer	Inner	Outer
Middle	N/A	N/A	N/A	N/A
Rear	110	110	110	110

AXLE LOADS (lb.)		
	Left	Right
Front	7,600	7,620
Middle	N/A	N/A
Rear	13,910	12,370

Table 3.2-2. Stopping Distance Test Results Form
(longest stopping distance in each test condition in bold)

Stopping Distance (ft)					
Vehicle Direction	CW	CW	CCW	CCW	
Speed (mph)	Stop 1	Stop 2	Stop 3	Stop 4	**Average**
20 (dry)	28.73	22.20	26.24	**29.25**	26.60
30 (dry)	47.33	47.78	**52.34**	49.36	49.20
40 (dry)	78.45	71.37	**94.62**	71.79	79.05
45 (dry)	109.74	91.31	**113.25**	106.53	105.20
20 (wet)	**34.66**	31.98	29.61	31.19	31.86

Table 3.2-3. Stability Test Results Form

Stability Test Results (Split Friction Road surface)			
Vehicle Direction	Attempt	Did test bus stay in 12' lane? (Yes/No)	Comments
Driver side on high friction	1	Yes	None noted
	2	Yes	None noted
Driver side on low friction	1	Yes	None noted
	2	Yes	None noted

Table 3.2-4. Parking Brake Test Form

PARKING BRAKE (Fully Loaded) – GRADE HOLDING						
Vehicle Direction	Attempt	Hold Time (min)	Slide (in)	Roll (in)	Did Hold	No Hold
Front up	1	5:00	N/A	N/A	✓	
	2	N/A	N/A	N/A		
	3	N/A	N/A	N/A		
Front down	1	5:00	N/A	N/A	✓	
	2	N/A	N/A	N/A		
	3	N/A	N/A	N/A		

Table 3.2-5. Record of All Braking System Faults/Repairs.

Date	Fault/Repair	Description
07/19/2019	None Noted	N/A

3.2 Safety - Bus Braking

PARKING BRAKE TEST
PARKING BRAKE HELD FOR 5 MINUTES IN BOTH 20% UP AND 20% DOWN POSITIONS

4. PERFORMANCE - AN ACCELERATION, GRADEABILITY, AND TOP SPEED TEST

4-I. TEST OBJECTIVE

The objective of this test is to determine the acceleration, gradeability, and top speed capabilities of the bus.

4-II. TEST DESCRIPTION

In this test, the bus was operated at SLW on a chassis dynamometer. The procedure dictates that the test bus be accelerated to a maximum “power-limited”/”governed” or maximum “safe” speed not exceeding 80 mph. The maximum power-limited/governed speed, if applicable, is the top speed as limited by the engine control system. The maximum safe speed is defined as the maximum speed that the dynamometer, the tires or other bus components are limited to. The test vehicle speed was measured using a speed encoder built in the chassis dynamometer. The time intervals between 10 mph increments were recorded using a Data Acquisitions System. Time-speed data and the top speed attained were recorded on the Performance Data Form. The recorded data was used to generate a percent grade versus speed table and a speed versus time curve. All the above are available in the following pages.

4-III. DISCUSSION

This test consisted of three runs from standstill to full throttle on the chassis dynamometer. Speed versus time data was obtained for each run and results are averaged to minimize test variability. The test was performed up to a maximum safe speed of 55.9 mph. The calculated gradeability results are attached. The average time to reach 30 mph was 14.3 seconds. The maximum gradeablity at 10 mph was 27.95% and at 40 mph was 4.35%. This bus passed this section of the test.

PERFORMANCE DATA FORM

Bus Number: 1911	Date: 11/26/19
Personnel: S.I. / J.S.	

Temperature (°F): 74.3	Humidity (%): 32
Barometric Pressure (in.Hg): 28.5	

		INITIALS:
Air Conditioning - OFF	✓Checked	J.S.
Heater pump motor - OFF	✓Checked	J.S.
Defroster - OFF	✓ Checked	J.S.
Exterior and interior lights - ON	✓ Checked	J.S.
Windows and doors - CLOSED	✓ Checked	J.S.

ACCELERATION, GRADEABILITY, TOP SPEED

Recorded Interval Times			
Speed	Run 1	Run 2	Run 3
10 mph	3.7	3.5	3.4
20 mph	7.2	7.2	7.4
30 mph	14.2	14.2	14.5
40 mph	23.0	22.9	23.3
50 mph	35.7	35.7	36.2

Maximum Speed (mph): 55.9 (maximum safe dynamometer speed reached)

PERFORMANCE SUMMARY SHEET

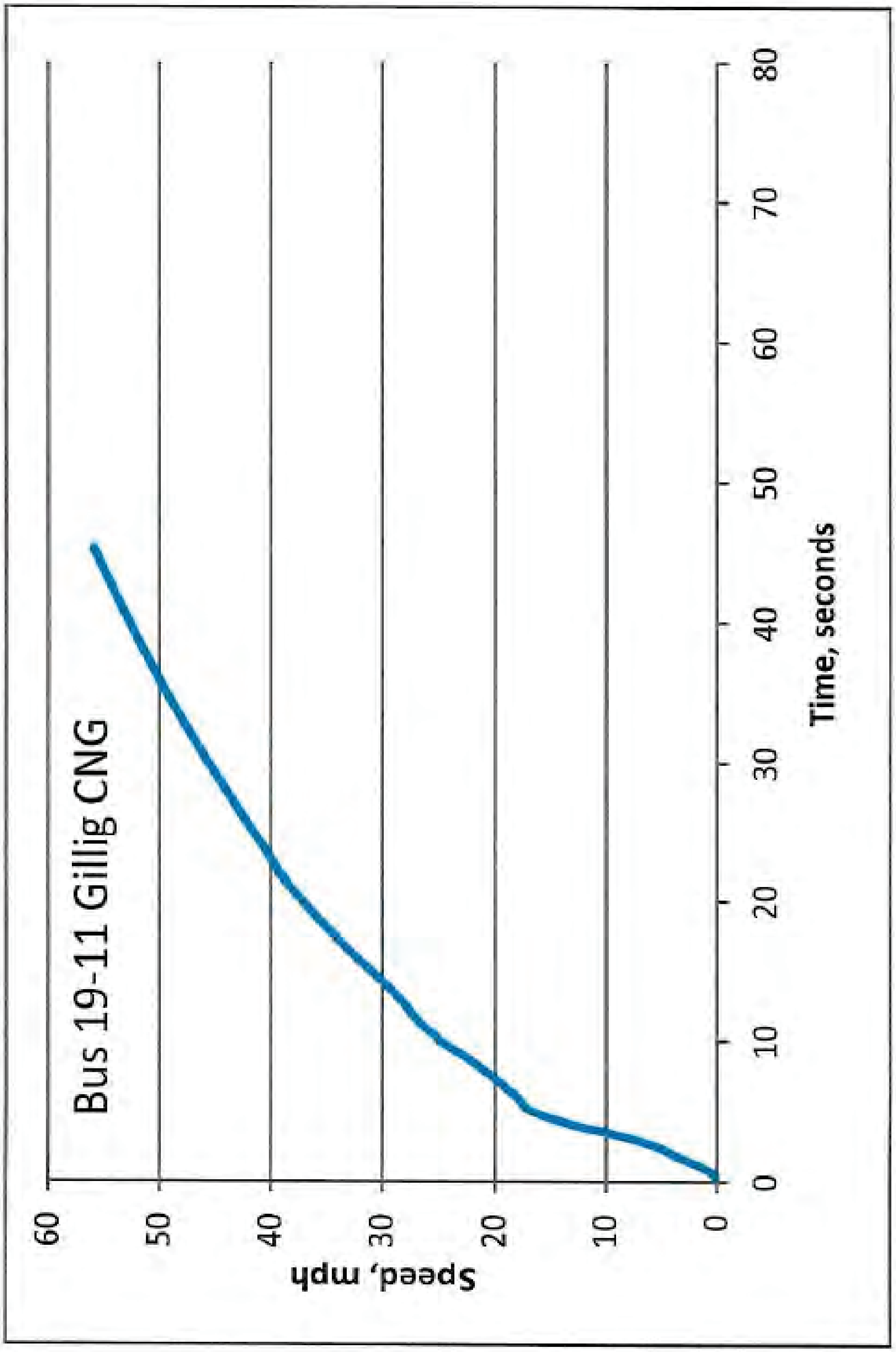
Bus Number: 1911	Date: 11/26/19
Personnel: S.I. & J.S.	

Test Conditions:

Temperature (°F): 74.3	Humidity (%): 32
Barometric Pressure (in.Hg): 28.5	

Test Results:

Vehicle Speed (MPH)	Time (SEC)	Acceleration (FT/SEC^2)	Max. Grade (%)
1.0	0.9	3.73	11.58
5.0	2.3	4.11	12.76
10.0	3.5	9.00	27.95
15.0	4.5	5.56	17.27
20.0	7.3	2.26	7.02
25.0	10.2	2.16	6.71
30.0	14.3	1.89	5.87
35.0	18.2	1.84	5.71
40.0	23.1	1.40	4.35
45.0	29.2	1.16	3.60
50.0	35.9	1.0	3.11
55.0	43.7	0.84	2.61
55.9	45.3	Maximum Speed	


Bus 19-11 Gillig CNG
Speed, mph
0
10
20
30
40
50
60
Time, seconds
0
10
20
30
40
50
60
70
80

5.2 STRUCTURAL STRENGTH AND DISTORTION TESTS - STRUCTURAL DISTORTION

5.2-I. TEST OBJECTIVE

The objective of this test is to observe the operation of the bus subsystems when the bus is placed in a longitudinal twist simulating operation over a curb or through a pothole.

5.2-II. TEST DESCRIPTION

With the bus loaded to GVW, each wheel of the bus was raised (one at a time) to simulate operation over a curb and the following were inspected:

1. Body
2. Windows
3. Doors
4. Roof vents
5. Special seating
6. Undercarriage
7. Engine
8. Service doors
9. Escape hatches
10. Steering mechanism

Each wheel was then lowered (one at a time) to simulate operation through a pothole and the same items inspected.

5.2-III. DISCUSSION

The test sequence was repeated ten times. The first and last test is with all wheels level. The other eight tests are with each wheel 6 inches higher and 6 inches lower than the other three wheels.

All doors, windows, escape mechanisms, engine, steering and ADA accessible devices operated normally throughout the test. The undercarriage and body indicated no deficiencies. No water leakage was observed during the test. The results of this test are indicated on the following data forms. This bus passed this section of the test.

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Page 1 of 10

Bus Number: 1911	Date: 07/03/19
Personnel: E.D.,E.L.,P.D.,J.P.& T.G.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	■ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
Windows	No Deficiencies
Front Doors	No Deficiencies
Rear Doors	No Deficiencies
Escape Mechanisms/ Roof Vents	No Deficiencies
Engine	No Deficiencies
ADA Accessible/ Special Seating	No Deficiencies
Undercarriage	No Deficiencies
Service Doors	No Deficiencies
Body	No Deficiencies
Windows/ Body Leakage	No Deficiencies
Steering Mechanism	No Deficiencies

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Bus Number: 1911	Date: 07/03/19
Personnel: E.D.,E.L., P.D.,J.P. & T.G.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	☐ before	☐ after
Left front	■ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies
Front Doors	No Deficiencies
Rear Doors	No Deficiencies
Escape Mechanisms/ Roof Vents	No Deficiencies
Engine	No Deficiencies
ADA Accessible/ Special Seating	No Deficiencies
Undercarriage	No Deficiencies
Service Doors	No Deficiencies
Body	No Deficiencies
Windows/ Body Leakage	No Deficiencies
Steering Mechanism	No Deficiencies

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Page 3 of 10

Bus Number: 1911	Date: 07/03/19
Personnel: E.D.,E.L.,P.D., J.P. & T.G.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	■ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies
Front Doors	No Deficiencies
Rear Doors	No Deficiencies
Escape Mechanisms/ Roof Vents	No Deficiencies
Engine	No Deficiencies
ADA Accessible/ Special Seating	No Deficiencies
Undercarriage	No Deficiencies
Service Doors	No Deficiencies
Body	No Deficiencies
Windows/ Body Leakage	No Deficiencies
Steering Mechanism	No Deficiencies

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Bus Number: 1911	Date: 07/03/19
Personnel: E.D.,E.L.,P.D., J.P. & T.G.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	■ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies
Front Doors	No Deficiencies
Rear Doors	No Deficiencies
Escape Mechanisms/ Roof Vents	No Deficiencies
Engine	No Deficiencies
ADA Accessible/ Special Seating	No Deficiencies
Undercarriage	No Deficiencies
Service Doors	No Deficiencies
Body	No Deficiencies
Windows/ Body Leakage	No Deficiencies
Steering Mechanism	No Deficiencies

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Page 5 of 10

Bus Number: 1911	Date: 07/03/19
Personnel: E.D.,E.L.,P.D., J.P. & T.G.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	■ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies
Front Doors	No Deficiencies
Rear Doors	No Deficiencies
Escape Mechanisms/ Roof Vents	No Deficiencies
Engine	No Deficiencies
ADA Accessible/ Special Seating	No Deficiencies
Undercarriage	No Deficiencies
Service Doors	No Deficiencies
Body	No Deficiencies
Windows/ Body Leakage	No Deficiencies
Steering Mechanism	No Deficiencies

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Bus Number: 1911	Date: 07/03/19
Personnel: E.D.,E.L.,P.D., J.P. & T.G.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	■ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies
Front Doors	No Deficiencies
Rear Doors	No Deficiencies
Escape Mechanisms/ Roof Vents	No Deficiencies
Engine	No Deficiencies
ADA Accessible/ Special Seating	No Deficiencies
Undercarriage	No Deficiencies
Service Doors	No Deficiencies
Body	No Deficiencies
Windows/ Body Leakage	No Deficiencies
Steering Mechanism	No Deficiencies

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Page 7 of 10

Bus Number: 1911	Date: 07/03/19
Personnel: E.D.,E.L.,P.D., J.P. & T.G.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	■ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies
Front Doors	No Deficiencies
Rear Doors	No Deficiencies
Escape Mechanisms/ Roof Vents	No Deficiencies
Engine	No Deficiencies
ADA Accessible/ Special Seating	No Deficiencies
Undercarriage	No Deficiencies
Service Doors	No Deficiencies
Body	No Deficiencies
Windows/ Body Leakage	No Deficiencies
Steering Mechanism	No Deficiencies

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Bus Number: 1911	Date: 07/03/19
Personnel: E.D.,E.L.,P.D., J.P. & T.G.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	■ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies
Front Doors	No Deficiencies
Rear Doors	No Deficiencies
Escape Mechanisms/ Roof Vents	No Deficiencies
Engine	No Deficiencies
ADA Accessible/ Special Seating	No Deficiencies
Undercarriage	No Deficiencies
Service Doors	No Deficiencies
Body	No Deficiencies
Windows/ Body Leakage	No Deficiencies
Steering Mechanism	No Deficiencies

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 1911	Date: 07/03/19
Personnel: E.D.,E.L.,P.D., J.P. & T.G.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	☐ before	☐ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	■ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies
Front Doors	No Deficiencies
Rear Doors	No Deficiencies
Escape Mechanisms/ Roof Vents	No Deficiencies
Engine	No Deficiencies
ADA Accessible/ Special Seating	No Deficiencies
Undercarriage	No Deficiencies
Service Doors	No Deficiencies
Body	No Deficiencies
Windows/ Body Leakage	No Deficiencies
Steering Mechanism	No Deficiencies

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Bus Number: 1911	Date: 07/03/19
Personnel: E.D.,E.L.,P.D., J.P. & T.G.	Temperature(°F): 78

Wheel Position : (check one)		
All wheels level	☐ before	■ after
Left front	☐ 6 in higher	☐ 6 in lower
Right front	☐ 6 in higher	☐ 6 in lower
Right rear	☐ 6 in higher	☐ 6 in lower
Left rear	☐ 6 in higher	☐ 6 in lower
Right center	☐ 6 in higher	☐ 6 in lower
Left center	☐ 6 in higher	☐ 6 in lower

	Comments
Windows	No Deficiencies
Front Doors	No Deficiencies
Rear Doors	No Deficiencies
Escape Mechanisms/ Roof Vents	No Deficiencies
Engine	No Deficiencies
ADA Accessible/ Special Seating	No Deficiencies
Undercarriage	No Deficiencies
Service Doors	No Deficiencies
Body	No Deficiencies
Windows/ Body Leakage	No Deficiencies
Steering Mechanism	No Deficiencies

5.2 STRUCTURAL DISTORTION TEST

LEFT REAR WHEELS SIX INCHES LOWER

RIGHT REAR WHEELS SIX INCHES LOWER

5.3 STRUCTURAL STRENGTH AND DISTORTION TESTS - STATIC TOWING TEST

5.3-I. TEST OBJECTIVE

The objective of this test is to determine the characteristics of the bus towing mechanisms under static loading conditions.

5.3-II. TEST DESCRIPTION

Utilizing a load-distributing yoke, a hydraulic cylinder was used to apply a static tension load equal to 1.2 times the bus curb weight. The load was applied to both the front and rear, if applicable, towing fixtures at an angle of 20 degrees with the longitudinal axis of the bus, first to one side then the other in the horizontal plane, and then upward and downward in the vertical plane. Any permanent deformation or damage to the tow eyes or adjoining structure was recorded.

5.3-III. DISCUSSION

The test bus submitted for testing was not equipped with any type of tow eyes or tow hooks. Therefore, the static towing test was not performed. This bus is deemed to pass this section of the test, but no points were allotted for this section.

5.4 STRUCTURAL STRENGTH AND DISTORTION TESTS - DYNAMIC TOWING TEST

5.4-I. TEST OBJECTIVE

The objective of this test is to verify the integrity of the towing fixtures and determine the feasibility of towing the bus under manufacturer specified procedures.

5.4-II. TEST DESCRIPTION

This test required the bus to be towed at curb weight using the specified equipment and instructions provided by the manufacturer and a heavy-duty wrecker. The bus was towed for 5 miles at a speed of 20 mph for each recommended towing configuration. After releasing the bus from the wrecker, the bus was visually inspected for any structural damage or permanent deformation. All doors, windows and passenger escape mechanisms were inspected for proper operation.

5.4-III. DISCUSSION

The bus was towed using a heavy-duty wrecker. The towing interface was accomplished by incorporating a hydraulic under-lift. A front lift tow was performed. No problems, deformation, or damage was noted during testing. This bus passed this section of the test.

DYNAMIC TOWING TEST DATA FORM

Page 1 of 1

Bus Number: 1911	Date: 10/03/19
Personnel: S.R.,E.D.&P.D.	

Temperature (°F): 56	
Wind Direction: NE	Wind Speed (mph): 5

Inspect tow equipment-bus interface.
Comments: An adequate connection between tow equipment and bus was made
Using a wheel lift.
Inspect tow equipment-wrecker interface.
Comments: An adequate connection between tow equipment and wrecker.
Towing Comments: Full tow test was done using a wheel lift.
Description and location of any structural damage: None noted
General Comments: None noted

5.4 DYNAMIC TOWING TEST

TOWING INTERFACE

TEST BUS IN TOW

5.5 STRUCTURAL STRENGTH AND DISTORTION TESTS – JACKING TEST

5.5-I. TEST OBJECTIVE

The objective of this test is to inspect for damage due to the deflated tire, and determine the feasibility of jacking the bus with a portable hydraulic jack to a height sufficient to replace a deflated tire.

5.5-II. TEST DESCRIPTION

With the bus at curb weight, the tire(s) at one corner of the bus were replaced with deflated tire(s) of the appropriate type. A portable hydraulic floor jack was then positioned in a manner and location specified by the manufacturer and used to raise the bus to a height sufficient to provide 3-in clearance between the floor and an inflated tire. The deflated tire(s) were replaced with the original tire(s) and the jack was lowered. Any structural damage or permanent deformation was recorded on the test data sheet. This procedure was repeated for each corner of the bus.

5.5-III. DISCUSSION

During the deflated portion of the test, the jacking point clearances ranged from 4.9 inches to 13.9 inches. No deformation or damage was observed during testing. A complete listing of jacking point clearances is provided in the Jacking Test Data Form. This bus passed this section of the test.

JACKING CLEARANCE SUMMARY

Condition	Frame Point Clearance
Front axle – one tire flat	10.1
Rear axle – one tire flat	13.4
Rear axle – two tires flat	9.9

JACKING TEST DATA FORM

Bus Number: 1911	Date: 07/02/19
Personnel: E.D.,S.R. & E.L.	Temperature (°F): 74

Record any permanent deformation or damage to bus as well as any difficulty encountered during jacking procedure.

I= Inflated D= Deflated

Deflated Tire	Jacking Pad Clearance Body/Frame (in)	Jacking Pad Clearance Axle/Suspension (in)	Comments
Right front	12.9 “ I 10.1 “ D	8.7 “ I 6.0 ” D	Body & Axle
Left front	12.1 “ I 10.6 “ D	8.6 “ I 5.6 “ D	Body & Axle
Right rear—outside	14.7 “ I 13.9 “ D	8.3 “ I 7.6 “ D	Body & Suspension
Right rear—both	14.7 “ I 9.9 “ D	8.3 “ I 4.9 “ D	Body & Suspension
Left rear—outside	14.4 “ I 13.4 “ D	8.1 “ I 7.5 “ D	Body & Suspension
Left rear—both	14.4 “ I 10.9 “ D	8.1 “ I 5.5 “ D	Body & Suspension
Right middle or tag—outside	N/A	N/A	N/A
Right middle or tag—both	N/A	N/A	N/A
Left middle or tag—outside	N/A	N/A	N/A
Left middle or tag—both	N/A	N/A	N/A

Additional comments of any deformation or difficulty during jacking:

None noted

5.5 JACKING TEST

JACK IN PLACE-FRONT

JACK IN PLACE-REAR

5.6 STRUCTURAL STRENGTH AND DISTORTION TESTS - HOISTING TEST

5.6-I. TEST OBJECTIVE

The objective of this test is to determine possible damage or deformation caused by the jack/stands.

5.6-II. TEST DESCRIPTION

With the bus at curb weight, the front end of the bus was raised to a height sufficient to allow manufacturer-specified placement of jack stands under the axles or jacking pads independent of the hoist system. The bus was checked for stability on the jack stands and for any damage to the jacking pads or bulkheads. The procedure was repeated for the tag/middle axles (if equipped), and rear end of the bus. The procedure was then repeated for the front, tag/middle (if equipped) axles, and rear simultaneously.

5.6-III. DISCUSSION

The test was conducted using four posts of a six-post electric lift and 19 inch jack stands. The bus was hoisted from the front wheels and then from the rear wheels, and then from the front and rear wheels simultaneously and placed on jack stands.

The bus accommodated the placement of the vehicle lifts and jack stands and the procedure was performed without any instability noted. This bus passed this section of the test.

HOISTING TEST DATA FORM

Page 1 of 1

Bus Number: 1911	Date: 06/27/19
Personnel: S.R. & E.D.	Temperature (°F): 87

Comments of any structural damage to the jacking pads or axles while both the front wheels are supported by the jack stands:
None noted
Comments of any structural damage to the jacking pads or axles while both the rear wheels are supported by the jack stands:
None noted
Comments of any structural damage to the jacking pads or axles while both the tag axle wheels are supported by the jack stands:
N/A
Comments of any structural damage to the jacking pads or axles while the front, tag axle and rear wheels are supported by the jack stands:
None noted
Comments of any problems or interference placing wheel hoists under wheels:
None noted

5.6 HOISTING TEST

JACK STANDS IN PLACE-FRONT OF BUS

JACK STANDS IN PLACE-FRONT AND REAR OF BUS

5.7 STRUCTURAL DURABILITY TEST

5.7-I. TEST OBJECTIVE

The objective of this test is to perform an accelerated durability test that approximates 25 percent of the service life of the vehicle.

5.7-II. TEST DESCRIPTION

The test vehicle was driven a total of 15,000 miles; approximately 12,500 miles on the LTI Durability Test Track and approximately 2,500 miscellaneous other miles. The test was conducted with the bus operated under three different loading conditions. The first segment consisted of approximately 6,250 miles with the bus operated at GVW. The second segment consisted of approximately 2,500 miles with the bus operated at SLW. The remainder of the test, approximately 6,250 miles, was conducted with the bus loaded to CW. The loads on both axles and GVW were within their ratings with the bus loaded as specified by the manufacturer. All subsystems were running during these tests in their normal operating modes. All manufacturer-recommended servicing was followed and noted on the vehicle maintainability log. Servicing items accelerated by the durability tests were compressed by 10:1; all others were done on a 1:1 mi/mi basis. Unscheduled breakdowns and repairs were recorded on the same log as are any unusual occurrences as noted by the driver. Once a week the test vehicle was washed down and thoroughly inspected for any signs of failure.

5.7-III. DISCUSSION

The Structural Durability Test was started on July 3, 2019 and was conducted until December 2, 2019. The first 6,250 miles were performed at a GVW of 41,500 lb. and completed on September 13, 2019. The next 2,500-mile SLW segment was performed at 36,830 lb. and completed on September 30, 2019 and the final 6,250-mile segment was performed at a CW of 30,670 lb. and completed on December 2, 2019.

The following mileage summary presents the accumulation of miles during the Structural Durability Test. The driving schedule is included, showing the operating duty cycle. A detailed plan view of the LTI Test Track Facility and Durability Test Track are attached for reference. Also, a durability element profile detail shows all the measurements of the different conditions. Finally, photographs illustrating some of the failures that were encountered during the Structural Durability Test are included. This bus passed this section of the test, as there were no uncorrected Class 1 or Class 2 failures and the unscheduled maintenance of 9 hours was less than 125 hours.

Gillig, LLC Bus # 1911

MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
07/01/19 TO 07/07/19	61.00	53.00	114.00
07/08/19 TO 07/14/19	467.00	73.00	540.00
07/15/19 TO 07/21/19	325.00	104.00	429.00
07/22/19 TO 07/28/19	309.00	37.00	346.00
07/29/19 TO 08/04/19	416.00	61.00	477.00
08/05/19 TO 08/11/19	731.00	94.00	825.00
08/12/19 TO 08/18/19	567.00	93.00	660.00
08/19/19 TO 08/25/19	572.00	92.00	664.00
08/26/19 TO 09/01/19	719.00	94.00	813.00
09/02/19 TO 09/08/19	544.00	161.00	705.00
09/09/19 TO 09/15/19	655.00	110.00	765.00
09/16/19 TO 09/22/19	747.00	144.00	891.00
09/23/2019 TO 09/29/19	932.00	217.00	1149.00
09/30/19 TO 10/06/19	1008.00	154.00	1162.00
10/07/19 TO 10/13/19	528.00	112.00	640.00

Gillig, LLC Bus # 1911

MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
10/14/19 TO 10/20/19	1065.00	111.00	1176.00
10/21/19 TO 10/27/19	546.00	65.00	611.00
10/28/19 TO 11/03/19	683.00	49.00	732.00
11/04/19 TO 11/10/19	774.00	77.00	851.00
11/11/19 TO 11/17/19	851.00	523.00	1374.00
11/18/19 TO 11/24/19	0.00	0.00	0.00
11/25/19 TO 12/01/19	0.00	79.00	79.00
12/02/19 TO 12/08/19	0.00	48.00	48.00
TOTAL	12500.00	2551.00	15051.00

Driving Schedule for Bus Operation on the Durability Test Track.

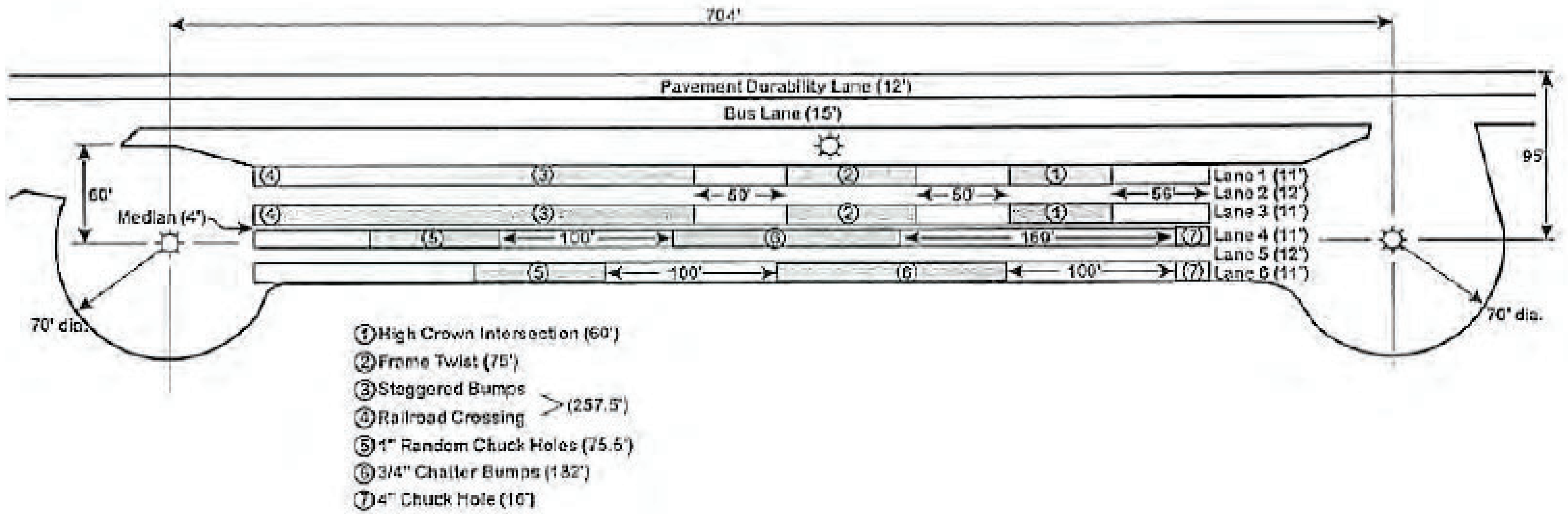
STANDARD OPERATING SCHEDULE

Monday through Friday

	HOUR	ACTION
Shift 1	midnight	D
	1:40 am	C
	1:50 am	B
	2:00 am	D
	3:35 am	C
	3:45 am	B
	4:05 am	D
	5:40 am	C
	5:50 am	B
	6:00 am	D
	7:40 am	C
	7:50 am	F
Shift 2	8:00 am	D
	9:40 am	C
	9:50 am	B
	10:00 am	D
	11:35 am	C
	11:45 am	B
	12:05 pm	D
	1:40 pm	C
	1:50 pm	B
	2:00 pm	D
	3:40 pm	C
	3:50 pm	F
Shift 3	4:00 pm	D
	5:40 pm	C
	5:50 pm	B
	6:00 pm	D
	7:40 pm	C
	7:50 pm	B
	8:05 pm	D
	9:40 pm	C
	9:50 pm	B
	10:00 pm	D
	11:40 pm	C
	11:50 pm	F

B—Break
C---Cycle all systems five times, visual inspection, driver's log entries
D—Drive bus as specified by procedure
F----Fuel bus, complete driver's log shift entries


Full-Scale Research Facilities at
the Pennsylvania Transportation Institute
Brake Slope
Large Impact Pendulum
1-Mile Oval
Vehicle Durability Course
Crash Safety Research Facility
Modified Durability Course
Vehicle Handling Area
Vehicle Research and Testing Lab
Fueling
Office Building
Bridge Research Facility
Entrance Road



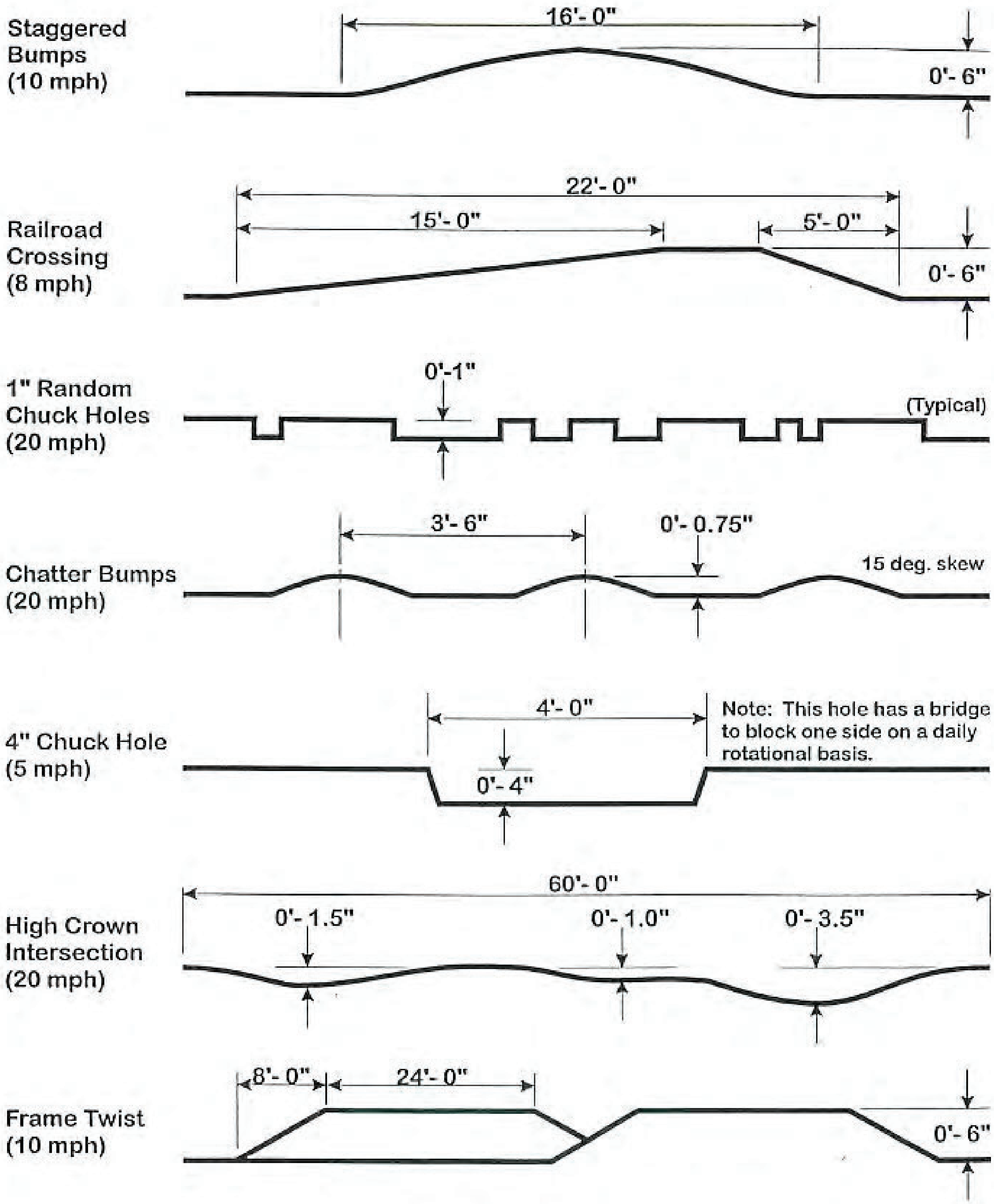
Plan View

Vehicle Durability Test Track

Track 1 (Track 2 has similar layout)

The Larson Transportation Institute

Penn State



Durability Element Profiles

The Pennsylvania Transportation Institute
Penn State

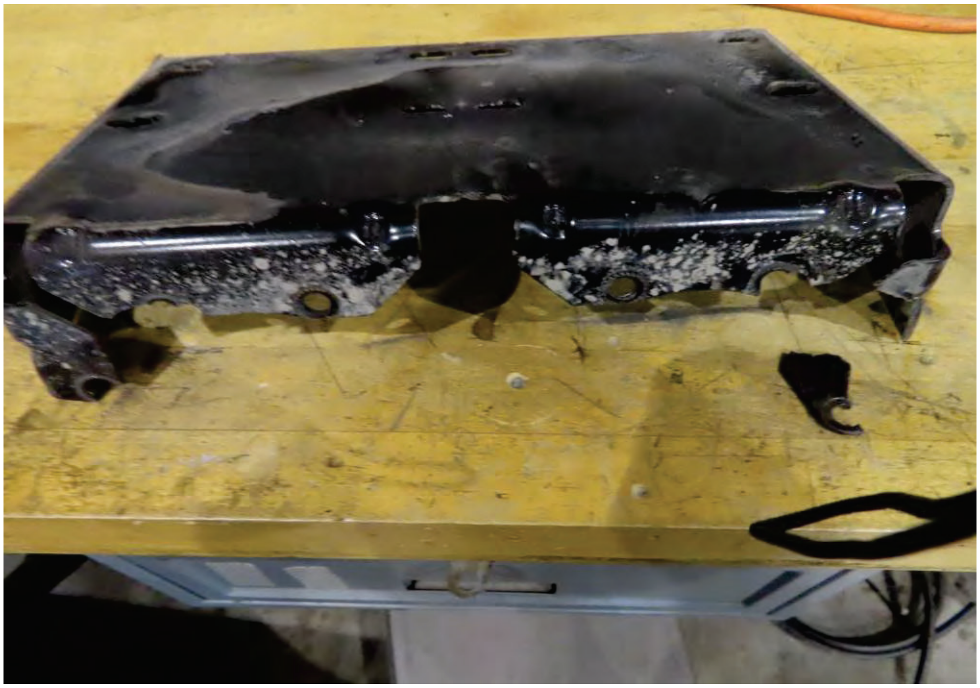
(Page 1 of 1)

UNSCHEDULED MAINTENANCE

Gillig, LLC Bus# 1911

DATE	TEST MILES	ISSUE	ACTION	LABOR HOURS	DOWN TIME
10/09/19	9,558	Air dryer bracket is cracked.	Removed and replaced air dryer bracket.	2.00	2.00
10/17/19	10,976	Driver's side front air bag is leaking.	Replaced driver's side front air bag.	4.00	4.00
10/21/19	11,491	Rubber is completely missing from front bump stops.	Found broken huck bolt on streetside rear suspension that bolts to main frame. New bump stops and 5/8" bolt were installed.	1.00	1.00
10/23/19	11,491	Front shocks are leaking and lower shock bushings are damaged.	Replaced both front shocks.	2.00	2.00

UNSCHEDULED MAINTENANCE



AIR DRYER BRACKET IS CRACKED
(9,558 TEST MILES)

DRIVER'S SIDE FRONT AIR BAG LEAKING
(10,976 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.

BROKEN HUCK BOLT REPLACED
(11,491 TEST MILES)

FRONT SHOCK LEAKING
(11,491 TEST MILES)

6. FUEL ECONOMY TEST - A FUEL CONSUMPTION TEST USING AN APPROPRIATE OPERATING CYCLE

6-I. TEST OBJECTIVE

The objective of this test is to provide accurate comparable fuel consumption data on transit buses produced by different manufacturers. This fuel economy test bears no relation to the calculations done by the Environmental Protection Agency (EPA) to determine levels for the Corporate Average Fuel Economy Program. EPA's calculations are based on tests conducted under laboratory conditions intended to simulate city and highway driving. This fuel economy test, as designated here, is a measurement of the fuel expended by a vehicle traveling a specified test operating profile, under specified operating conditions that are typical of transit bus operation. The results of this test may not represent actual mileage in transit service, but will provide data that can be used by FTA Grantees to compare the efficiency of buses tested using this procedure.

6-II. TEST DESCRIPTION

This test was performed in the emissions bay of the LTI Vehicle Testing Laboratory. The Laboratory is equipped with a Schenk Pegasus 300 HP, large-roll (72 inch diameter) chassis dynamometer suitable for heavy-vehicle emissions testing. The driving cycles are the Manhattan cycle, a low average speed, highly transient urban cycle (Figure 1), the Orange County Bus Cycle, a medium average speed transient urban cycle (Figure 2), and the EPA HD-UDDS Cycle, which consists of urban and highway driving segments (Figure 3). A fuel economy test was comprised of two runs for the three different driving cycles, and the average value was reported.

For gaseous fuels, like compressed natural gas (CNG), liquefied natural gas (LNG), cryogenic fuels, and other fuels in the vapor state, a calibrated gaseous flowmeter will be used to determine the fuel consumption. The pressure and temperature across the flow element will be monitored by the flow computer. The flow computer will use this data to calculate the gas flow rate. The flow computer will also display the flow rate (scfm) as well as the total fuel used (scf). The total fuel used (scf) for each test will be recorded on the Fuel Economy Data Form.

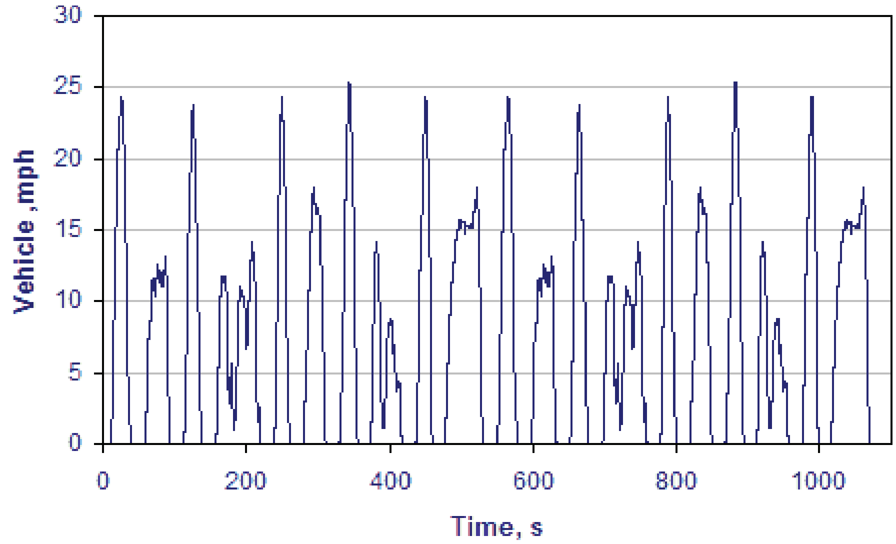


Figure 1. Manhattan Driving Cycle (duration 1089 sec, Maximum speed 25.4 mph, average speed 6.8 mph)

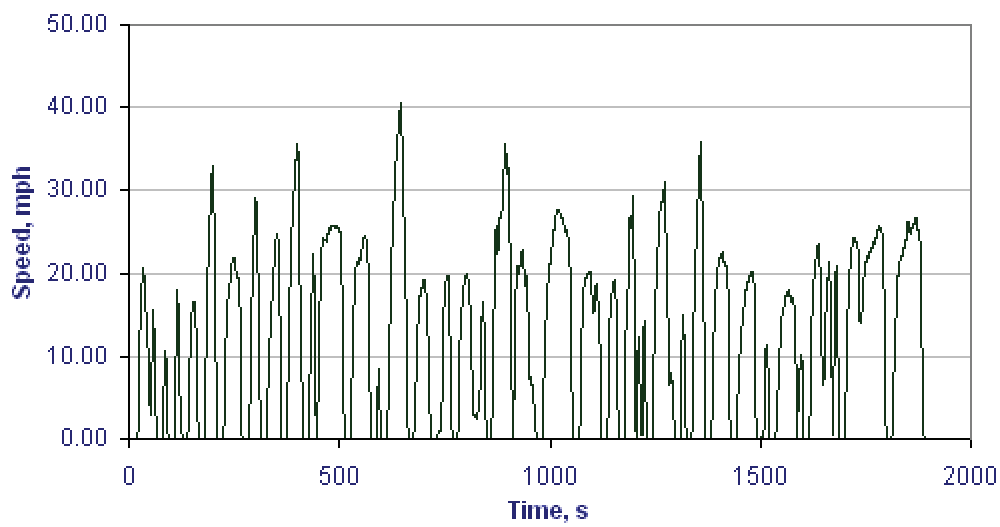


Figure 2. Orange County Bus Cycle (Duration 1909 Sec, Maximum Speed 41 mph, Average Speed 12 mph).

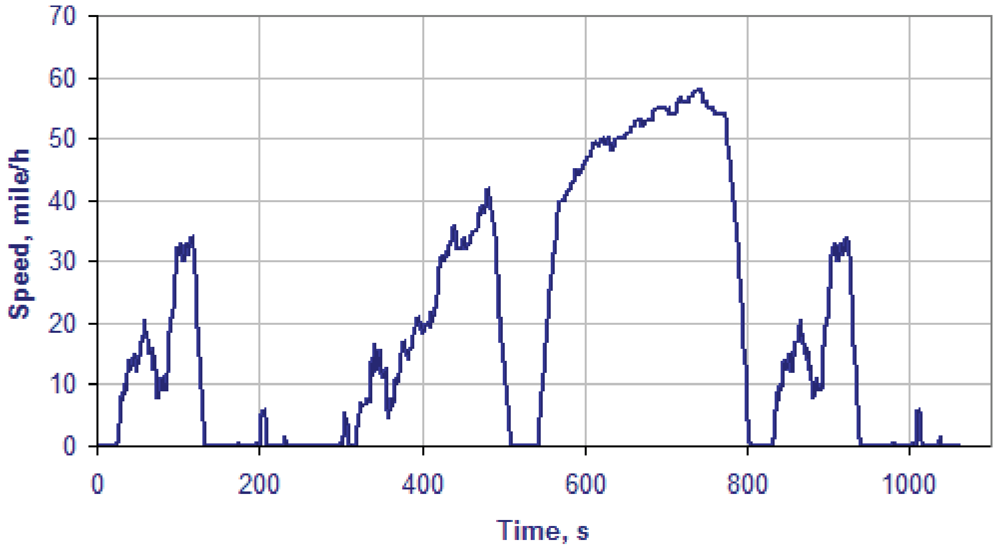


Figure 3. HD-UDDS Cycle (duration 1060 seconds, Maximum Speed 58 mph, Average Speed 18.86 mph).

6-III. DISCUSSION

The driving cycle consists of three simulated transit driving cycles: Manhattan, Orange County Bus Cycle and the HD-UDDS, as described in 6-II. The fuel consumption for each driving cycle and idle was measured.

An extensive pretest maintenance check was made including the replacement of all lubrication fluids. The details of the pretest maintenance are given in the first three Pretest Maintenance Forms. The fourth sheet shows the Pretest Inspection Form. Finally, the summary sheet provides the average fuel consumption for the three test cycles and for a 20 minute idle. **The average fuel consumption for the Manhattan, OCBC and the HD-UDDS were 53.9 mpg, 36.7 mpg and 27.1 mpg respectively. For idle, the fuel consumption was 110 scf/hr**.

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Page 1 of 3

Bus Number: 1911	Date: 11/19/19	SLW (lb.): 36,830
Personnel: T.S., E.D. & P.D.		

FUEL SYSTEM	OK
Install fuel measurement system	✓
Replace fuel filter	✓
Check for fuel leaks	✓
Specify fuel type (CNG)	✓
Remarks: None noted	
BRAKES/TIRES	OK
Inspect hoses	✓
Inspect brakes	✓
Check tire inflation pressures (mfg. specs.)	✓
Check tire wear (less than 50%)	✓
Remarks: None noted	
COOLING SYSTEM	OK
Check hoses and connections	✓
Check system for coolant leaks	✓
Remarks: None noted	

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 1911	Date: 11/19/19
Personnel: T.S., E.D. & P.D.	

ELECTRICAL SYSTEMS	OK
Check battery	✓
Inspect wiring	✓
Inspect terminals	✓
Check lighting	✓
Remarks: None noted	

DRIVE SYSTEM	OK
Drain transmission fluid	N/A
Replace filter/gasket	N/A
Check hoses and connections	N/A
Replace transmission fluid	N/A
Check for fluid leaks	N/A
Remarks: Refer to manufacturer's maintenance manual for frequency of service.	

LUBRICATION	OK
Drain crankcase oil	✓
Replace filters	✓
Replace crankcase oil	✓
Check for oil leaks	✓
Check oil level	✓
Lube all chassis grease fittings	✓
Lube universal joints	✓
Replace differential lube including axles	N/A
Remarks: Refer to manufacturer's maintenance manual for service on differential.	

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Page 3 of 3

Bus Number: 1911	Date: 11/19/19
Personnel: T.S.,E.D.,P.D. & S.R.	

EXHAUST/EMISSION SYSTEM	OK
Check for exhaust leaks	✓
Remarks: None noted	

ENGINE	OK
Replace air filter	✓
Inspect air compressor and air system	✓
Inspect vacuum system, if applicable	N/A
Check and adjust all drive belts	✓
Check cold start assist, if applicable	N/A
Remarks: None noted	

STEERING SYSTEM	OK
Check power steering hoses and connectors	✓
Service fluid level	N/A
Check power steering operation	✓
Remarks: None noted	

	OK
Ballast bus to seated load weight	✓

TEST DRIVE	OK
Check brake operation	✓
Check transmission operation	✓
Remarks: None noted	

FUEL ECONOMY PRE-TEST INSPECTION FORM

Page 1 of 1

Bus Number: 1911	Date: 11/20/19
Personnel: T.S.	

PRE WARM-UP	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	T.S.
Cold tire pressure (psi): Front 110 Middle N/A Rear 110	T.S.
Engine oil level	T.S.
Engine coolant level	T.S.
Interior and exterior lights on, evaporator fan on	T.S.
Fuel economy instrumentation installed and working properly.	T.S.
Fuel line -- no leaks or kinks	T.S.
Bus is loaded to SLW during coast down	T.S.
WARM-UP	**If OK, Initial**
Bus driven for at least one hour warm-up	J.S.

FUEL ECONOMY DATA FORM
(Gaseous and Liquid fuels)

Page 1 of 1

Bus Number: 1911	Manufacturer: Gillig	Date: 11/26/19
Fuel Type: CNG	Personnel: S.I. & J.S.	
Temperature (°F): 74.3	Humidity (%): 32	Barometric Pressure (in.Hg): 28.5
SLW (lb.):36,830		

Cycle	Manhattan	Orange County	HD-UDDS	Idle
Fuel Consumption scf/mile	53.9	36.7	27.1	110 scf/hr

Comments: Maximum speed limited to 55.9 mph. The bus could not keep up with thie speed
trace where it exceeded 55 mph during the UDDS test cycle.

7. NOISE

7.1 INTERIOR NOISE AND VIBRATION TESTS

7.1-I. TEST OBJECTIVE

The objective of these tests is to measure and record interior noise levels and check for audible vibration under various operating conditions.

7.1-II. TEST DESCRIPTION

During this series of tests, the interior noise level was measured at several locations with the bus operating under the following three conditions:

1. With the bus stationary, a white noise generating system provided a uniform sound pressure level equal to 80 dB(A) on the left, exterior side of the bus. The engine and all accessories were switched off and all openings including doors and windows were closed. This test was performed at the LTI Test Track Facility.

2. The bus was accelerated at full throttle from a standing start to 35 mph on a level pavement. All openings were closed and all accessories were operating during the test. This test was performed on the track at the LTI Test Track Facility.

3. The bus was operated at various speeds from 0 to 55 mph with and without the air conditioning and accessories on. Any audible vibration or rattles were noted. This test was performed on the test segment between the LTI Test Track and the Bus Testing Center.

All tests were performed in an area free from extraneous sound-making sources or reflecting surfaces. The ambient sound level as well as the surrounding weather conditions were recorded in the test data.

7.1-III. DISCUSSION

For the first part, the overall average of the six measurements was 46.3 dB(A); ranging from 44.7 dB(A) at the rear passenger seats to 47.7 dB(A) at the driver's seat. The interior ambient noise level for this test was less than 30 dB(A).

For the second part, the interior noise level ranged from 75.7 dB(A) at the front passenger seats to 77.5 dB(A) at the rear passenger seats. The overall average was 76.8 dB(A). The interior ambient noise level for this test was less than 30 dB(A).

No vibrations or rattles were noted during the third part of this test. This bus passed this section of the test.

INTERIOR NOISE TEST DATA FORM
Test Condition 1: 80 dB(A) Stationary White Noise
Page 1 of 3

Bus Number: 1911	Date: 10/01/19
Personnel: E.D.,S.R. & P.D.	
Temperature (°F): 68	Humidity (%): 94
Wind Speed (mph): 6	Wind Direction: SW
Barometric Pressure (in.Hg): 30.12	
Interior Ambient Noise Level dB(A): Less than 30	Exterior Ambient Noise Level dB(A): 39.2
Microphone Height During Testing (in): 45 ½	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	47.7
Front Passenger Seats	46.1
In Line with Front Speaker	46.9
In Line with Middle Speaker	46.9
In Line with Rear Speaker	45.7
Rear Passenger Seats	44.7

Comments: None noted

INTERIOR NOISE TEST DATA FORM
Test Condition 2: 0 to 35 mph Acceleration Test
Page 2 of 3

Bus Number: 1911	Date: 09/17/19
Personnel: T.S.,E.D.,S.R. & S.B.	
Temperature (°F): 65	Humidity (%): 62
Wind Speed (mph): 3	Wind Direction: NE
Barometric Pressure (in.Hg): 30.17	
Interior Ambient Noise Level dB(A): Less than 30	Exterior Ambient Noise Level dB(A): 42.4
Microphone Height During Testing (in): 45 ½	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	77.4
Front Passenger Seats	75.7
Middle Passenger Seats	76.7
Rear Passenger Seats	77.5

Comments: None noted

INTERIOR NOISE TEST DATA FORM
Test Condition 3: Audible Vibration Test

Bus Number: 1911	Date: 09/17/19
Personnel: T.S.,S.R.,E.D. & S.B.	
Temperature (°F): 78	

Describe the following possible sources of noise and give the relative location on the bus.

Source of Noise	Location	Description of Noise
Engine and Accessories	None noted	None noted
Windows and Doors	None noted	None noted
Seats and Wheel Chair lifts	None noted	None noted
Other	None noted	None noted

Comment on any other vibration or noise source which may have occurred that is not described above: None noted

Comments: None noted

7.1 INTERIOR NOISE TEST

TEST BUS SET-UP FOR 80 dB(A)
INTERIOR NOISE TEST

7.2 EXTERIOR NOISE TESTS

7.2-I. TEST OBJECTIVE

The objective of this test is to record exterior noise levels when a bus is operated under various conditions.

7.2-II. TEST DESCRIPTION

In the exterior noise tests, the bus was operated at a SLW in three different conditions using a smooth, straight and level roadway:

1. Accelerating at full throttle from a constant speed starting from 35 mph.

2. Accelerating at full throttle from standstill.

3. Stationary, with the engine at low idle, high idle, and wide open throttle, where applicable. In addition, the bus was tested with and without the air conditioning operating.

The test site is at the Larson Transportation Institute Test Track and the test procedures were performed in accordance with SAE Standards SAE J366b, Exterior Sound Level for Heavy Trucks and Buses. The test site is an open space free of large reflecting surfaces. A noise meter placed at a specified location outside the bus was used to measure the noise level.

During the test, special attention was paid to:

1. The test site characteristics regarding parked vehicles, signboards, buildings, or other sound-reflecting surfaces
2. Proper usage of all test equipment including set-up and calibration
3. The ambient sound level

7.2-III. DISCUSSION

The Exterior Noise Test determines the noise level generated by the vehicle under different driving conditions and at stationary low and high idle, with and without air conditioning and accessories operating. The test site is a large, level, bituminous paved area with no reflecting surfaces nearby.

With an outside ambient noise level of 44.3 dB(A), the average of the two highest readings obtained while accelerating from a constant speed was 71.3 dB(A) on the right side and 72.8 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 45.7 dB(A), the average of the two highest readings obtained were 74.2 dB(A) on the right side and 74.1 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 59.3 dB(A) at low idle, 62.7 dB(A) at high idle and 71.6 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 56.3 dB(A) at low idle, 61.6 dB(A) at high idle and 71.3 dB(A) at wide open throttle. The exterior ambient noise level measured during this test was 41.7 dB(A). This bus passed this section of the test.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed

Bus Number: 1911	Date: 09/16/19
Personnel: T.S., E.D. & S.B.	
Temperature (°F): 74	Humidity (%): 72
Wind Speed (mph): 0	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.04	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■	
Initial Sound Level Meter Calibration: 94.0 dB(A)	
Exterior Ambient Noise Level: 44.3 dB(A)	

Accelerating from Constant Speed Curb (Right) Side		Accelerating from Constant Speed Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	71.3	1	71.9
2	70.3	2	73.0
3	70.8	3	72.4
4	71.0	4	72.6
5	71.3	5	71.9
6	N/A	6	N/A
7	N/A	7	N/A
8	N/A	8	N/A
9	N/A	9	N/A
10	N/A	10	N/A
Average of two highest actual noise levels = 71.3 dB(A)		Average of two highest actual noise levels = 72.8 dB(A)	

Final Sound Level Meter Calibration Check: 94.0 dB(A)

Comments: None noted

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill

Bus Number: 1911	Date: 09/16/19
Personnel: T.S.,E.D. & S.B.	
Temperature (°F): 74	Humidity (%): 70
Wind Speed (mph): 0	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.04	

Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■

Initial Sound Level Meter Calibration: 93.9 dB(A)

Exterior Ambient Noise Level: 45.7 dB(A)

Accelerating from Standstill Curb (Right) Side		Accelerating from Standstill Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	74.2	1	73.9
2	74.1	2	74.1
3	74.2	3	73.7
4	74.0	4	73.9
5	74.2	5	74.1
6	N/A	6	N/A
7	N/A	7	N/A
8	N/A	8	N/A
9	N/A	9	N/A
10	N/A	10	N/A
Average of two highest actual noise levels = 74.2 dB(A)		Average of two highest actual noise levels = 74.1 dB(A)	

Final Sound Level Meter Calibration Check: 93.9 dB(A)

Comments: None noted

EXTERIOR NOISE TEST DATA FORM
Stationary

Bus Number: 1911	Date: 09/16/19
Personnel: T.S.,E.D. & S.B.	
Temperature (°F): 75	Humidity (%): 67
Wind Speed (mph): 0	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.04	
Initial Sound Level Meter Calibration: 93.9 dB(A)	
Exterior Ambient Noise Level: 41.7 dB(A)	

Air Conditioning ON

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	701	60.4	58.1
High Idle	1002	62.5	62.9
Wide Open Throttle	1808	72.2	71.0

Air Conditioning OFF

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	703	56.2	56.4
High Idle	1001	61.5	61.7
Wide Open Throttle	1819	71.3	71.3

Final Sound Level Meter Calibration Check: 93.9 dB(A)

Comments: None noted

7.2 EXTERIOR NOISE TESTS

TEST BUS UNDERGOING EXTERIOR NOISE TESTING

8.0 EMISSIONS TEST – DYNAMOMETER-BASED EMISSIONS TEST USING TRANSIT DRIVING CYCLES

8-I. TEST OBJECTIVE

The objective of this test is to provide comparable emissions data on transit buses produced by different manufacturers. This chassis-based emissions test bears no relation to engine certification testing performed for compliance with the Environmental Protection Agency (EPA) regulation. EPA's certification tests are performed on an engine by itself on a dynamometer operating under the Federal Test Protocol.

The Bus Testing Center emissions test is a measurement of the gaseous engine emissions CO, CO2, NOx, HC and particulates (diesel vehicles) produced by a complete vehicle operating on a large-roll chassis dynamometer. The test is performed for three differed driving cycles intended to simulate a range of transit operating environments. The test is performed under laboratory conditions in compliance with EPA 1065 and SAE J2711. The results of this test may not represent actual in-service vehicle emissions but will provide data that can be used by recipients to compare the emissions of buses tested under a range of consistent operating conditions.

8-II. TEST DESCRIPTION

This test was performed in the emissions bay of the LTI Vehicle Testing Laboratory. The Laboratory is equipped with a Schenk Pegasus 300 HP, large-roll (72 inch diameter) chassis dynamometer suitable for heavy-vehicle emissions testing. The emissions laboratory provides capability for testing heavy-duty diesel, gasoline, and alternative-fueled buses for a variety of tailpipe emissions including particulate matter, oxides of nitrogen, carbon monoxide, carbon dioxide, and hydrocarbons. It is equipped with a Horiba full-scale dilution tunnel and a constant volume sampling (CVS) emissions measurement system. The system includes Horiba Mexa 7400 Series gas analyzers and a Horiba HF47 Particulate Sampling System. Test operation is automated using Horiba CDTCS software. The computer controlled dynamometer is capable of simulating over-the-road operation for a variety of vehicles and driving cycles.

The emissions test was performed as soon as practical after the completion of the GVW portion of the structural durability test. The driving cycles are the Manhattan cycle, a low average speed, highly transient urban cycle (Figure 1), the Orange County Bus Cycle, a medium average speed transient urban cycle (Figure 2), and the EPA HD-UDDS Cycle, which consists of urban and highway driving segments (Figure 3). An emissions test was comprised of two runs for each of the three different driving cycles, and the average values were reported.

Test results reported include the average grams per mile value for each of the gaseous emissions of carbon dioxide, carbon monoxide, oxides of nitrogen, total hydrocarbons and non-methane hydrocarbons. In addition, emissions of particulate matter will also be reported for diesel fuel buses. Testing is performed in accordance with EPA CFR49, Part 1065 and SAE J2711 as practically determined by the FTA Emissions Testing Protocol developed by West Virginia University and Penn State University.

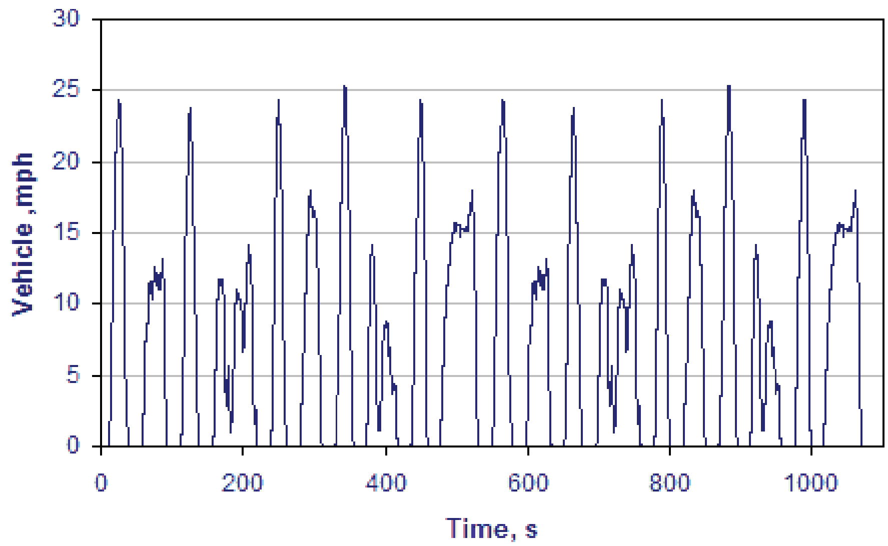


Figure 8.1. *Manhattan Driving Cycle (Duration 1089 sec, Maximum Speed 25.4 mph, Average Speed 6.8 mph)*

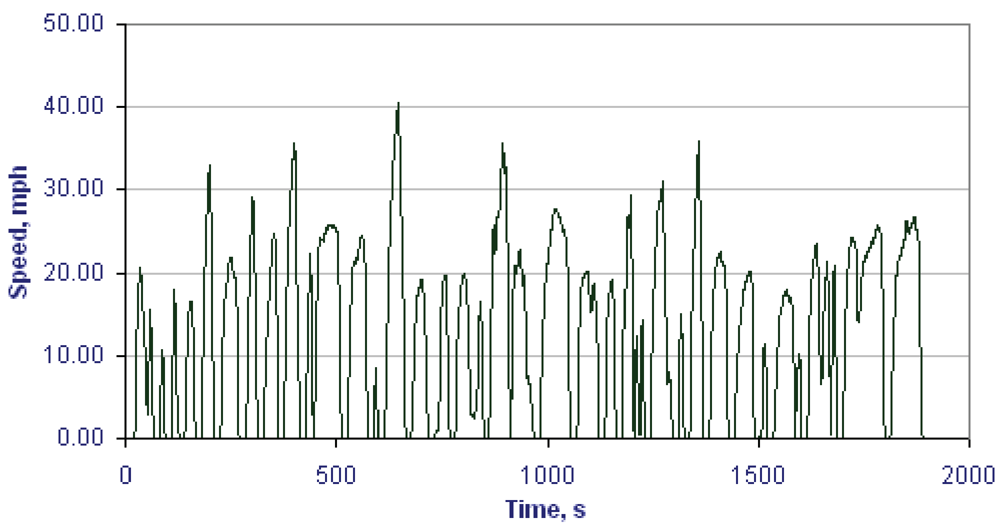


Figure 8.2. *Orange County Bus Cycle (Duration 1909 Sec, Maximum Speed 41 mph, Average Speed 12 mph)*

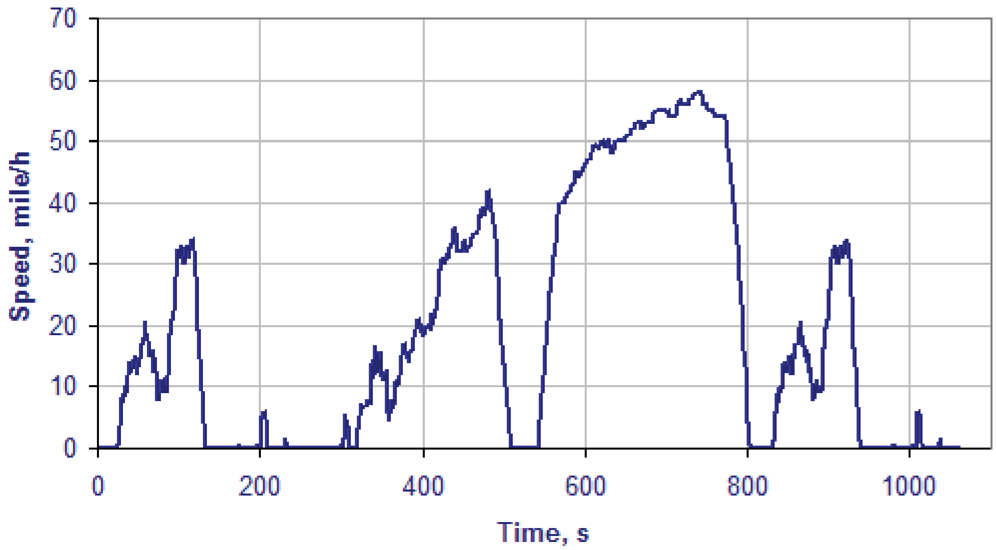


Figure 8.3. *HD-UDDS Cycle (Duration 1060 seconds, Maximum Speed 58 mph, Average Speed 18.86 mph)*

8-III. TEST ARTICLE

The test article is a Gillig, LLC , 40 Foot Low Floor L9N model transit bus equipped with a CNG fueled Cummins / L9N 280 motor. The bus was tested on November 26, 2019 with the odometer reading 18,162 miles.

8-IV. TEST EQUIPMENT

Testing was performed in the LTI Vehicle Testing Laboratory emissions testing bay. The test bay is equipped with a Schenk Pegasus 72-inch, large-roll chassis dynamometer. The dynamometer is electronically controlled to account for vehicle road-load characteristics and for simulating the inertia characteristics of the vehicle. Power to the roller is supplied and absorbed through an electronically controlled 3-phase ac motor. Absorbed power is returned to the electrical grid.

Vehicle exhaust is collected by a Horiba CVS, full-flow dilution tunnel. The system has separate tunnels for diesel and gasoline/natural gas fueled vehicles. In the case of diesel vehicles, particulate emissions are measured gravimetrically using 47mm Teflon filters. These filters are housed in a Horiba HF47 particulate sampler, per EPA 1065 test procedures. Heated gaseous emissions of hydrocarbons and NOx are sampled by Horiba heated oven analyzers.

Gaseous emissions for CO, CO2 and cold NOx are measured using a Horiba Mexa 7400 series gas analyzer. System operation, including the operation of the chassis dynamometer, and all calculations are controlled by a Dell workstation running Horiba CDCTS test control software. Particulate Filters are weighed in a glove box using a Sartorius microbalance accurate to 1 microgram.

8-V. TEST PREPARATION AND PROCEDURES

The test bus was prepared for emissions testing in accordance with the Fuel Economy Pre-Test Maintenance Form. (In the event that fuel economy test was performed immediately prior to emissions testing this step does not have to be repeated) This is done to ensure that the bus is tested in optimum operating condition. The manufacturer-specified preventive maintenance shall be performed before this test. The ABS system is disabled for operation on the chassis dynamometer. Any manufacturer-recommended changes to the pre-test maintenance procedure must be noted on the revision sheet. The Fuel Economy Pre-Test Inspection Form will also be completed before performing the Emissions test. Both the Fuel Economy Pre-Test Maintenance Form and the Fuel Economy Pre-Test Inspection Form are found in section 6, Fuel Economy Test.

Prior to performing the emissions test, each bus is evaluated to determine its road-load characteristics using coast-down techniques in accordance with SAE J1263. This data is used to program the chassis dynamometer to accurately simulate over-the-road operation of the bus.

Warm-up consisted of driving the bus for 20 minutes at approximately 40 mph on the chassis dynamometer. During emissions testing, the test driver followed the prescribed driving cycle by watching the speed trace and instructions on the Horiba Drivers-Aid monitor which is placed in front of the windshield. The CDCTS computer monitored the test and collected data for calculation of emissions at the end of the test.

This bus was tested for emissions at seated load weight. The emissions data was obtained at the following conditions:

1. Air conditioning off
2. Heater off
3. Defroster off
4. Exterior and interior lights on
5. Windows and Doors closed
6. Seated load weight

The test tanks or the bus fuel tank(s) were filled prior to the fuel economy test with the CNG fuel.

8-VI DISCUSSION

Table 8.1 provides the emissions testing results on a grams per mile basis for each of the exhaust constituents measured and for each driving cycle performed.

TABLE 8.1 Emissions Test Results

Test Completed at SLW: 36,830 lb.			
Driving Cycle	**Manhattan**	**Orange County Bus**	**UDDS**
CO_2, gm/mi	2864	1975	1473
CO, gm/mi	5.8	3.6	2.6
THC, gm/mi	0.23	0.25	0.23
NMHC, gm/mi	0.02	0.02	0.01
NO_x, gm/mi	0.02	0.01	0.05

8. EMISSIONS TEST

BUS TESTED ON CHASSIS DYNAMOMETER FOR EMISSIONS AND FUEL ECONOMY

PARTIAL

STURAA TEST

12 YEAR

500,000 MILE BUS

from

GILLIG, LLC

MODEL 40’ LOW FLOOR BAE HYBRID

JULY 2012

PTI-BT-R1206-P

The Thomas D. Larson
Pennsylvania Transportation Institute
Vehicle Systems and Safety Program

201 Transportation Research Building (814) 865-1891
The Pennsylvania State University
University Park, PA 16802

Bus Testing and Research Center

2237 Old Route 220 N. (814) 695-3404
Duncansville, PA 16635

MECHANICAL TESTING
CERTIFICATE 3172.01

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EXECUTIVE SUMMARY

Gillig LLC., submitted a model 40' Low Floor BAE Hybrid, diesel-powered 40 seat (including the driver) 41-foot bus, for a partial STURAA Test in the 12 yr/500,000 mile category. The odometer reading at the time of delivery was 4,472 miles. The Federal Transit Administration determined that the following tests would be performed; 1.1 Accessibility of Components & Subsystems, 1.3 Removal & Replacement of Selected Subsystems, 4. Performance, 6. Fuel Economy, 7. Noise Tests and 8. Emissions. Testing started on April 12, 2012 and was completed on July 9, 2012. The Check-In section of the report provides a description of the bus and specifies its major components.

The interior of the bus is configured with seating for 40 passengers including the driver. Free floor space will accommodate 32 standing passengers resulting in a potential load of 72 persons. At 150 lbs per person, this load results in a measured gross vehicle weight of 41,210 lbs. **Note: at Gross Vehicle Load (GVL) the weight of the rear axle is 2,230 lbs over the rear GAWR and 1,610 lbs over the GVWR**

Effective January 1, 2010 the Federal Transit Administration determined that the total number of simulated passengers used for loading all test vehicles will be based on the full complement of seats and free-floor space available for standing passengers (150 lbs per passenger). The passenger loading used for dynamic testing will not be reduced in order to comply with Gross Axle Weight Ratings (GAWR's) or the Gross Vehicle Weight Ratings (GVWR's) declared by the manufacturer. Cases where the loading exceeds the GAWR and/or the GVWR will be noted accordingly. During the testing program, all test vehicles transported or operated over public roadways will be loaded to comply with the GAWR and GVWR specified by the manufacturer.

Accessibility, in general, was adequate, components covered in Section 1.3 (Repair and/or Replacement of Selected Subsystems) along with all other components encountered during testing, were found to be readily accessible and no restrictions were noted.

The performance of the bus is illustrated by a speed vs. time plot. Acceleration and gradeability test data are provided in Section 4, Performance. The average time to obtain 50 mph was 41.50 seconds. The Stopping Distance phase of the Brake Test was completed with the following results; for the Uniform High Friction Test average stopping distances were 28.93' at 20 mph, 58.16' at 30 mph, 100.68' at 40 mph and 130.90' at 45 mph. The average stopping distance for the Uniform Low Friction Test was 30.38'. There was no deviation from the test lane during the performance of the Stopping Distance phase. During the Stability phase of Brake Testing the test bus experienced no deviation from the test lane but did experience pull to the left during both approaches to the Split Friction Road surface. The Parking Brake phase was completed with the test bus maintaining the parked position for the full five minute period with no slip or roll observed in both the uphill and downhill positions.

A Fuel Economy Test was run on simulated central business district, arterial, and commuter courses. The results were 4.66 mpg, 3.87 mpg, and 5.76 mpg respectively; with an overall average of 4.64 mpg.

A series of Interior and Exterior Noise Tests was performed. These data are listed in Section 7.1 and 7.2 respectively.

The Emissions Test was performed. These results are available in Section 8 of this report.

ABBREVIATIONS

ABTC	-	Altoona Bus Test Center
A/C	-	air conditioner
ADB	-	advance design bus
ATA-MC	-	The Maintenance Council of the American Trucking Association
CBD	-	central business district
CW	-	curb weight (bus weight including maximum fuel, oil, and coolant; but without passengers or driver)
dB(A)	-	decibels with reference to 0.0002 microbar as measured on the "A" scale
DIR	-	test director
DR	-	bus driver
EPA	-	Environmental Protection Agency
FFS	-	free floor space (floor area available to standees, excluding ingress/egress areas, area under seats, area occupied by feet of seated passengers, and the vestibule area)
GVL	-	gross vehicle load (150 lb for every designed passenger seating position, for the driver, and for each 1.5 sq ft of free floor space)
GVW	-	gross vehicle weight (curb weight plus gross vehicle load)
GVWR	-	gross vehicle weight rating
MECH	-	bus mechanic
mpg	-	miles per gallon
mph	-	miles per hour
PM	-	Preventive maintenance
PSBRTF	-	Penn State Bus Research and Testing Facility
PTI	-	Pennsylvania Transportation Institute
rpm	-	revolutions per minute
SAE	-	Society of Automotive Engineers
SCH	-	test scheduler
SEC	-	secretary
SLW	-	seated load weight (curb weight plus 150 lb for every designed passenger seating position and for the driver)
STURAA	-	Surface Transportation and Uniform Relocation Assistance Act
TD	-	test driver
TECH	-	test technician
TM	-	track manager
TP	-	test personnel

TEST BUS CHECK-IN

I. OBJECTIVE

The objective of this task is to log in the test bus, assign a bus number, complete the vehicle data form, and perform a safety check.

II. TEST DESCRIPTION

The test consists of assigning a bus test number to the bus, cleaning the bus, completing the vehicle data form, obtaining any special information and tools from the manufacturer, determining a testing schedule, performing an initial safety check, and performing the manufacturer's recommended preventive maintenance. The bus manufacturer must certify that the bus meets all Federal regulations.

III. DISCUSSION

The check-in procedure is used to identify in detail the major components and configuration of the bus.

The test bus consists of a Gillig, LLC., model 40’ Low Floor BAE Hybrid. The bus has a front door equipped with a Lift-U model LU11 foldout handicap ramp forward of the front axle and a rear door forward of the rear axle. Power is provided by a diesel-fueled, Cummins model ISB 6.7 L 280H engine coupled to a BAE Hybrid Propulsion System.

The measured curb weight is 9,590 lbs for the front axle and 20,820 lbs for the rear axle. These combined weights provide a total measured curb weight of 30,410 lbs. There are 40 seats including the driver and room for 32 standing passengers bringing the total passenger capacity to 72. Gross load is 150 lb x 72 = 10,800 lbs. At full capacity, the measured gross vehicle weight is 41,210 lbs. **Note: at GVL the load is 2,230 lbs over the rear GAWR and 1,610 lbs over the GVWR.**

VEHICLE DATA FORM

Bus Number: 1206	Arrival Date: 4-12-12
Bus Manufacturer: Gillig	Vehicle Identification Number (VIN): 15GGD3012C1180795
Model Number: 40' Low Floor BAE Hybrid	Date: 4-12-12
Personnel: E.D., E.L. & B.L.	

WEIGHT:

Individual Wheel Reactions:

Weights (lb)	Front Axle		Middle Axle		Rear Axle	
	Right	Left	Right	Left	Right	Left
CW	4,840	4,750	N/A	N/A	9,850	10,970
SLW	5,800	5,680	N/A	N/A	11,660	13,340
GVW	7,080	6,900	N/A	N/A	12,670	14,560

Total Weight Details:

Weight (lb)	CW	SLW	GVW	GAWR
Front Axle	9,590	11,480	13,980	14,600
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	20,820	25,000	27,230	25,000
Total	30,410	36,480	41,210	GVWR: 39,600

Dimensions:

Length (ft/in)	41 / 9.5
Width (in)	101.0
Height (in)	134.3
Front Overhang (in)	100.5
Rear Overhang (in)	122.5
Wheel Base (in)	278.5
Wheel Track (in)	Front: 85.5
	Rear: 77.5

VEHICLE DATA FORM

Bus Number: 1206	Date: 4-12-12

CLEARANCES:

Lowest Point Outside Front Axle	Location: Frame	Clearance(in): 11.3
Lowest Point Outside Rear Axle	Location: Rub guard	Clearance(in): 12.6
Lowest Point between Axles	Location: Frame	Clearance(in): 13.5
Ground Clearance at the center (in)	13.5	
Front Approach Angle (deg)	6.4	
Rear Approach Angle (deg)	5.9	
Ramp Clearance Angle (deg)	5.5	
Aisle Width (in)	Front - 23.2	Rear – 23.1
Inside Standing Height at Center Aisle (in)	Front – 95.3	Rear – 76.4

BODY DETAILS:

Body Structural Type	Semi-monocoque		
Frame Material	Stainless steel		
Body Material	Aluminum		
Floor Material	Center Section / Plywood – Upper section / composite		
Roof Material	Composite		
Windows Type	■ Fixed (Bottom)	■ Movable (Top)	
Window Mfg./Model No.	Spec-Temp / AS3 M41 DOT 243		
Number of Doors	_1_ Front	_1_ Rear	
Mfr. / Model No.	Vapor Bus International / 12A 0003		
Dimension of Each Door (in)	Front - 75.2 x 32.0	Rear – 77.7 x 28.3	
Passenger Seat Type	■ Cantilever	■ Pedestal	☐ Other (explain)
Mfr. / Model No.	American Seating / Metropolitan		
Driver Seat Type	■ Air	☐ Spring	☐ Other (explain)
Mfr. / Model No.	Recaro / Ergo Metro		
Number of Seats (including Driver)	40 Note; 8 stow for 2 wheelchair positions.		

VEHICLE DATA FORM

Bus Number: 1206	Date: 4-12-12

BODY DETAILS (Contd..)

Free Floor Space (ft^2)	52.5		
Height of Each Step at Normal Position (in)	Front 1. 16.3	2. N/A	3. N/A
	Middle 1. N/A	2. N/A	3. N/A
	Rear 1. 15.9	2. N/A	3. N/A
Step Elevation Change - Kneeling (in)	Front – 3.7 Rear – 0.9		

ENGINE

Type	■ C.I.	☐ Alternate Fuel	
	☐ S.I.	☐ Other (explain)	
Mfr. / Model No.	Cummins / ISB 6.7 280H		
Location	☐ Front	■ Rear	☐ Other (explain)
Fuel Type	☐ Gasoline	☐ CNG	☐ Methanol
	■ Diesel	☐ LNG	☐ Other (explain)
Fuel Tank Capacity (indicate units)	127 gals		
Fuel Induction Type	■ Injected	☐ Carburetion	
Fuel Injector Mfr. / Model No.	Cummins / ISB 6.7 280H		
Carburetor Mfr. / Model No.	N/A		
Fuel Pump Mfr. / Model No.	Cummins / ISB 6.7 280H		
Alternator (Generator) Mfr. / Model No.	N/A		
Maximum Rated Output (Volts / Amps)	N/A		
Air Compressor Mfr. / Model No.	Wabco / 5286962		
Maximum Capacity (ft^3 / min)	Not available.		
Starter Type	■ Electrical	☐ Pneumatic	☐ Other (explain)
Starter Mfr. / Model No.	Prestolite Leece Neville / M105R3506SE/4A		

Bus Number: 1206	Date: 4-12-12

TRANSMISSION

Transmission Type	☐ Manual	■ Automatic	
Mfr. / Model No.	BAE / HybriDrive Propulsion System		
Control Type	☐ Mechanical	■ Electrical	☐ Other
Torque Converter Mfr. / Model No.	BAE / HybriDrive Propulsion System		
Integral Retarder Mfr. / Model No.	N/A		

SUSPENSION

Number of Axles	2		
Front Axle Type	☐ Independent	■ Beam Axle	
Mfr. / Model No.	Arvin Meritor / FH946RX206		
Axle Ratio (if driven)	N/A		
Suspension Type	■ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Koni / 91 3021		
Middle Axle Type	☐ Independent	☐ Beam Axle	
Mfr. / Model No.	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type	☐ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	☐ Independent	■ Beam Axle	
Mfr. / Model No.	Arvin Meritor / 71163WX61-456		
Axle Ratio (if driven)	4.56		
Suspension Type	■ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	4		
Mfr. / Model No.	Koni / 90 3031		

VEHICLE DATA FORM

Bus Number: 1206	Date: 4-12-12

WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Alcoa / 22.5 x 8.25 Durabright
	Tire Mfr./ Model No.	Goodyear / Metro Miler / B305/85R 22.5
Rear	Wheel Mfr./ Model No.	Alcoa / 22.5 x 8.25 Durabright
	Tire Mfr./ Model No.	Goodyear / Metro Miler / B305/85R 22.5

BRAKES

Front Axle Brakes Type	■ Cam	☐ Disc	☐ Other (explain)
Mfr. / Model No.	Meritor / 16.5 x 6 Cast Plus Drum		
Middle Axle Brakes Type	☐ Cam	☐ Disc	☐ Other (explain)
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	■ Cam	☐ Disc	☐ Other (explain)
Mfr. / Model No.	Meritor / 14.5 x 10 W Drum		
Retarder Type	N/A		
Mfr. / Model No.	N/A		

HVAC

Heating System Type	☐ Air	■ Water	☐ Other
Capacity (Btu/hr)	98,000		
Mfr. / Model No.	Thermo King / TE14		
Air Conditioner	■ Yes	☐ No	
Location	Rear		
Capacity (Btu/hr)	81,000		
A/C Compressor Mfr. / Model No.	(2) - Copeland Scroll / ZR61K3E-TF5-130		

STEERING

Steering Gear Box Type	Hydraulic gear with Electric Assist
Mfr. / Model No.	TRW / TAS65
Steering Wheel Diameter	16.0
Number of turns (lock to lock)	5.25

VEHICLE DATA FORM

Bus: 1206	Date: 4-12-12

OTHERS

Wheel Chair Ramps	Location: Front	Type: Fold-out ramp
Wheel Chair Lifts	Location: N/A	Type: N/A
Mfr. / Model No.	Lift-U / LU11	
Emergency Exit	Location: Windows Doors Roof hatch	Number: 6 2 2

CAPACITIES

Fuel Tank Capacity (units)	127 gals
Engine Crankcase Capacity (gallons)	4.4
Transmission Capacity (gallons)	7.0
Differential Capacity (gallons)	5.5
Cooling System Capacity (quarts)	15.0
Power Steering Fluid Capacity (quarts)	8.4

OTHERS

Urea System; Mfr. / Model No.	Denoxtronic 2.2 / A028Y792
Accessory Power System; Mfr. / Model No.	BAE / 89954-363A929G1
Propulsion Control System; Mfr. / Model No.	BAE / 89954-115E3092G3
Energy Storage System; Mfr. / Model No.	BAE / 89954S0CN362A9758G202
Battery Pack Cooling System; Mfr. / Model No.	EMP/BAE 24v ECP

VEHICLE DATA FORM

Bus Number: 1206	Date: 4-16-12

List all spare parts, tools and manuals delivered with the bus.

Part Number	Description	Qty.
P60-5536	Air filter	1
FF5632	Fuel filter	1
3937736	Oil filter	1
B228	Transmission filter	1
NA	Plate	2
NA	Bolts	8
F5 19763	Fuel filter element	1
NA	Driver's handbook	1

COMPONENT/SUBSYSTEM INSPECTION FORM

Bus Number: 1206	Date: 4-16-12

Subsystem	Checked	Initials	Comments
Air Conditioning Heating and Ventilation	✓	E.D.	None noted.
Body and Sheet Metal	✓	E.D.	None noted.
Frame	✓	E.D.	None noted.
Steering	✓	E.D.	Electric Steering Assist
Suspension	✓	E.D.	None noted.
Interior/Seating	✓	E.D.	None noted.
Axles	✓	E.D.	None noted.
Brakes	✓	E.D.	None noted.
Tires/Wheels	✓	E.D.	None noted.
Exhaust	✓	E.D.	None noted.
Fuel System	✓	E.D.	None noted.
Power Plant	✓	E.D.	None noted.
Accessories	✓	E.D.	None noted.
Lift System	✓	E.D.	None noted.
Interior Fasteners	✓	E.D.	None noted.
Batteries	✓	E.D.	None noted.

CHECK - IN

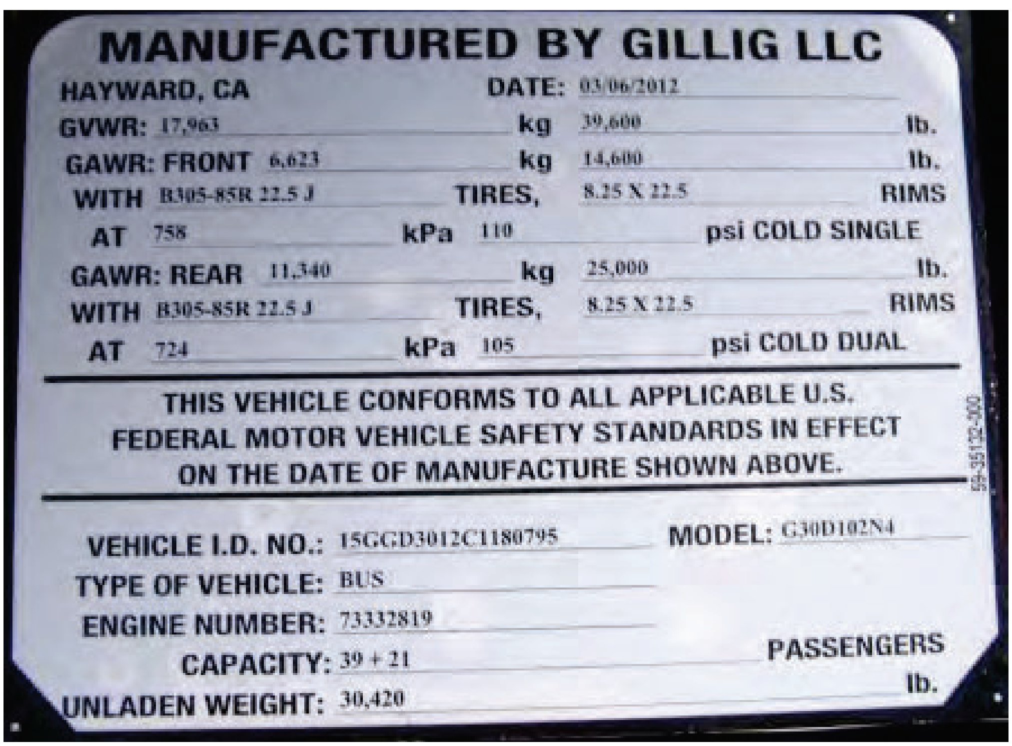
GILLIG, LLC., MODEL 40’ LOW FLOOR BAE HYBRID

CHECK - IN CONT.

GILLIG, LLC.,
MODEL 40’ LOW FLOOR BAE HYBRID EQUIPPED WITH A LIFT-U MODEL LU11 FOLD-OUT RAMP

CHECK - IN CONT.

OPERATOR'S AREA



VIN TAG

CHECK - IN CONT.

INTERIOR

1. MAINTAINABILITY

1.1 ACCESSIBILITY OF COMPONENTS AND SUBSYSTEMS

1.1-I. TEST OBJECTIVE

The objective of this test is to check the accessibility of components and subsystems.

1.1-II. TEST DESCRIPTION

Accessibility of components and subsystems is checked, and where accessibility is restricted the subsystem is noted along with the reason for the restriction.

1.1-III. DISCUSSION

Accessibility, in general, was adequate. Components covered in Section 1.3 (repair and/or replacement of selected subsystems), along with all other components encountered during testing, were found to be readily accessible and no restrictions were noted.

ACCESSIBILITY DATA FORM

Bus Number: 1206	Date: 7-8-12

Component	Checked	Initials	Comments
ENGINE :			
Oil Dipstick	✓	J.P.	
Oil Filler Hole	✓	J.P.	
Oil Drain Plug	✓	J.P.	
Oil Filter	✓	J.P.	
Fuel Filter	✓	J.P.	
Air Filter	✓	J.P.	
Belts	✓	J.P.	
Coolant Level	✓	J.P.	
Coolant Filler Hole	✓	J.P.	
Coolant Drain	✓	J.P.	
Spark / Glow Plugs	✓	J.P.	
Alternator	✓	J.P.	
Diagnostic Interface Connector	✓	J.P.	
TRANSMISSION :			
Fluid Dip-Stick	✓	J.P.	
Filler Hole	✓	J.P.	Fill through dip tube.
Drain Plug	✓	J.P.	
SUSPENSION :			
Bushings	✓	J.P.	
Shock Absorbers	✓	J.P.	
Air Springs	✓	J.P.	
Leveling Valves	✓	J.P.	
Grease Fittings	✓	J.P.	

ACCESSIBILITY DATA FORM

Bus Number: 1206	Date: 7-9-12

Component	Checked	Initials	Comments
HVAC :			
A/C Compressor	✓	J.P.	
Filters	✓	J.P.	
Fans	✓	J.P.	
ELECTRICAL SYSTEM :			
Fuses	✓	J.P.	
Batteries	✓	J.P.	
Voltage regulator	✓	J.P.	
Voltage Converters	✓	J.P.	
Lighting	✓	J.P.	
MISCELLANEOUS :			
Brakes	✓	J.P.	
Handicap Lifts/Ramps	✓	J.P.	
Instruments	✓	J.P.	
Axles	✓	J.P.	
Exhaust	✓	J.P.	
Fuel System	✓	J.P.	
OTHERS :			

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS

1.3-I. TEST OBJECTIVE

The objective of this test is to establish the time required to replace and/or repair selected subsystems.

1.3-II. TEST DESCRIPTION

The test will involve components that may be expected to fail or require replacement during the service life of the bus. In addition, any component that fails during the NBM testing is added to this list. Components to be included are:

1. Transmission
2. Alternator
3. Starter
4. Batteries
5. Windshield wiper motor

1.3-III. DISCUSSION

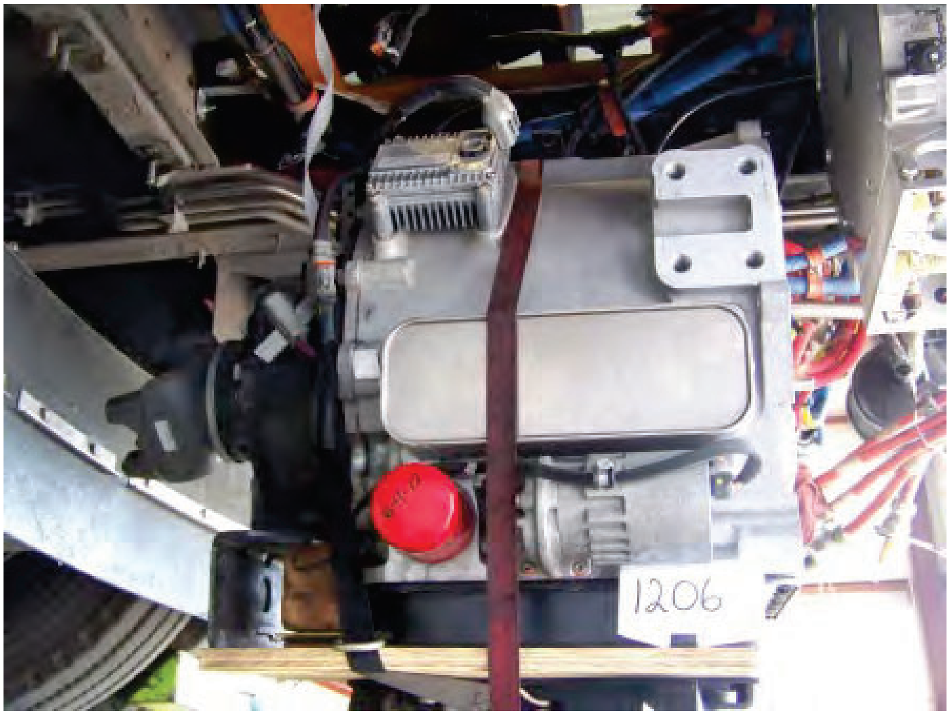
At the end of the test, the remaining items on the list were removed and replaced. The hybrid drive assembly took 10.0 man-hours (two men 5.0 hrs) to remove and replace. The time required for repair/replacement of the four remaining components is given on the following Repair and/or Replacement Form.

REPLACEMENT AND/OR REPAIR FORM

Page 1 of 1

Subsystem	Replacement Time
Hybrid Drive	10.00 man hours
Wiper Motor	0.75 man hours
Starter	0.50 man hours
Hybrid battery pack	1.50 man hours
Batteries	0.50 man hours
Accessory Power System	1.00 man hours

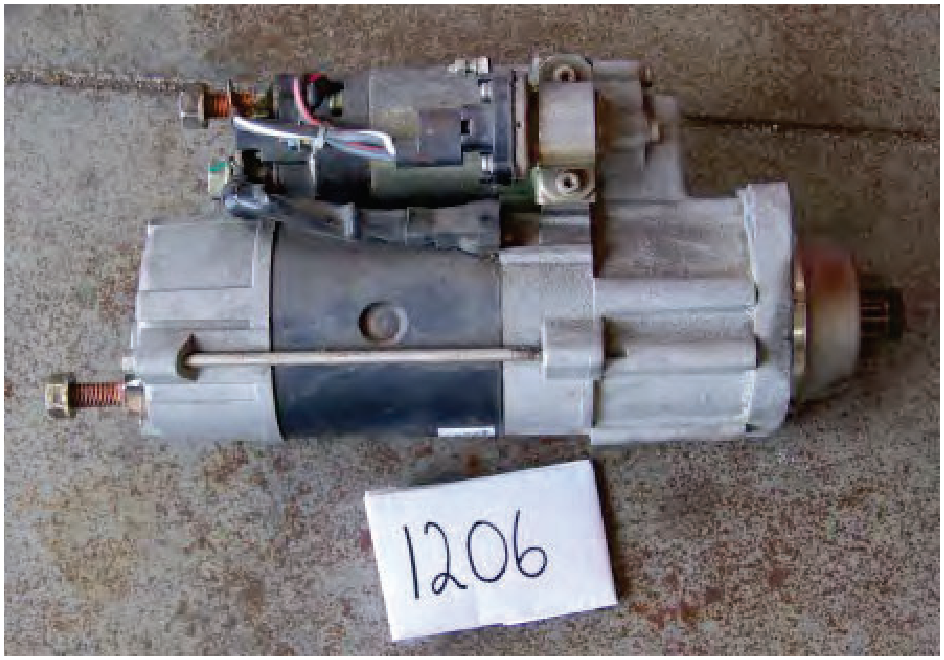
1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS



HYBRID DRIVE REMOVAL AND REPLACEMENT (10.00 MAN HOURS)

WIPER MOTOR REMOVAL AND REPLACEMENT (0.75 MAN HOURS)

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS CONT.



STARTER REMOVAL AND REPLACEMENT (0.50 MAN HOURS)

HYBRID BATTERY PACK REMOVAL AND REPLACEMENT (1.50 MAN HOURS)

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS CONT.

ACCESSORY POWER SYSTEM REMOVAL AND REPLACEMENT (1.00 MAN HOUR)

4.0 PERFORMANCE

4.1 PERFORMANCE - AN ACCELERATION, GRADEABILITY, AND TOP SPEED TEST

4.1-I. TEST OBJECTIVE

The objective of this test is to determine the acceleration, gradeability, and top speed capabilities of the bus.

4.1-II. TEST DESCRIPTION

In this test, the bus will be operated at SLW on the skid pad at the PSBRTF. The bus will be accelerated at full throttle from a standstill to a maximum "geared" or "safe" speed as determined by the test driver. The vehicle speed is measured using a Correvit non-contacting speed sensor. The times to reach speed between ten mile per hour increments are measured and recorded using a stopwatch with a lap timer. The time to speed data will be recorded on the Performance Data Form and later used to generate a speed vs. time plot and gradeability calculations.

4.1-III. DISCUSSION

This test consists of three runs in both the clockwise and counterclockwise directions on the Test Track. Velocity versus time data is obtained for each run and results are averaged together to minimize any test variability which might be introduced by wind or other external factors. The test was performed up to a maximum speed of 50 mph. The fitted curve of velocity vs. time is attached, followed by the calculated gradeability results. The average time to obtain 50 mph was 41.50 seconds.

PERFORMANCE DATA FORM

Bus Number: 1206	Date: 6/6/12
Personnel: M.R., T.S. & E.D.	

Temperature (°F): 63	Humidity (%): 63
Wind Direction: 0	Wind Speed (mph): Calm
Barometric Pressure (in.Hg): 30.02	

		INITIALS:
Ventilation fans-ON HIGH	✓Checked	T.S.
Heater pump motor-Off	✓Checked	T.S.
Defroster-OFF	✓ Checked	T.S.
Exterior and interior lights-ON	✓ Checked	T.S.
Windows and doors-CLOSED	✓ Checked	T.S.

ACCELERATION, GRADEABILITY, TOP SPEED

Counter Clockwise Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	5.31	5.25	5.25
20 mph	9.69	9.35	9.53
30 mph	14.99	14.82	15.16
40 mph	25.71	24.82	25.82
Top Test Speed(mph) 50	45.36	43.32	44.88

Clockwise Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	5.31	5.54	5.35
20 mph	9.43	9.45	9.42
30 mph	14.93	14.74	14.58
40 mph	25.06	24.71	24.77
Top Test Speed(mph) 50	38.47	38.49	38.46

1206.ACC

PERFORMANCE SUMMARY SHEET

BUS MANUFACTURER :GILLIG BUS NUMBER :1206
BUS MODEL :40' LOW FLR BAE HYBR TEST DATE :06/06/12

TEST CONDITIONS :

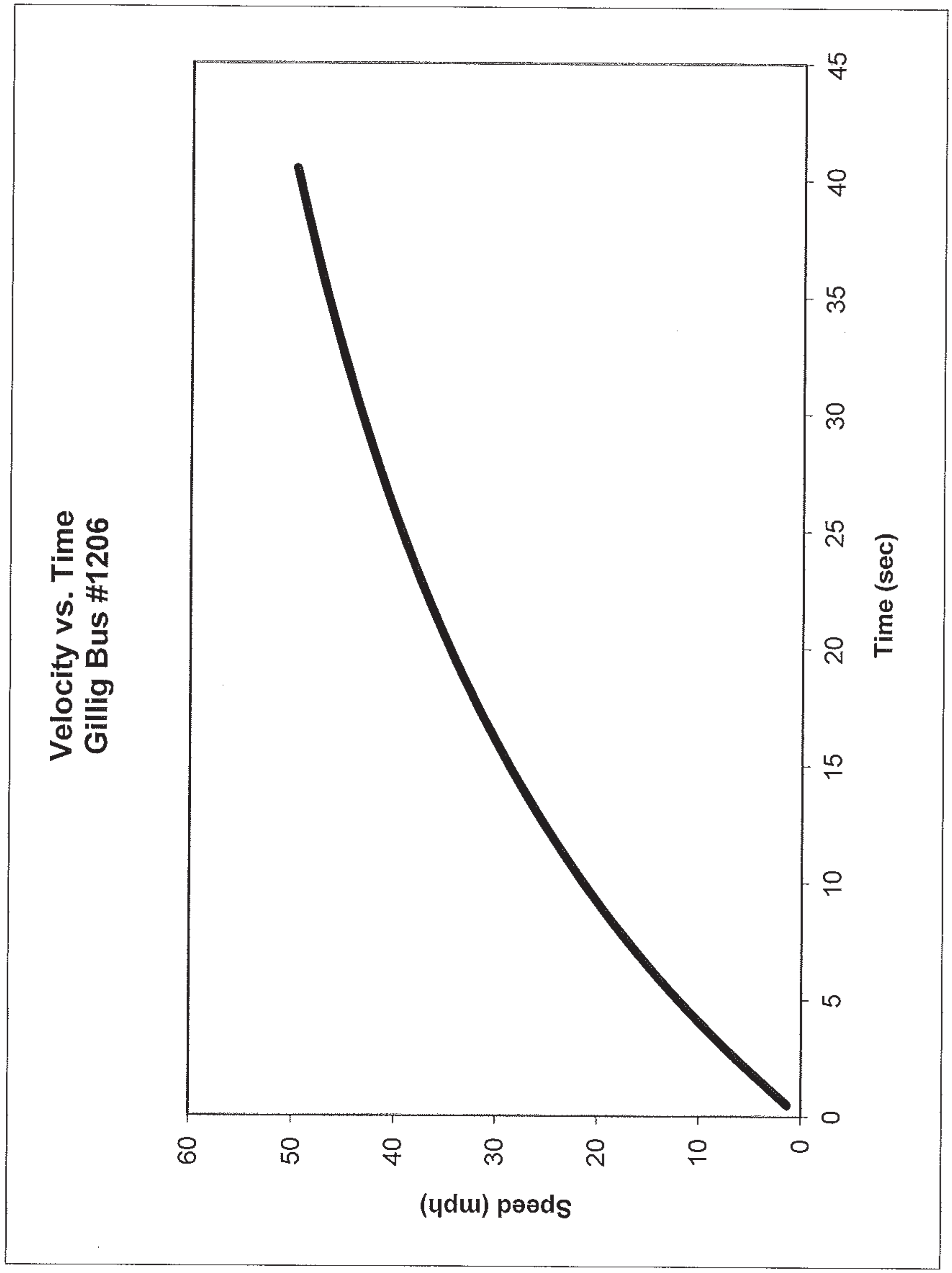
TEMPERATURE (DEG F) : 63.0
WIND DIRECTION : CALM
WIND SPEED (MPH) : .0
HUMIDITY (%) : 63
BAROMETRIC PRESSURE (IN. HG) : 30.0

VEHICLE SPEED (MPH)	AVERAGE TIME (SEC) CCW DIRECTION	CW DIRECTION	TOTAL
10.0	5.27	5.40	5.34
20.0	9.52	9.43	9.48
30.0	14.99	14.75	14.87
40.0	25.45	24.85	25.15
50.0	44.52	38.47	41.50

TEST SUMMARY :

VEHICLE SPEED (MPH)	TIME (SEC)	ACCELERATION (FT/SEC^2)	MAX. GRADE (%)
1.0	.37	4.0	12.4
5.0	1.91	3.6	11.4
10.0	4.04	3.3	10.2
15.0	6.43	2.9	9.0
20.0	9.17	2.5	7.8
25.0	12.32	2.2	6.7
30.0	16.00	1.8	5.7
35.0	20.39	1.5	4.7
40.0	25.71	1.2	3.9
45.0	32.35	1.0	3.1
50.0	40.89	.7	2.3

NOTE : Gradeability results were calculated from performance test data. Actual sustained gradeability performance for vehicles equipped with auto transmission may be lower than the values indicated here.


Velocity vs. Time
Gillig Bus #1206
Speed (mph)
0
10
20
30
40
50
60
Time (sec)
0
5
10
15
20
25
30
35
40
45

4.0 PERFORMANCE

4.2 Performance - Bus Braking

4.2 I. TEST OBJECTIVE

The objective of this test is to provide, for comparison purposes, braking performance data on transit buses produced by different manufacturers.

4.2 II. TEST DESCRIPTION

The testing will be conducted at the PTI Test Track skid pad area. Brake tests will be conducted after completion of the GVW portion of the vehicle durability test. At this point in testing the brakes have been subjected to a large number of braking snubs and will be considered well burnished. Testing will be performed when the bus is fully loaded at its GVW. All tires on each bus must be representative of the tires on the production model vehicle.

The brake testing procedure comprises three phases:

1. Stopping distance tests
   - i. Dry surface (high-friction, Skid Number within the range of 70-76)
   - ii. Wet surface (low-friction, Skid Number within the range of 30-36)
2. Stability tests
3. Parking brake test

Stopping Distance Tests

The stopping distance phase will evaluate service brake stops. All stopping distance tests on dry surface will be performed in a straight line and at the speeds of 20, 30, 40 and 45 mph. All stopping distance tests on wet surface will be performed in straight line at speed of 20 mph.

The tests will be conducted as follows:

1. Uniform High Friction Tests: Four maximum deceleration straight-line brake applications each at 20, 30, 40 and 45 mph, to a full stop on a uniform high-friction surface in a 3.66-m (12-ft) wide lane.

2. Uniform Low Friction Tests: Four maximum deceleration straight-line brake applications from 20 mph on a uniform low friction surface in a 3.66-m (12-ft) wide lane.

When performing service brake stops for both cases, the test vehicle is accelerated on the bus test lane to the speed specified in the test procedure and this speed is maintained into the skid pad area. Upon entry of the appropriate lane of the skid pad area, the vehicle's service brake is applied to stop the vehicle as quickly as possible. The stopping distance is measured and recorded for both cases on the test data form. Stopping distance results on dry and wet surfaces will be recorded and the average of the four measured stopping distances will be considered as the measured stopping distance. Any deviation from the test lane will be recorded.

Stability Tests

This test will be conducted in both directions on the test track. The test consists of four maximum deceleration, straight-line brake applications on a surface with split coefficients of friction (i.e., the wheels on one side run on high-friction SN 70-76 or more and the other side on low-friction [where the lower coefficient of friction should be less than half of the high one] at initial speed of 30 mph).

(I) The performance of the vehicle will be evaluated to determine if it is possible to keep the vehicle within a 3.66m (12 ft) wide lane, with the dividing line between the two surfaces in the lane’s center. The steering wheel input angle required to keep the vehicle in the lane during the maneuver will be reported.

Parking Brake Test

The parking brake phase utilizes the brake slope, which has a 20% grade. The test vehicle, at its GVW, is driven onto the brake slope and stopped. With the transmission in neutral, the parking brake is applied and the service brake is released. The test vehicle is required to remain stationary for five minutes. The parking brake test is performed with the vehicle facing uphill and downhill.

4.2-III. DISCUSSION

The Stopping Distance phase of the Brake Test was completed with the following results; for the Uniform High Friction Test average stopping distances were 28.93’ at 20 mph, 58.16’ at 30 mph, 100.68’ at 40 mph and 130.90’ at 45 mph. The average stopping distance for the Uniform Low Friction Test was 30.38’ There was no deviation from the test lane during the performance of the Stopping Distance phase.

During the Stability phase of Brake Testing the test bus experienced no deviation from the test lane but did experience pull to the left during both approaches to the Split Friction Road surface.

The Parking Brake phase was completed with the test bus maintaining the parked position for the full five minute period with no slip or roll observed in both the uphill and downhill positions.

Table 4.2-6. Braking Test Data Forms

Page 1 of 3

Bus Number: 1206	Date: 4-25-12
Personnel: M.R., T.S. & E.D.	
Amb. Temperature (^{o}F): 52	Wind Speed (mph): 1
Wind Direction: N	Pavement Temp (°F): Start: 57.9 End: 85.3

TIRE INFLATION PRESSURE (psi):

Tire Type:
Front: Goodyear Metro Miler 305/85R 22.5 Rear: Goodyear Metro Miler 305/85R 22.5

	Left Tire(s)		Right Tire(s)	
Front	120		120	
	Inner	Outer	Inner	Outer
Rear	120	120	120	120
Rear	N/A	N/A	N/A	N/A

AXLE LOADS (lb)

	Left	Right
Front	6,900	7,080
Rear	14,560	12,670

FINAL INSPECTION

Bus Number: 1206	Date: 4-25-12
Personnel: T.S., E.D. & M.R.	

Table 4.2-7. Record of All Braking System Faults/Repairs.

Date	Personnel	Fault/Repair	Description
4-25-12	T.S. & E.D.	None noted.	

Table 4.2-8.1. Stopping Distance Test Results Form

Stopping Distance (ft)					
Vehicle Direction	CW	CW	CCW	CCW	
Speed (mph)	**Stop 1**	**Stop 2**	**Stop 3**	**Stop 4**	**Average**
20 (dry)	29.71	29.66	26.87	29.46	28.93
30 (dry)	58.31	58.37	58.47	57.47	58.16
40 (dry)	101.07	100.5	100.45	101.15	100.68
45 (dry)	130.99	130.73	131.61	130.76	130.90
20 (wet)	30.06	30.77	30.44	30.24	30.38

Table 4.2-8.2. Stability Test Results Form

Stability Test Results (Split Friction Road surface)		
Vehicle Direction	Attempt	Did test bus stay in 12’ lane? (yes/no)
CW	1	Yes
	2	Yes
CCW	1	Yes
	2	Yes

Table 4.2-8.3. Parking Brake Test Form

Page 3 of 3

PARKING BRAKE (Fully Loaded) – GRADE HOLDING						
Vehicle Direction	Attempt	Hold Time (min)	Slide (in)	Roll (in)	Did Hold	No Hold
Front up	1	5 min.	0	0	✓	
	2					
	3					
Front down	1	5 min.	0	0	✓	
	2					
	3					

6. FUEL ECONOMY TEST - A FUEL CONSUMPTION TEST USING AN APPROPRIATE OPERATING CYCLE

6-I. TEST OBJECTIVE

The objective of this test is to provide accurate comparable fuel consumption data on transit buses produced by different manufacturers. This fuel economy test bears no relation to the calculations done by the Environmental Protection Agency (EPA) to determine levels for the Corporate Average Fuel Economy Program. EPA's calculations are based on tests conducted under laboratory conditions intended to simulate city and highway driving. This fuel economy test, as designated here, is a measurement of the fuel expended by a vehicle traveling a specified test loop under specified operating conditions. The results of this test will not represent actual mileage but will provide data that can be used by recipients to compare buses tested by this procedure.

6-II. TEST DESCRIPTION

This test requires operation of the bus over a course based on the Transit Coach Operating Duty Cycle (ADB Cycle) at seated load weight using a procedure based on the Fuel Economy Measurement Test (Engineering Type) For Trucks and Buses: SAE 1376 July 82. The procedure has been modified by elimination of the control vehicle and by modifications as described below. The inherent uncertainty and expense of utilizing a control vehicle over the operating life of the facility is impractical.

The fuel economy test will be performed as soon as possible (weather permitting) after the completion of the GVW portion of the structural durability test. It will be conducted on the bus test lane at the Penn State Test Facility. Signs are erected at carefully measured points which delineate the test course. A test run will comprise 3 CBD phases, 2 Arterial phases, and 1 Commuter phase. An electronic fuel measuring system will indicate the amount of fuel consumed during each phase of the test. The test runs will be repeated until there are at least two runs in both the clockwise and counterclockwise directions in which the fuel consumed for each run is within ± 4 percent of the average total fuel used over the 4 runs. A 20-minute idle consumption test is performed just prior to and immediately after the driven portion of the fuel economy test. The amount of fuel consumed while operating at normal/low idle is recorded on the Fuel Economy Data Form. This set of four valid runs along with idle consumption data comprise a valid test.

The test procedure is the ADB cycle with the following four modifications:

1. The ADB cycle is structured as a set number of miles in a fixed time in the following order: CBD, Arterial, CBD, Arterial, CBD, and Commuter. A separate idle fuel consumption measurement is performed at the beginning and end of the fuel economy test. This phase sequence permits the reporting of fuel consumption for each of these phases separately, making the data more useful to bus manufacturers and transit properties.

2. The operating profile for testing purposes shall consist of simulated transit type service at seated load weight. The three test phases (figure 6-1) are: a central business district (CBD) phase of 2 miles with 7 stops per mile and a top speed of 20 mph; an arterial phase of 2 miles with 2 stops per mile and a top speed of 40 mph; and a commuter phase of 4 miles with 1 stop and a maximum speed of 40 mph. At each designated stop the bus will remain stationary for seven seconds. During this time, the passenger doors shall be opened and closed.

3. The individual ADB phases remain unaltered with the exception that 1 mile has been changed to 1 lap on the Penn State Test Track. One lap is equal to 5,042 feet. This change is accommodated by adjusting the cruise distance and time.

4. The acceleration profile, for practical purposes and to achieve better repeatability, has been changed to "full throttle acceleration to cruise speed".

Several changes were made to the Fuel Economy Measurement Test (Engineering Type) For Trucks and Buses: SAE 1376 July 82:

1. Sections 1.1, and 1.2 only apply to diesel, gasoline, methanol, and any other fuel in the liquid state (excluding cryogenic fuels).

1.1 SAE 1376 July 82 requires the use of at least a 16-gal fuel tank. Such a fuel tank when full would weigh approximately 160 lb. It is judged that a 12-gal tank weighing approximately 120 lb will be sufficient for this test and much easier for the technician and test personnel to handle.

1.2 SAE 1376 July 82 mentions the use of a mechanical scale or a flowmeter system. This test procedure uses a load cell readout combination that provides an accuracy of 0.5 percent in weight and permits on-board weighing of the gravimetric tanks at the end of each phase. This modification permits the determination of a fuel economy value for each phase as well as the overall cycle.

2. Section 2.1 applies to compressed natural gas (CNG), liquefied natural gas (LNG), cryogenic fuels, and other fuels in the vapor state.

2.1 A laminar type flowmeter will be used to determine the fuel consumption. The pressure and temperature across the flow element will be monitored by the flow computer. The flow computer will use this data to calculate the gas flow rate. The flow computer will also display the flow rate (scfm) as well as the total fuel used (scf). The total fuel used (scf) for each phase will be recorded on the Fuel Economy Data Form.

3. Use both Sections 1 and 2 for dual fuel systems.

FUEL ECONOMY CALCULATION PROCEDURE

A. For diesel, gasoline, methanol and fuels in the liquid state.

The reported fuel economy is based on the following: measured test quantities--distance traveled (miles) and fuel consumed (pounds); standard reference values--density of water at 60EF (8.3373 lbs/gal) and volumetric heating value of standard fuel; and test fuel specific gravity (unitless) and volumetric heating value (BTU/gal). These combine to give a fuel economy in miles per gallon (mpg) which is corrected to a standard gallon of fuel referenced to water at 60EF. This eliminates fluctuations in fuel economy due to fluctuations in fuel quality. This calculation has been programmed into a computer and the data processing is performed automatically.

The fuel economy correction consists of three steps:

1.) Divide the number of miles of the phase by the number of pounds of fuel consumed

phase	miles per phase	total miles per run
CBD	1.9097	5.7291
ART	1.9097	3.8193
COM	3.8193	3.8193

$$\mathbf{FEo_{mi/lb}} = \text{Observed fuel economy} = \frac{\text{miles}}{\text{lb of fuel}}$$

2.) Convert the observed fuel economy to miles per gallon [mpg] by multiplying by the specific gravity of the test fuel Gs (referred to water) at 60°F and multiply by the density of water at 60°F

$$\mathbf{FEo_{mpg} = FEc_{mi/lb}} \times Gs \times Gw$$

where **Gs** = Specific gravity of test fuel at 60°F (referred to water)
Gw = 8.3373 lb/gal

3.) Correct to a standard gallon of fuel by dividing by the volumetric heating value of the test fuel (H) and multiplying by the volumetric heating value of standard reference fuel (Q). Both heating values must have the same units.

$$\mathbf{FEc = FEo_{mpg}} \times \frac{Q}{H}$$

where

H = Volumetric heating value of test fuel [BTU/gal]
Q = Volumetric heating value of standard reference fuel

Combining steps 1-3 yields

$$\Longrightarrow \; FEc = \frac{miles}{lbs} \times (Gs \times Gw) \times \frac{Q}{H}$$

4.) Covert the fuel economy from mpg to an energy equivalent of miles per BTU. Since the number would be extremely small in magnitude, the energy equivalent will be represented as miles/BTUx10^6.

Eq = Energy equivalent of converting mpg to mile/BTUx10^6.

$Eq = ((mpg)/(H))x10^6$

B. CNG, LNG, cryogenic and other fuels in the vapor state.

The reported fuel economy is based on the following: measured test quantities--distance traveled (miles) and fuel consumed (scf); density of test fuel, and volumetric heating value (BTU/lb) of test fuel at standard conditions (P=14.73 psia and T=60°F). These combine to give a fuel economy in miles per lb. The energy equivalent (mile/BTUx10^6) will also be provided so that the results can be compared to buses that use other fuels.

1.) Divide the number of miles of the phase by the number of standard cubic feet (scf) of fuel consumed.

phase	miles per phase	total miles per run
CBD	1.9097	5.7291
ART	1.9097	3.8193
COM	3.8193	3.8193

$$\mathbf{FEo_{mi/scf}} = \text{Observed fuel economy} = \frac{\text{miles}}{\text{scf of fuel}}$$

2.) Convert the observed fuel economy to miles per lb by dividing FEo by the density of the test fuel at standard conditions (Lb/ft^3).

Note: The density of test fuel must be determined at standard conditions as described above. If the density is not defined at the above standard conditions, then a correction will be needed before the fuel economy can be calculated.

$$\mathbf{FEo_{mi/lb}} = FEo / Gm$$

where Gm = Density of test fuel at standard conditions

3.) Convert the observed fuel economy (FEomi/lb) to an energy equivalent of ($miles/BTUx10^6$) by dividing the observed fuel economy (FEomi/lb) by the heating value of the test fuel at standard conditions.

$$Eq = ((FEomi/lb)/H)x10^6$$

where

Eq = Energy equivalent of miles/lb to $mile/BTUx10^6$
H = Volumetric heating value of test fuel at standard conditions

6-III. DISCUSSION

This is a comparative test of fuel economy using diesel fuel with a heating value of 20,208 btu/lb. The driving cycle consists of Central Business District (CBD), Arterial (ART), and Commuter (COM) phases as described in 6-II. The fuel consumption for each driving cycle and for idle is measured separately. The results are corrected to a reference fuel with a volumetric heating value of 126,700.0 btu/gal.

An extensive pretest maintenance check is made including the replacement of all lubrication fluids. The details of the pretest maintenance are given in the first three Pretest Maintenance Forms. The fourth sheet shows the Pretest Inspection. The next sheet shows the correction calculation for the test fuel. The next four Fuel Economy Forms provide the data from the four test runs. Finally, the summary sheet provides the average fuel consumption. The overall average is based on total fuel and total mileage for each phase. The overall average fuel consumption values were; CBD – 4.66 mpg, ART – 3.87 mpg, and COM – 5.76 mpg. Average fuel consumption at idle was 0.86 gph.

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 1206	Date: 6-25-12	SLW (lbs): 36,480
Personnel: T.S., S.R. & T.G.		

FUEL SYSTEM	OK	Date	Initials
Install fuel measurement system	✓	6/25/12	T.S.
Replace fuel filter	✓	6/25/12	T.S.
Check for fuel leaks	✓	6/25/12	T.S.
Specify fuel type (refer to fuel analysis)	Diesel		
Remarks: None noted.			
BRAKES/TIRES	**OK**	**Date**	**Initials**
Inspect hoses	✓	6/25/12	S.R.
Inspect brakes	✓	6/25/12	S.R.
Relube wheel bearings	✓	6/25/12	S.R.
Check tire inflation pressures (mfg. specs.)	✓	6/25/12	S.R.
Remarks: None noted.			
COOLING SYSTEM	**OK**	**Date**	**Initials**
Check hoses and connections	✓	6/25/12	T.G.
Check system for coolant leaks	✓	6/25/12	T.G.
Remarks: None noted.			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 1206	Date: 6-25-12
Personnel: T.S., S.R. & T.G.	

ELECTRICAL SYSTEMS	OK	Date	Initials
Check battery	✓	6/25/12	T.G.
Inspect wiring	✓	6/25/12	T.G.
Inspect terminals	✓	6/25/12	T.G.
Check lighting	✓	6/25/12	T.G.
Remarks: None noted.			
DRIVE SYSTEM	OK	Date	Initials
Drain transmission fluid	✓	6/25/12	T.S.
Replace filter/gasket	✓	6/25/12	T.S.
Check hoses and connections	✓	6/25/12	S.R.
Replace transmission fluid	✓	6/25/12	S.R.
Check for fluid leaks	✓	6/25/12	S.R.
Remarks: None noted.			
LUBRICATION	OK	Date	Initials
Drain crankcase oil	✓	6/25/12	T.S.
Replace filters	✓	6/25/12	T.S.
Replace crankcase oil	✓	6/25/12	T.G.
Check for oil leaks	✓	6/25/12	T.G.
Check oil level	✓	6/25/12	T.G.
Lube all chassis grease fittings	✓	6/25/12	S.R.
Lube universal joints	✓	6/25/12	S.R.
Replace differential lube including axles	✓	6/25/12	S.R.
Remarks: None noted.			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 1206	Date: 6-25-12
Personnel: T.S., S.R. & T.G.	

EXHAUST/EMISSION SYSTEM	OK	Date	Initials
Check for exhaust leaks	✓	6/25/12	T.G.
Remarks: None noted.			

ENGINE	OK	Date	Initials
Replace air filter	✓	6/25/12	T.S.
Inspect air compressor and air system	✓	6/25/12	S.R.
Inspect vacuum system, if applicable	✓	6/25/12	S.R.
Check and adjust all drive belts	✓	6/25/12	S.R.
Check cold start assist, if applicable	✓	6/25/12	S.R.
Remarks: None noted.			

STEERING SYSTEM	OK	Date	Initials
Check power steering hoses and connectors	✓	6/25/12	T.G.
Service fluid level	✓	6/25/12	T.G.
Check power steering operation	✓	6/25/12	T.G.
Remarks: None noted.			

	OK	Date	Initials
Ballast bus to seated load weight	✓	6/25/12	T.S.

TEST DRIVE	OK	Date	Initials
Check brake operation	✓	6/25/12	T.S.
Check transmission operation	✓	6/25/12	T.S.
Remarks: None noted.			

FUEL ECONOMY PRE-TEST INSPECTION FORM

Bus Number: 1206	Date: 6-26-12
Personnel: T.S. & S.R.	

PRE WARM-UP	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	T.S.
Cold tire pressure (psi): Front 110 Middle N/A Rear 105	S.R.
Tire wear:	S.R.
Engine oil level	T.S.
Engine coolant level	T.S.
Interior and exterior lights on, evaporator fan on	T.S.
Fuel economy instrumentation installed and working properly.	T.S.
Fuel line -- no leaks or kinks	T.S.
Speed measuring system installed on bus. Speed indicator installed in front of bus and accessible to TECH and Driver.	S.R.
Bus is loaded to SLW	T.S.
WARM-UP	**If OK, Initial**
Bus driven for at least one hour warm-up	T.S.
No extensive or black smoke from exhaust	T.S.
POST WARM-UP	**If OK, Initial**
Warm tire pressure (psi): Front 110 Middle N/A Rear 105	T.S.
Environmental conditions Average wind speed <12 mph and maximum gusts <15 mph Ambient temperature between 30°F(-1C°) and 90°F(32°C) Track surface is dry Track is free of extraneous material and clear of interfering traffic	T.S.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Page 1 of 4

Bus Number: 1206	Manufacturer: Gillig	Date: 6-26-12
Run Number: 1	Personnel: B.G., T.S. & S.R.	
Test Direction: ☐CW or ■CCW	Temperature (°F): 61	Humidity (%): 55
SLW (lbs): 36,480	Wind Speed (mph) & Direction:13/NNW	Barometric Pressure (in.Hg): 29.92

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Flow Meter Reading (gals)		Fuel Used (gals)
	Start	Finish		Start	Start	Finish	
CBD #1	0	9:06	9:06	33.8	0	.372	.372
ART #1	0	4:12	4:12	35.2	0	.455	.455
CBD #2	0	9:10	9:10	35.5	0	.351	.351
ART #2	0	4:13	4:13	37.4	0	.437	.437
CBD #3	0	9:11	9:11	37.2	0	.352	.352
COMMUTER	0	6:03	6:03	38.7	0	.566	.566
							Total Fuel = 2.533 gals

20 minute idle : Total Fuel Used = 0.282 gals

Heating Value = 20,208 BTU/LB

Comments: None noted.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 1206	Manufacturer: Gillig	Date: 6-26-12
Run Number: 2	Personnel: B.G., T.S. & S.R.	
Test Direction: ■CW or □CCW	Temperature (°F): 62	Humidity (%): 55
SLW (lbs): 36,480	Wind Speed (mph) & Direction:13/NNW	Barometric Pressure (in.Hg): 29.92

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Flow Meter Reading (gals)		Fuel Used (gals)
	Start	Finish		Start	Start	Finish	
CBD #1	0	9:11	9:11	38.1	0	.336	.336
ART #1	0	4:14	4:14	39.7	0	.444	.444
CBD #2	0	9:11	9:11	38.1	0	.351	.351
ART #2	0	4:13	4:13	38.6	0	.430	.430
CBD #3	0	9:11	9:11	38.9	0	.349	.349
COMMUTER	0	6:05	6:05	40.4	0	.577	.577
							Total Fuel = 2.487 gals

20 minute idle : Total Fuel Used = N/A gals

Heating Value = 20,208 BTU/LB

Comments: None noted.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 1206	Manufacturer: Gillig	Date: 6-26-12
Run Number: 3	Personnel: B.G., T.S. & S.R.	
Test Direction: □CW or ■CCW	Temperature (°F): 64	Humidity (%): 49
SLW (lbs): 36,480	Wind Speed (mph) & Direction:13/NNW	Barometric Pressure (in.Hg): 29.91

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Flow Meter Reading (gals)		Fuel Used (gals)
	Start	Finish		Start	Start	Finish	
CBD #1	0	9:07	9:07	35.3	0	.375	.375
ART #1	0	4:13	4:13	36.5	0	.431	.431
CBD #2	0	9:11	9:11	36.2	0	.381	.381
ART #2	0	4:11	4:11	40.6	0	.416	.416
CBD #3	0	9:10	9:10	38.2	0	.358	.358
COMMUTER	0	6:01	6:01	39.8	0	.600	.600
							Total Fuel = 2.561 gals

20 minute idle : Total Fuel Used = N/A gals

Heating Value = 20,2078 BTU/LB

Comments: None noted.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 1206	Manufacturer: Gillig	Date: 6-26-12
Run Number: 4	Personnel: B.G., T.S. & S.R.	
Test Direction: ■CW or □CCW	Temperature (°F): 73	Humidity (%): 29
SLW (lbs): 36,480	Wind Speed (mph) & Direction:13/NNW	Barometric Pressure (in.Hg): 29.85

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Flow Meter Reading (gals)		Fuel Used (gals)
	Start	Finish		Start	Start	Finish	
CBD #1	0	9:11	9:11	40.1	0	.356	.356
ART #1	0	4:15	4:15	39.5	0	.442	.442
CBD #2	0	9:05	9:05	37.8	0	.364	.364
ART #2	0	4:16	4:16	41.3	0	.410	.410
CBD #3	0	9:13	9:13	38.9	0	.376	.376
COMMUTER	0	6:04	6:04	41.2	0	.585	.585
							Total Fuel = 2.533 gals

20 minute idle : Total Fuel Used = 0.221 gals

Heating Value = 20,208 BTU/LB

Comments: None noted.

FUEL ECONOMY SUMMARY SHEET

BUS MANUFACTURER :**Gillig** BUS NUMBER :**1206**
BUS MODEL :BAE Hybrid TEST DATE :06/26/12

FUEL TYPE : DIESEL
SP. GRAVITY : .8400
HEATING VALUE : 20208.00 BTU/Lb
FUEL TEMPERATURE : 99.00 deg F
Standard Conditions : 60 deg F and 14.7 psi
Density of Water : 8.3373 lb/gallon at 60 deg F

CYCLE	TOTAL FUEL USED(GAL)	TOTAL MILES	FUEL ECONOMY MPG(Measured)	FUEL ECONOMY MPG (Corrected)
Run # :1, CCW				
CBD	1.075	5.73	5.330	4.68
ART	.892	3.82	4.283	3.76
COM	.566	3.82	6.749	5.92
TOTAL	2.533	13.37	5.278	4.63
Run # :2, CW				
CBD	1.036	5.73	5.531	4.86
ART	.874	3.82	4.371	3.84
COM	.577	3.82	6.620	5.81
TOTAL	2.487	13.37	5.376	4.72
Run # :3, CCW				
CBD	1.114	5.73	5.144	4.52
ART	.847	3.82	4.510	3.96
COM	.600	3.82	6.367	5.59
TOTAL	2.561	13.37	5.221	4.58
Run # :4, CW				
CBD	1.096	5.73	5.228	4.59
ART	.852	3.82	4.484	3.94
COM	.585	3.82	6.530	5.73
TOTAL	2.533	13.37	5.278	4.63

IDLE CONSUMPTION (MEASURED)

First 20 Minutes Data : .28GAL Last 20 Minutes Data : .22GAL
Average Idle Consumption : .75GAL/Hr

RUN CONSISTENCY: % Difference from overall average of total fuel used

Run 1 : -.2 Run 2 : 1.6 Run 3 : -1.3 Run 4 : -.2

SUMMARY (CORRECTED VALUES)

Average Idle Consumption : .86 G/Hr
Average CBD Phase Consumption : 4.66 MPG
Average Arterial Phase Consumption : 3.87 MPG
Average Commuter Phase Consumption : 5.76 MPG
Overall Average Fuel Consumption : 4.64 MPG
Overall Average Fuel Consumption : 32.80 Miles/ Million BTU

7. NOISE

7.1 INTERIOR NOISE AND VIBRATION TESTS

7.1-I. TEST OBJECTIVE

The objective of these tests is to measure and record interior noise levels and check for audible vibration under various operating conditions.

7.1-II. TEST DESCRIPTION

During this series of tests, the interior noise level will be measured at several locations with the bus operating under the following three conditions:

1. With the bus stationary, a white noise generating system shall provide a uniform sound pressure level equal to 80 dB(A) on the left, exterior side of the bus. The engine and all accessories will be switched off and all openings including doors and windows will be closed. This test will be performed at the ABTC.

2. The bus accelerating at full throttle from a standing start to 35 mph on a level pavement. All openings will be closed and all accessories will be operating during the test. This test will be performed on the track at the Test Track Facility.

3. The bus will be operated at various speeds from 0 to 55 mph with and without the air conditioning and accessories on. Any audible vibration or rattles will be noted. This test will be performed on the test segment between the Test Track and the Bus Testing Center.

All tests will be performed in an area free from extraneous sound-making sources or reflecting surfaces. The ambient sound level as well as the surrounding weather conditions will be recorded in the test data.

7.1-III. DISCUSSION

This test is performed in three parts. The first part exposes the exterior of the vehicle to 80.0 dB(A) on the left side of the bus and the noise transmitted to the interior is measured. The overall average of the six measurements was 49.82 dB(A); ranging from 47.6 dB(A) at the driver's seat to 51.5 dB(A) in line with the middle speaker. The interior ambient noise level for this test was 30.3 dB(A).

The second test measures interior noise during acceleration from 0 to 35 mph. This noise level ranged from 65.1 dB(A) at the driver's seat to 70.7 dB(A) at the rear passenger seats. The overall average was 68.6 dB(A). The interior ambient noise level for this test was < 30.0 dB(A).

The third part of the test is to listen for resonant vibrations, rattles, and other noise sources while operating over the road. No vibrations or rattles were noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 1: 80 dB(A) Stationary White Noise

Bus Number: 1206	Date: 4-11-12
Personnel: T.S. & E.D.	
Temperature (°F): 41	Humidity (%): 70
Wind Speed (mph): 6	Wind Direction: W
Barometric Pressure (in.Hg): 29.92	
Initial Sound Level Meter Calibration: ■ checked by: T.S.	
Interior Ambient Noise Level dB(A): 30.3	Exterior Ambient Noise Level dB(A): 49.7
Microphone Height During Testing (in): 48	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	47.6
Front Passenger Seats	53.1
In Line with Front Speaker	50.5
In Line with Middle Speaker	51.5
In Line with Rear Speaker	48.5
Rear Passenger Seats	47.7

Final Sound Level Meter Calibration: ■ checked by: T.S.

Comments: All readings taken in the center aisle.

Remarks/comments/recommended changes: None noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 2: 0 to 35 mph Acceleration Test

Bus Number: 1206	Date: 6-6-12
Personnel: M.R., T.S. & E.D.	
Temperature (°F): 63	Humidity (%): 63
Wind Speed (mph): 0	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.02	
Initial Sound Level Meter Calibration: ■ checked by: E.D.	
Interior Ambient Noise Level dB(A): < 30	Exterior Ambient Noise Level dB(A): 38.6
Microphone Height During Testing (in): 29” above seat cushion.	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	65.1
Front Passenger Seats	68.5
Middle Passenger Seats	70.0
Rear Passenger Seats	70.7

Final Sound Level Meter Calibration: ■ checked by: E.D.

Comments: All readings taken in the center aisle.

Remarks/comments/recommended changes: None noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 3: Audible Vibration Test

Bus Number: 1206	Date: 6-6-12
Personnel: M.R., T.S. & E.D.	
Temperature (°F): 63	Humidity (%): 63
Wind Speed (mph): 0	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.02	

Describe the following possible sources of noise and give the relative location on the bus.

Source of Noise	Location
Engine and Accessories	None noted.
Windows and Doors	None noted.
Seats and Wheel Chair lifts	None noted.

Comment on any other vibration or noise source which may have occurred that is not described above: None noted.
Remarks/comments/recommended changes: None noted.

7.1 INTERIOR NOISE TEST

TEST BUS SET-UP FOR 80 dB(A)
INTERIOR NOISE TEST

7.2 EXTERIOR NOISE TESTS

7.2-I. TEST OBJECTIVE

The objective of this test is to record exterior noise levels when a bus is operated under various conditions.

7.2-II. TEST DESCRIPTION

In the exterior noise tests, the bus will be operated at a SLW in three different conditions using a smooth, straight and level roadway:

1. Accelerating at full throttle from a constant speed at or below 35 mph and just prior to transmission up shift.
2. Accelerating at full throttle from standstill.
3. Stationary, with the engine at low idle, high idle, and wide open throttle.

In addition, the buses will be tested with and without the air conditioning and all accessories operating. The exterior noise levels will be recorded.

The test site is at the PSBRTF and the test procedures will be in accordance with SAE Standards SAE J366b, Exterior Sound Level for Heavy Trucks and Buses. The test site is an open space free of large reflecting surfaces. A noise meter placed at a specified location outside the bus will measure the noise level.

During the test, special attention should be paid to:

1. The test site characteristics regarding parked vehicles, signboards, buildings, or other sound-reflecting surfaces
2. Proper usage of all test equipment including set-up and calibration
3. The ambient sound level

7.2-III. DISCUSSION

The Exterior Noise Test determines the noise level generated by the vehicle under different driving conditions and at stationary low and high idle, with and without air conditioning and accessories operating. The test site is a large, level, bituminous paved area with no reflecting surfaces nearby.

With an exterior ambient noise level of 39.1 dB(A), the average test result obtained while accelerating from a constant speed was 67.8 dB(A) on the right side and 65.9 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 39.1 dB(A), the average of the results obtained were 66.1 dB(A) on the right side and 62.8 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 58.7 dB(A) at low idle, 61.7 dB(A) at high idle, and 67.6 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 2.6 dB(A) lower at low idle, 1.7 dB(A) lower at high idle, and 0.3 dB(A) lower at wide open throttle. The exterior ambient noise level measured during this test was 39.1 dB(A).

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed

Page 1 of 3

Bus Number: 1206	Date: 6-6-12
Personnel: M.R., T.S. & E.D.	
Temperature (°F): 63	Humidity (%): 63
Wind Speed (mph): 0	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.02	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■ checked by: T.S.	
Initial Sound Level Meter Calibration: ■ checked by: T.S.	
Exterior Ambient Noise Level dB(A): 39.1	

Accelerating from Constant Speed Curb (Right) Side		Accelerating from Constant Speed Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	67.9	1	64.6
2	67.2	2	65.7
3	67.6	3	66.0
4	67.7	4	65.2
5	67.6	5	65.2
Average of two highest actual noise levels = 67.8 dB(A)		Average of two highest actual noise levels = 65.9 dB(A)	

Final Sound Level Meter Calibration Check: ■ checked by: T.S.

Remarks/Comments/recommended changes: None noted.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill

Bus Number: 1206	Date: 6-6-12
Personnel: M.R., T.S. & E.D.	
Temperature (°F): 63	Humidity (%): 63
Wind Speed (mph): 0	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.02	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■ checked by: T.S.	
Initial Sound Level Meter Calibration: ■ checked by: T.S.	
Exterior Ambient Noise Level dB(A): 39.1	

Accelerating from Standstill Curb (Right) Side		Accelerating from Standstill Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	64.3	1	62.5
2	65.1	2	65.8
3	65.8	3	62.6
4	65.9	4	62.5
5	66.3	5	62.7
Average of two highest actual noise levels = 66.1 dB(A)		Average of two highest actual noise levels = 62.8 dB(A)	

Final Sound Level Meter Calibration Check: ■ checked by: T.S.

Remarks/comments/recommended changes: None noted.

EXTERIOR NOISE TEST DATA FORM
Stationary

Bus Number: 1206	Date: 6-6-12
Personnel: M.R., T.S. & E.D.	
Temperature (°F): 63	Humidity (%): 63
Wind Speed (mph): 0	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.02	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■ checked by: T.S.	
Initial Sound Level Meter Calibration: ■ checked by: T.S.	
Exterior Ambient Noise Level dB(A): 39.1	

Accessories and Air Conditioning ON

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	800	59.2	58.1
High Idle	1,200	63.2	60.1
Wide Open Throttle	2,299	68.9	66.3

Accessories and Air Conditioning OFF

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	800	57.2	54.9
High Idle	1,200	61.2	58.7
Wide Open Throttle	2,298	68.3	66.3

Final Sound Level Meter Calibration Check: ■ checked by: T.S.

Remarks/Comments/recommended changes: None noted.

7.2 EXTERIOR NOISE TESTS

TEST BUS UNDERGOING EXTERIOR NOISE TESTING

8. EMISSIONS TEST – DYNAMOMETER-BASED EMISSIONS TEST USING TRANSIT DRIVING CYCLES

8-I. TEST OBJECTIVE

The objective of this test is to provide comparable emissions data on transit buses produced by different manufacturers. This chassis-based emissions test bears no relation to engine certification testing performed for compliance with the Environmental Protection Agency (EPA) regulation. EPA's certification tests are performed using an engine dynamometer operating under the Federal Test Protocol. This emissions test is a measurement of the gaseous engine emissions CO, CO2, NOx, HC and particulates (diesel vehicles) produced by a vehicle operating on a large-roll chassis dynamometer. The test is performed for three differed driving cycles intended to simulate a range of transit operating environments. The cycles consist of Manhattan Cycle, the Orange County Bus driving cycle, and the Urban Dynamometer Driving Cycle (UDDS). The test is performed under laboratory conditions in compliance with EPA 1065 and SAE J2711. The results of this test may not represent actual in-service vehicle emissions but will provide data that can be used by recipients to compare buses tested under different operating conditions.

8-II. TEST DESCRIPTION

This test is performed in the emissions bay of the LTI Vehicle Testing Laboratory. The Laboratory is equipped with a Schenk Pegasus 300 HP, large-roll (72 inch diameter) chassis dynamometer suitable for heavy-vehicle emissions testing. The dynamometer is located in the end test bay and is adjacent to the control room and emissions analysis area. The emissions laboratory provides capability for testing heavy-duty diesel and alternative-fueled buses for a variety of tailpipe emissions including particulate matter, oxides of nitrogen, carbon monoxide, carbon dioxide, and hydrocarbons. It is equipped with a Horiba full-scale CVS dilution tunnel and emissions sampling system. The system includes Horiba Mexa 7400 Series gas analyzers and a Horiba HF47 Particulate Sampling System. Test operation is automated using Horiba CDTCS software. The computer controlled dynamometer is capable of simulating over-the-road operation for a variety of vehicles and driving cycles.

The emissions test will be performed as soon as permissible after the completion of the GVW portion of the structural durability test. The driving cycles are the Manhattan cycle, a low average speed, highly transient urban cycle (Figure 1), the Orange County Bus Cycle which consists of urban and highway driving segments (Figure 2), and the EPA UDDS Cycle (Figure 3). An emissions test will comprise of two runs for the three different driving cycles, and the average value will be reported. Test results reported will include the average grams per mile value for each of the gaseous emissions for gasoline buses, for all the three driving cycles. In addition, the particulate matter emissions are included for diesel buses, and non-methane hydrocarbon emissions (NMHC) are included for CNG buses. Testing is performed in accordance with EPA CFR49, Part 1065 and SAE J2711 as practically determined by the FTA Emissions Testing Protocol developed by West Virginia University and Penn State University.

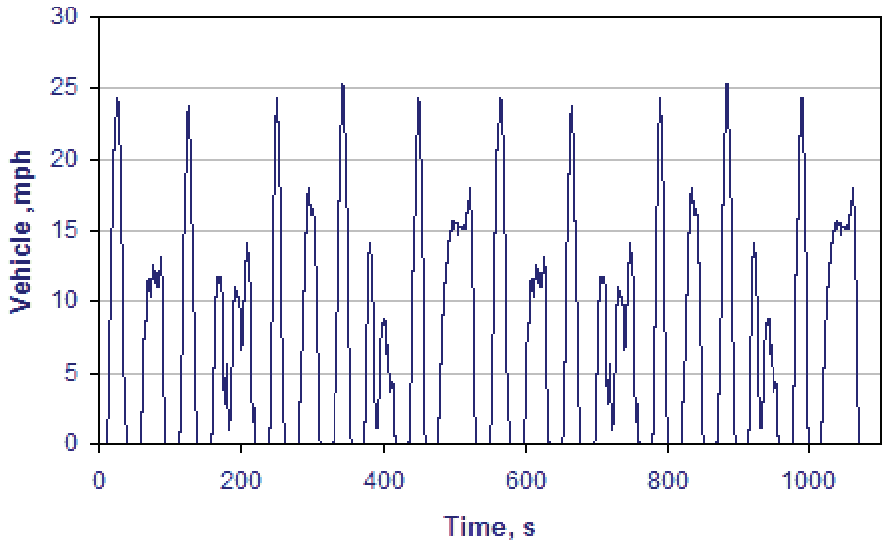


Figure 1*. Manhattan Driving Cycle (duration 1089 sec, Maximum speed 25.4mph, average speed 6.8mph)*

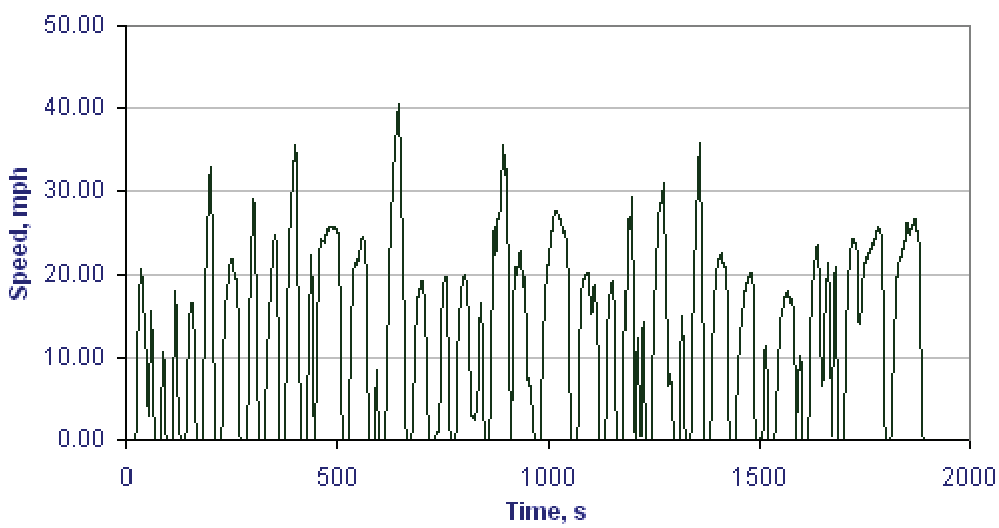


Figure 2*. Orange County Bus Cycle (Duration 1909 Sec, Maximum Speed 41mph, Average Speed 12mph)*

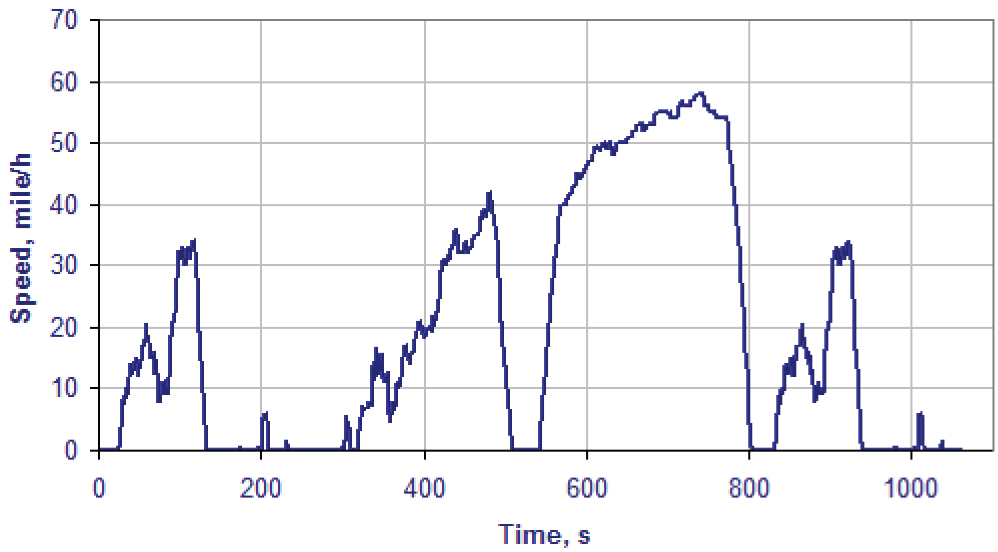


***Figure 3**. HD-UDDS Cycle (duration 1060seconds, Maximum Speed 58mph, Average Speed 18.86mph)*

8-III. <u>TEST ARTICLE</u>

The test article is a Gillig, LLC., model 40' Low Floor BAE Hybrid transit bus equipped with diesel fueled Cummins model ISB 6.7 L 280H engine. The bus was tested on June 28, 2012.

8-IV. <u>TEST EQUIPMENT</u>

Testing is performed in the LTI Vehicle Testing Laboratory emissions testing bay. The test bay is equipped with a Schenk Pegasus 72-inch, large-roll chassis dynamometer. The dynamometer is electronically controlled to account for vehicle road-load characteristics and for simulating the inertia characteristics of the vehicle. Power to the roller is supplied and absorbed through an electronically controlled 3-phase ac motor. Absorbed power is dumped back onto the electrical grid.

Vehicle exhaust is collected by a Horiba CVS, full-flow dilution tunnel. The system has separate tunnels for diesel and gasoline/natural gas fueled vehicles. In the case of diesel vehicles, particulate emissions are measured gravimetrically using 47mm Teflon filters. These filters are housed in a Horiba HF47 particulate sampler, per EPA 1065 test procedures.. Heated gaseous emissions of hydrocarbons and NOx are sampled by Horiba heated oven analyzers. Gaseous emissions for CO, CO2 and cold NOx are measured using a Horiba Mexa 7400 series gas analyzer. System operation, including the operation of the chassis dynamometer, and all calculations are controlled by a Dell workstation running Horiba CDCTS test control software. Particulate Filters are weighed in a glove box using a Sartorius microbalance accurate to 1 microgram.

8-V. TEST PREPARATION AND PROCEDURES

All vehicles are prepared for emissions testing in accordance with the Fuel Economy Pre-Test Maintenance Form. (In the event that fuel economy test was performed immediately prior to emissions testing this step does not have to be repeated) This is done to ensure that the bus is tested in optimum operating condition. The manufacturer-specified preventive maintenance shall be performed before this test. The ABS system and when applicable, the regenerative braking system are disabled for operation on the chassis dynamometer. Any manufacturer-recommended changes to the pre-test maintenance procedure must be noted on the revision sheet. The Fuel Economy Pre-Test Inspection Form will also be completed before performing. Both the Fuel Economy Pre-Test Maintenance Form and the Fuel Economy Pre-Test Inspection Form are found on the following pages.

Prior to performing the emissions test, each bus is evaluated to determine its road-load characteristics using coast-down techniques in accordance with SAE J1263. This data is used to program the chassis dynamometer to accurately simulate over-the-road operation of the bus.

Warm-up consists of driving the bus for 20 minutes at approximately 40 mph on the chassis dynamometer. The test driver follows the prescribed driving cycle watching the speed trace and instructions on the Horiba Drivers-Aid monitor which is placed in front of the windshield. The CDCTS computer monitors driver performance and reports any errors that could potentially invalidate the test.

All buses are tested at half seated load weight. The base line emissions data are obtained at the following conditions:

1. Air conditioning off
2. Evaporator fan or ventilation fan on
3. One Half Seated load weight
4. Appropriate test fuel with energy content (BTU/LB) noted in CDTCS software
5. Exterior and interior lights on
6. Heater Pump Motor off
7. Defroster off
8. Windows and Doors closed

The test tanks or the bus fuel tank(s) will be filled prior to the fuel economy test with the appropriate grade of test fuel.

8-VI DISCUSSION

The following Table 1 provides the emissions testing results on a grams per mile basis for each of the exhaust constituents measured and for each driving cycle performed.

TABLE 1 Emissions Test Results

Driving Cycle	Manhattan	Orange County Bus	UDDS
CO_2, gm/mi	2,449	1,953	1,677
CO, gm/mi	0.0	0.0	0.0
THC, gm/mi	0.03	0.01	0.01
NMHC, gm/mi	0.01	0.0	0.0
NO_x, gm/mi	1.1	1.06	1.41
Particulates. gm/mi	0.008	0.005	0.005
Fuel consumption mpg	4.15	5.22	6.08

FUEL ECONOMY/EMISSIONS PRE-TEST MAINTENANCE FORM

Bus Number: 1206	Date: 6/25/12	SLW (lbs): 36,480
Personnel: T.S., S.R. & T.G.		

FUEL SYSTEM	OK	Date	Initials
Install fuel measurement system	✓	6/25/12	T.S.
Replace fuel filter	✓	6/25/12	T.S.
Check for fuel leaks	✓	6/25/12	T.S.
Specify fuel type (refer to fuel analysis)	Diesel		
Remarks: None noted.			
BRAKES/TIRES	OK	Date	Initials
Inspect hoses	✓	6/25/12	S.R.
Inspect brakes	✓	6/25/12	S.R.
Relube wheel bearings	✓	6/25/12	S.R.
Check tire inflation pressures (mfg. specs.)	✓	6/25/12	S.R.
Remarks: None noted.			
COOLING SYSTEM	OK	Date	Initials
Check hoses and connections	✓	6/25/12	T.G.
Check system for coolant leaks	✓	6/25/12	T.G.
Remarks: None noted.			

FUEL ECONOMY/EMISSIONS PRE-TEST MAINTENANCE FORM

Bus Number: 1206	Date: 6/25/12
Personnel: T.S., S.R. & T.G.	

ELECTRICAL SYSTEMS	OK	Date	Initials
Check battery	✓	6/25/12	T.G.
Inspect wiring	✓	6/25/12	T.G.
Inspect terminals	✓	6/25/12	T.G.
Check lighting	✓	6/25/12	T.G.
Remarks/comments/recommended changes: None noted.			

DRIVE SYSTEM	OK	Date	Initials
Drain transmission fluid	✓	6/25/12	T.S.
Replace filter/gasket	✓	6/25/12	T.S.
Check hoses and connections	✓	6/25/12	S.R.
Replace transmission fluid	✓	6/25/12	S.R.
Check for fluid leaks	✓	6/25/12	S.R.
Remarks/comments/recommended changes: None noted.			

LUBRICATION	OK	Date	Initials
Drain crankcase oil	✓	6/25/12	T.S.
Replace filters	✓	6/25/12	T.S.
Replace crankcase oil	✓	6/25/12	T.G.
Check for oil leaks	✓	6/25/12	T.G.
Check oil level	✓	6/25/12	T.G.
Lube all chassis grease fittings	✓	6/25/12	S.R.
Lube universal joints	✓	6/25/12	S.R.
Replace differential lube including axles	✓	6/25/12	S.R.
Remarks/comments/recommended changes: None noted.			

FUEL ECONOMY/EMISSIONS PRE-TEST MAINTENANCE FORM

Bus Number: 1206	Date: 6/25/12
Personnel: T.S., S.R. & T.G.	

EXHAUST/EMISSION SYSTEM	OK	Date	Initials
Check for exhaust leaks	✓	6/25/12	T.G.
Remarks/comments/recommended changes: None noted.			

ENGINE	OK	Date	Initials
Replace air filter	✓	6/25/12	T.S.
Inspect air compressor and air system	✓	6/25/12	S.R.
Inspect vacuum system, if applicable	✓	6/25/12	S.R.
Check and adjust all drive belts	✓	6/25/12	S.R.
Check cold start assist, if applicable	✓	6/25/12	S.R.
Remarks/comments/recommended changes: None noted.			

STEERING SYSTEM	OK	Date	Initials
Check power steering hoses and connectors	✓	6/25/12	T.G.
Service fluid level	✓	6/25/12	T.G.
Check power steering operation	✓	6/25/12	T.G.
Remarks/comments/recommended changes: None noted.			

	OK	Date	Initials
Ballast bus to seated load weight	✓	6/25/12	T.S.

TEST DRIVE	OK	Date	Initials
Check brake operation	✓	6/25/12	T.S.
Check transmission operation	✓	6/25/12	T.S.
Remarks/comments/recommended changes: None noted.			

FUEL ECONOMY/EMISSIONS PRE-TEST INSPECTION FORM

Bus Number: 1206	Date: 6/26/12
Personnel: T.S. & S.R.	

PRE WARM-UP	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	T.S.
Cold tire pressure (psi): Front _110_ Middle____ Rear _105	S.R.
Tire wear: less than 50%	S.R.
Engine oil level	T.S.
Engine coolant level	T.S.
Interior and exterior lights on, evaporator fan on	T.S.
Fuel economy instrumentation installed and working properly.	T.S.
Fuel line -- no leaks or kinks	T.S.
Speed measuring system installed on bus. Speed indicator installed in front of bus and accessible to TP and Driver.	S.R.
Bus is loaded to SLW	T.S.
WARM-UP	**If OK, Initial**
Bus driven for at least one hour warm-up	T.S.
No extensive or black smoke from exhaust	T.S.
POST WARM-UP	**If OK, Initial**
Warm tire pressure (psi): Front_110_ Middle____ Rear_105	T.S.
Environmental conditions Average wind speed <12 mph and maximum gusts <15 mph Ambient temperature between 30°(±1°C) and 90°F(32°C)) Track surface is dry Track is free of extraneous material and clear of interfering traffic	T.S.

FEDERAL TRANSIT BUS TEST

Performed for the Federal Transit Administration U.S. DOT
In accordance with 49 CFR, Part 665

Manufacturer: Gillig LLC
Model: Low Floor

Partial Test

August 2022

Report Number: LTI-BT-R2022-06-P

The Thomas D. Larson
Pennsylvania Transportation Institute
201 Transportation Research Building
The Pennsylvania State University
University Park, PA 16802
(814) 865-1891

Bus Testing and Research Center
2237 Plank Road
Duncansville, PA 16635
(814) 695-3404

PennState
College of Engineering

LTI BUS RESEARCH
AND TESTING CENTER

FEDERAL TRANSIT BUS TEST

Performed for the Federal Transit Administration, U.S. DOT
1200 New Jersey Avenue, SE
Washington, DC 20590

In accordance with 49 CFR Part, 665

Manufacturer: Gillig LLC
Manufacturer's address: 451 Discovery Drive
Livermore, CA 94551

Model: Low Floor

Partial Test

Report Number: LTI-BT-R2022-06-P

ACCREDITED
Mechanical Testing Certificate 3172.01

David Klinikowski	Director, Bus Research and Testing Center	August 16th, 2022
Quality Authorization	*Title*	*Date*

TABLE OF CONTENTS

EXECUTIVE SUMMARY

TEST HIGHLIGHTS

The information in this report pertains only to this specific bus, as received from the manufacturer for testing.

The Check-In section of the report provides a description of the bus and specifies its major components. The following table gives the salient specifications.

Manufacturer	Gillig LLC
Model	Low Floor
Chassis Make/Model	Gillig / Low Floor
Chassis Modified	No
Length	41 feet / 9.9 inches
Fuel	Diesel – Electric Hybrid
Service Life	12 Year / 500,000 Miles - Partial
Number of Seats (including driver)	39 or 32 and 2 wheelchairs
Manufacturer-Designated Standing Passenger Capacity	34
Gross Vehicle Weight used for testing	42,380 lb.
Gross Vehicle Weight Rating	44,300 lb.
Mileage at Delivery	2,956 miles
Test Start Date	May 02, 2022
Test Completion Date	June 10, 2022
Report Issuance Date	August 16, 2022

The measured curb weight was 11,220 lb. for the front axle and 20,170 lb. for the rear axle. These combined weights provided a total measured curb weight of 31,390 lb. There are 39 seats including the driver (7 seats stow away for two wheelchair positions) and free floor space for 36 standing passengers bringing the potential total passenger capacity to 75. However, a placard shows the maximum number of standing passengers as 34, therefore, the gross load represents a total of 73 passengers. Gross load is calculated as 150 lb. x 73 = 10,950 lb. The wheelchair positions are not used for gross load because 34 standees can only be achieved when the wheelchair positions are not in use and utilizing the space for standees yields a higher gross load for testing. At full declared capacity, the measured gross vehicle weight was 42,380 lb. The heaviest seated load weight is achieved using the two wheelchair positions with 32 seated passengers, including the driver. Seated load is calculated as (32 x 150 lb.) + (2 x 600 lb.) = 6,000 lb. There is a potential to overload this bus with the available floor space for standing passengers.

The FTA determined that this bus be tested for check in, safety-braking, performance (EV and hybrid mode), fuel/energy economy (EV and hybrid mode), interior noise (EV and hybrid mode), exterior noise (EV and hybrid mode) and emissions (hybrid mode); the baseline full Bus Testing report for this test is PTI-BT-R0405.

During testing, it was noticed that the castle nut on the drag link, where it connects to the pitman arm, was on upside down. The pitman arm and drag link were replaced. In addition, the battery thermal management system (BTMS) control module was replaced as it was found defective, and a new auto breathing valve was installed on the cooling system.

ABBREVIATIONS AND ACRONYMS

ABS - anti-skid braking system
ABTC - Altoona Bus Test Center
A/C - air conditioner, or air conditioning
AC - alternating current
ADA - American Disability Act
Ah - Ampere hours
CDCTS - chassis dynamometer test control system
CVS - constant volume sampling
CW - curb weight (bus weight including maximum fuel, oil, and coolant; but without passengers or driver)
dB(A) - decibels with reference to 0.0002 microbar as measured on the "A" scale
DC - direct current
DIR - test director
DR - bus driver
EPA - Environmental Protection Agency
GAWR – gross axle weight rating
GVL - gross vehicle load (150 lb. for every designed passenger seating position, for the driver, and for each 1.5 sq ft of free floor space)
GVW - gross vehicle weight (curb weight plus gross vehicle load)
GVWR - gross vehicle weight rating
HD-UDDS – Heavy Duty-Urban Dynamometer Driving Schedule
LTI - Larson Transportation Institute
mpg - miles per gallon
mph - miles per hour
PM - Preventive maintenance
PSTT - Penn State Test Track
rpm - revolutions per minute
SAE - Society of Automotive Engineers
SCF - Standard cubic foot
SCH - test scheduler
SA - staff assistant
SLW - seated load weight (curb weight plus 150 lb. for every designed passenger seating position and for the driver)
TD - test driver
TECH - test technician
TM - track manager
TP - test personnel
Wh - Watt hour

TEST BUS CHECK-IN

I. OBJECTIVE

The objective of this task is to log in the test bus, assign a bus number, complete the vehicle data form, and perform a safety check.

II. TEST DESCRIPTION

The test consisted of assigning a bus test number to the bus, cleaning the bus, completing the vehicle data form, obtaining any special information and tools from the manufacturer, determining a testing schedule, performing an initial safety check, and performing the manufacturer's recommended preventive maintenance. The bus manufacturer certified that the bus meets all Federal regulations.

III. DISCUSSION

The check-in procedure is used to identify in detail the major components and configuration of the bus.

The test bus consisted of a Gillig LLC, Low Floor model. The bus has a front passenger door forward of the front axle and a rear passenger door forward of the rear axle. The front passenger door is equipped with a Lift-U LU18-02-12 electric bi-fold ramp. This is a diesel electric hybrid bus. Power is provided by a diesel fueled, Cummins B6.7 280 hp engine coupled to an Allison / eGen Flex transmission and an Allison VCM TCM HGM 29566342 motor control system.

The measured curb weight was 11,220 lb. for the front axle and 20,170 lb. for the rear axle. These combined weights provided a total measured curb weight of 31,390 lb. There are 39 seats including the driver (7 seats stow away for two wheelchair positions) and free floor space for 36 standing passengers bringing the potential total passenger capacity to 75. However, a placard shows the maximum number of standing passengers as 34, therefore, the gross load represents a total of 73 passengers. Gross load is calculated as 150 lb. x 73 = 10,950 lb. The wheelchair positions are not used for gross load because 34 standees can only be achieved when the wheelchair positions are not in use and utilizing the space for standees yields a higher gross load for testing. At full declared capacity, the measured gross vehicle weight was 42,380 lb. The heaviest seated load weight is achieved using the two wheelchair positions with 32 seated passengers, including the driver. Seated load is calculated as (32 x 150 lb.) + (2 x 600 lb.) = 6,000 lb. There is a potential to overload this bus with the available floor space for standing passengers.

VEHICLE DATA FORM

Bus Number: 2022-06-P	Date of Check-In: 05/02/22 to 05/05/22
Bus Manufacturer: Gillig LLC	Vehicle Identification Number (VIN): 15GGD3013N3197144
Model Name: Low Floor	Chassis Mfr./Mod. #: Gillig / Low Floor
Personnel: S.R., E.D., F.T., T.G., J.M. & M.R.	Starting Odometer Reading: 2,956 miles

WEIGHT:

Individual Wheel Reactions:

Weights (lb.)	Front Axle		Middle Axle		Rear Axle	
	Curb	Street	Curb	Street	Curb	Street
CW	5,610	5,610	N/A	N/A	9,420	10,750
SLW	6,530	6,540	N/A	N/A	11,210	13,100
GVW	7,820	7,750	N/A	N/A	12,480	14,330

Total Weight Details:

Weight (lb.)	CW	SLW	GVW	GAWR
Front Axle	11,220	13,070	15,570	15,660
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	20,170	24,310	26,810	28,640
Total	31,390	37,380	42,380	GVWR: 44,300 (Declared by Manufacturer)

Dimensions:

Length (ft/in)	41 / 4.8
Length Over Bumpers (ft/in)	41 / 9.9
Overall Length with Add-ons (ft/in)	42 / 8 (with bike rack)
Width (in)	100.4 (without mirrors) 132.5 (with mirrors)
Height of bus (in)	110.1
Overall Height (in)	130.1
Front Overhang (in)	100.3
Rear Overhang (in)	122.1
Wheelbase (in)	279.5
Wheel Track (in)	Front: 85.5
	Middle: N/A
	Rear: 78.0

VEHICLE DATA FORM

Bus Number: 2022-06-P	Date:05/02/22 to 05/05/22

CLEARANCES:

Lowest Point Outside Front Axle	Location: Framework beam	Clearance(in): 9.1
Lowest Point Outside Rear Axle	Location: Tube steel radiator guard on rear streetside	Clearance(in): 9.4
Lowest Point between Axles	Location: Bolt on coolant line clamp	Clearance(in): 12.3
Front Bumper Height (in)	14.8	
Rear Bumper Height (in)	20.2	
Ground Clearance at the center (in)	13.2	
Front Approach Angle (deg)*	8.4	
Rear Approach Angle (deg)*	8.3	
Ramp Clearance Angle (deg)	5.4	
Aisle Width (in)	23.9	
Inside Standing Height at Center Aisle (in)	95.2	

*measurements used to calculate approach and departure angles are taken from the centerline of the axles.

BODY DETAILS:

Body Structural Type	Semi-monocoque		
Frame Material	Stainless steel		
Body Material	Aluminum		
Floor Material	Plywood		
Roof Material	Composite		
Windows Type	■ Fixed	☐ Movable	
Window Mfg./Model No.	Ricon / 56725		
Number of Doors	_1_ Front (curbside)	_1_ Rear (curbside)	
Mfr. / Model No.	Front- Vapor Ameriview / 50940254-00 Rear- Vapor Ameriview / 50940254-01		
Dimension of Each Door (in)	Front- 32 x 75.1	Rear- 28.3 x 77.9	
Passenger Seat Type	■ Cantilever	■ Pedestal	☐ Other
Passenger Seat Mfg./ Model No.	USSC Gemini / SL81012-194690		
Driver Seat Type	■ Air	☐ Spring	☐ Other
Mfr. / Model No.	USSC / G2A		
Number of Seats (including Driver)	39 or 32 with two wheelchair positions		

Bus Number: 2022-06-P	Date: 05/02/22 to 05/05/22

BODY DETAILS (Contd.)

Free Floor Space (ft^2)	59.0 with seats 48.2 with wheelchairs			
Height of Each Step at Normal Position (in)	Front 1. 16.1	2. N/A	3. N/A	4. N/A
	Rear 1. 15.4	2. N/A	3. N/A	4. N/A
Step Elevation Change - Kneeling (in)	Front: 3.6	Rear: 1.1		

ENGINE

Type	■ C.I.	☐ Alternate Fuel	
	☐ S.I.	☐ Other (explain)	
Mfr. / Model No.	Cummins / B6.7 280hp		
Engine Power	280 hp @ 2400 rpm		
Engine Power	Max torque 910 ft. lb. @ 2300 rpm		
Location	☐ Front	■ Rear	☐ Other (explain)
Fuel Type	☐ Gasoline	☐ CNG	☐ Methanol
	■ Diesel	☐ LNG	☐ Other (explain)
Alternator (Generator) Mfr./Model No.	N/A*		
Maximum Rated Output (Volts / Amps)	N/A		
Air Compressor Mfr. / Model No.	Powerex-Iwata Air Technology, Inc. / SBBHS050020GG09		
Maximum Capacity (ft^3 / min)	12.5 cfm @ 145 PSIG		
Starter Type	☐ Electrical	☐ Pneumatic	■ Other *see below
Starter Mfr. / Model No.	Mopar / 428000-7202 / 04801839AD		

*Conventional alternator and starter have been replaced by the Allison eGEN FLEX hybrid transmission components. Hybrid drive generator is used to start engine.

TRANSMISSION

Transmission Type	☐ Manual	■ Automatic	☐ Load Sensing Adaptive
Mfr. / Model No.	Allison / eGEN Flex 40 Max		
Control Type	☐ Mechanical	■ Electrical	☐ Other
Integral Retarder Mfr. / Model No.	☐ Yes	■ No	

VEHICLE DATA FORM

Bus Number: 2022-06-P	Date: 05/02/22 to 05/05/22

ELECTRIC DRIVE SYSTEM

Type	☐ Series Battery Electric	■ Parallel Electric Hybrid
Number of Traction Motors	1	
Mfr. / Model No.	Allison / eGEN Flex 40 Max, PN 29563868	
Location of Traction Motor(s)	Rear	
Type	Electric	
Motor Control System Mfr./Model No.	Allison VCM TCM HGM / 29566342	
Location	Rear electrical panel (with access door open)	
Max Rated Power Output (kW)	209	
Nominal Voltage (volts)	644	
Drive Battery Mfr./ Model No.	Allison / eGEN Flex Max 29564244	
Number of Battery Packs	1	
Location of Battery Packs	Rooftop / Middle Streetside	
Individual Battery Capacity (kWh)	26	
Total Nominal Battery Capacity (kWh)	26	
Total Usable Battery Capacity (kWh)	20	
Total Nominal Battery Capacity (Ah)	31	
Battery Type (Chemistry)	Lithium Titanate	
Low Voltage Battery	■ 12 Volt ☐ 24 Volt	
Low Voltage Battery Mfr./Model No.	Deka / DP31CS	

Bus Number: 2022-06-P	Date: 05/02/22 to 05/05/22

SUSPENSION

Number of Axles	2		
Front Axle Type	☐ Independent	■ Beam Axle	
Mfr. / Model No.	Meritor / FH946KX75		
GAWR (lb.)	15,660		
Axle Ratio (if driven)	N/A		
Suspension Type	■ Air	☐ Spring	☐ Other
No. of Shock Absorbers	2		
Mfr. / Model No.	Koni (Holland) / 99B 3202SPI		
Sway Bar Equipped	Not sway bar equipped		
Middle Axle Type	☐ Independent	☐ Beam Axle	
Mfr. / Model No.	N/A		
GAWR (lb.)	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type	☐ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	☐ Independent	■ Beam Axle	
Mfr. / Model No.	Meritor / 79163KX28-538		
GAWR (lb.)	28,640		
Axle Ratio (if driven)	5.38		
Suspension Type	■ Air	☐ Spring	☐ Other
No. of Shock Absorbers	4		
Mfr. / Model No.	Koni (Holland) / 1 73703000 / 99B 3203		

Bus Number: 2022-06-P	Date: 05/02/22 to 05/05/22

WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Alcoa / Durabright EVO 22.5 x 8.25
	Wheel Weight Rating	8,050 lb.
	Tire Mfr./ Model No.	Michelin / XIncity 305/80R 22.5
	Tire Weight Rating	7,830 lb. (Single tire)
Rear	Wheel Mfr./ Model No.	Alcoa / Durabright EVO 22.5 x 8.25
	Wheel Weight Rating	8,050 lb.
	Tire Mfr./ Model No.	Michelin / XIncity 305/80R 22.5
	Tire Weight Rating	7,160 (Dual tire)

BRAKES

Front Axle Brakes Type	☐Cam	■ Disc	☐ Other (explain)
Mfr. / Model No.	Meritor / EX225H3		
Middle Axle Brakes Type	☐Cam	☐ Disc	☐ Other
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	☐Cam	■ Disc	☐Other (explain)
Mfr. / Model No.	Meritor / EX225H3		
External Parking Brake Mfr. / Model No.	N/A		

HVAC

Driver Heating System Type	■ Engine Coolant ☐ Electric
Capacity (Btu/hr)	62,000
Mfr./Model No.	Mobile Climate Control / 12-8530
Passenger Heating System Type	■ Engine Coolant ☐ Electric
Capacity (Btu/hr)	Under seat heaters 34,000 Front threshold 12,000
Mfr./Model No.	Mobile Climate Control / 12-11382 (under seat) Mobile Climate Control / 12-4482 (front threshold)
Auxiliary Heater	■Yes – Type: Diesel ☐ No
Mfr./Model No.	Proheat / PH9310/10-31K BTU
Driver Air Conditioner	■ Yes ☐ No
Location	Rear – Part of passenger air conditioning system
Capacity (Btu/hr)	Not available
A/C Compressor Mfr./Model Number	Part of passenger air conditioning system
Passenger Air Conditioner	■ Yes ☐ No

Bus Number: 2022-06-P	Date: 05/02/22 to 05/05/22

HVAC (cont.)

Passenger Air Conditioner	☐ Engine Driven	■ Electric	☐ Other
Location	Rear		
Capacity (Btu/hr)	62,000		
A/C Compressor Mfr./Model No.	Copeland Scroll Emerson / ZR48K3E-TF5-130		

STEERING

Steering Gear Box Type	Hydraulic		
Mfr. / Model No.	TRW / PBR110FAA		
Steering Wheel Diameter	20”		
Number of turns (lock to lock)	4 ¾		
Control Type	☐ Electric	■Hydraulic	☐Other (explain)

OTHERS

ADA Ramps	Location: Front Entry Door	Type: Bi-fold Electric
ADA Lifts	Location: N/A	Type: N/A
Mfr. / Model No.	Lift-U / LU18-02-12	
Emergency Exit	Location: Window Door Roof Hatch	Number: 6 2 2
Type	N/A	
Fire Suppression System Type	Amerex 17K CTRL	
Mfr./Model No.	Amerex / V25 ABC (Located in rear top curbside)	

*Additional handheld fire extinguisher on top of front curbside wheel well

CAPACITIES

Fuel Tank Capacity (gallons)	120 usable (127)
Engine Crankcase Capacity (gallons)	6.5
Transmission Capacity (gallons)	2.12
Differential Capacity (quarts)	18.8 – 20.8
Engine Cooling System Capacity (gallons)	14
Battery Cooling System Capacity (gallons)	4 (BTMS)
Electronic Cooling System Capacity (gallons)	1.7 (Electronic Cooling Package- ECP)
Drive Motor Cooling System (gallons)	2.12 (Combined with Transmission)
Power Steering Fluid Capacity (gallons)	1.5

VEHICLE DATA FORM
Page 8 of 8

Bus Number: 2022-06-P	Date: 05/02/22 to 05/05/22

List all spare parts, tools and manuals delivered with the bus.

Part Number	Description	Qty.
	DEF Fluid	2
	Interior intercom equipment	1

COMPONENT/SUBSYSTEM INSPECTION FORM

Page 1 of 1

Bus Number: 2022-06-P	Date: 05/04/22

Subsystem	Checked	Initials	Comments
Air Conditioning Heating and Ventilation	✓	E.D.	None noted.
Body and Sheet Metal	✓	E.D.	None noted.
Frame	✓	E.D.	None noted.
Steering	✓	E.D.	None noted.
Suspension	✓	E.D.	None noted.
Interior/Seating	✓	E.D.	None noted.
Axles	✓	E.D.	None noted.
Brakes	✓	E.D.	None noted.
Tires/Wheels	✓	E.D.	None noted.
Exhaust	✓	E.D.	None noted.
Fuel System	✓	E.D.	Hybrid Bus – Diesel & Electric
Transmission	✓	E.D.	None noted.
Drive Motor/Axle	✓	E.D.	Built into transmission
Engine	✓	E.D.	None noted.
Accessories	✓	E.D.	None noted.
ADA Accessible Lift System	N/A	E.D.	None noted.
ADA Accessible Ramp System	✓	E.D.	None noted.
Interior Fasteners	✓	E.D.	None noted.
Batteries	✓	E.D.	None noted.
Emergency Exits	✓	E.D.	None noted.
Fire Suppression System	✓	E.D.	None noted.

CHECK - IN

GILLIG LLC
LOW FLOOR

CHECK - IN CONT.

GILLIG LLC
LOW FLOOR

CHECK - IN CONT.

LIFT-U / LU18-02-12 ELECTRIC BI-FOLD RAMP

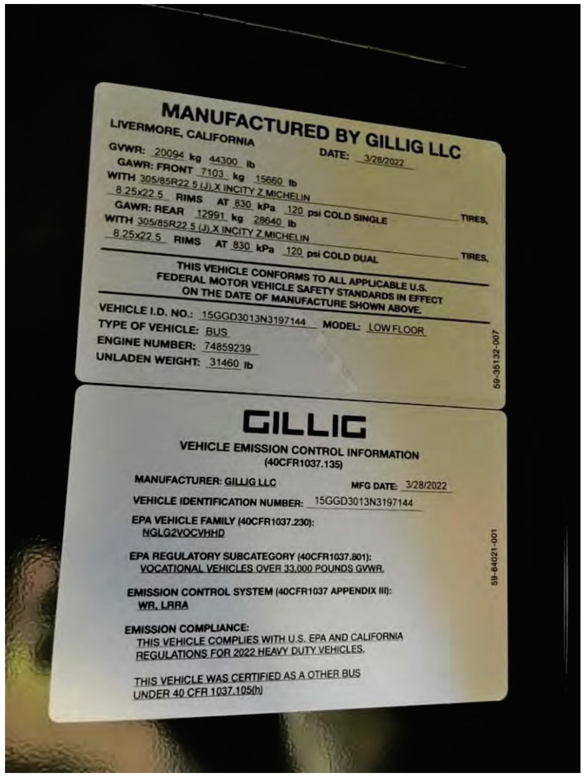
OPERATOR'S AREA

CHECK - IN CONT.

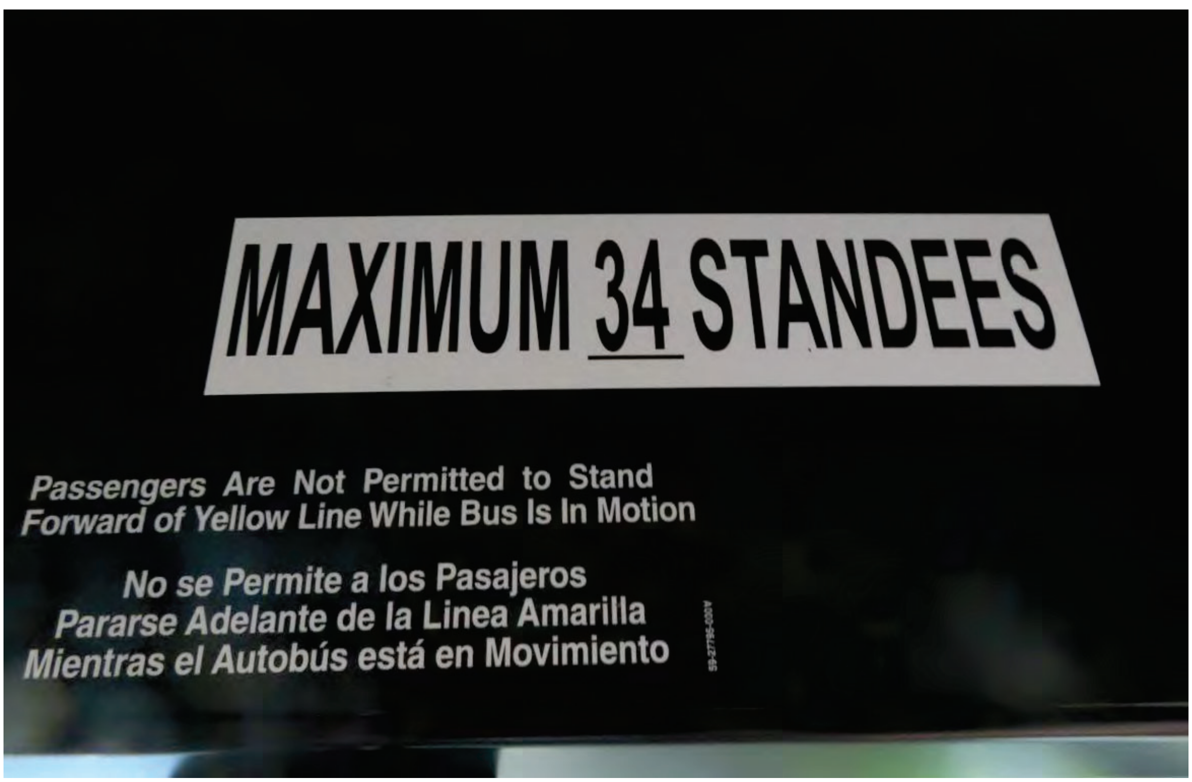
INTERIOR FROM FRONT

INTERIOR FROM REAR

CHECK - IN CONT.

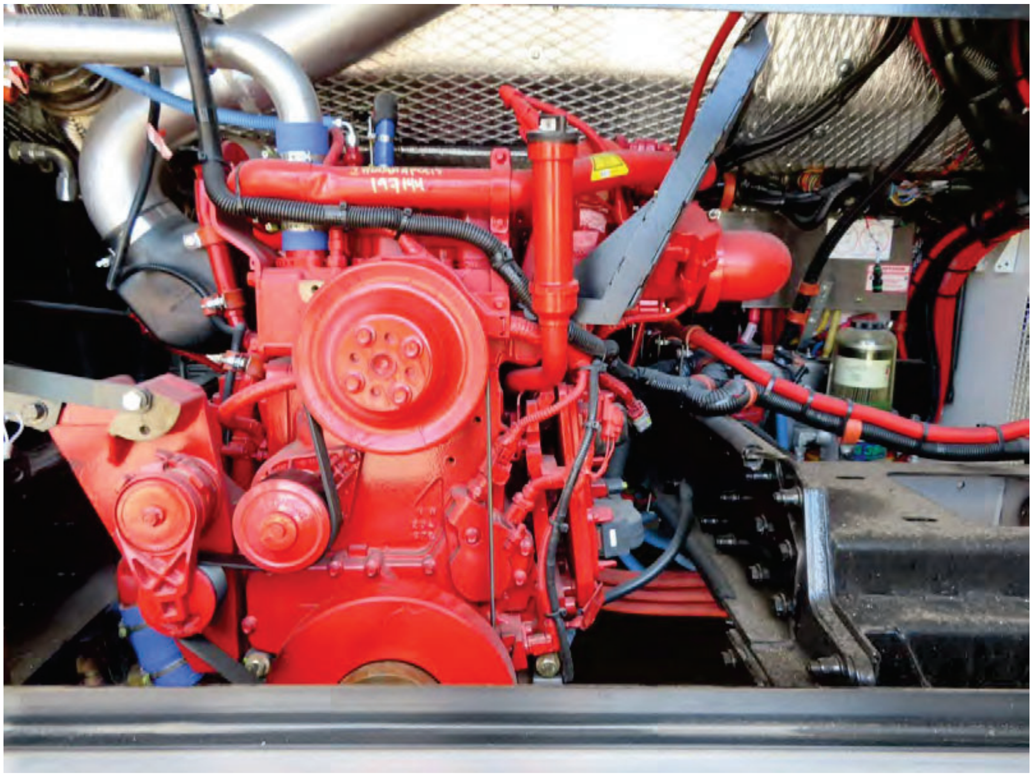


VIN TAG

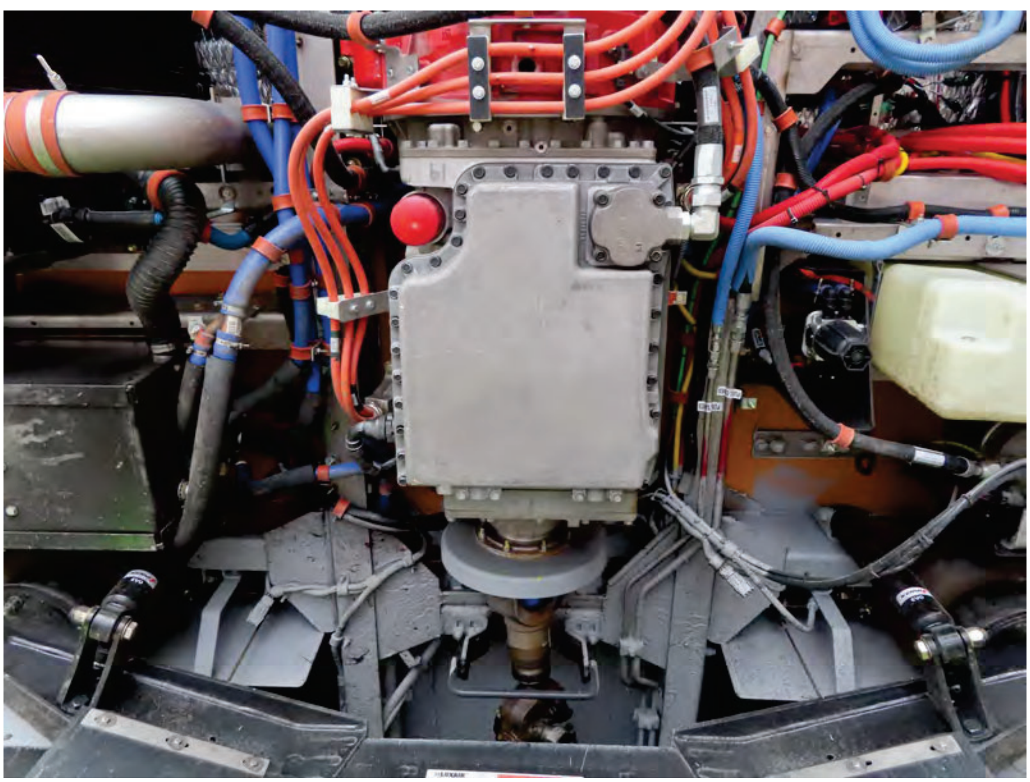


PLACARD SHOWING MAXIMUM STANDING PASSENGERS

CHECK - IN CONT.

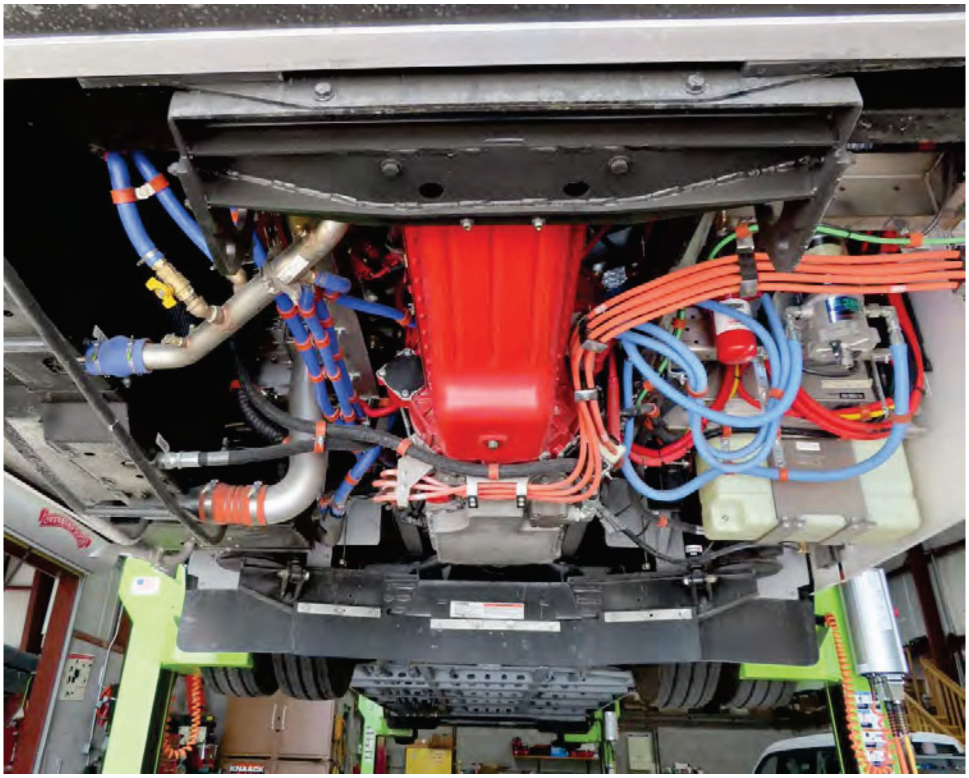


REAR ENGINE COMPARTMENT



ALLISON E-GEN FLEX TRANSMISSION

CHECK - IN CONT.



UNDERSIDE OF BUS

3.2 Safety - Braking

3.2 I. TEST OBJECTIVE

The objective of this test is to provide, for comparison purposes, braking performance data on transit buses produced by different manufacturers.

3.2 II. TEST DESCRIPTION

The testing was conducted at the LTI Test Track skid pad area. Brake tests were conducted after completion of the GVW portion of the vehicle durability test. At this point in testing the brakes have been subjected to a large number of braking snubs and will be considered well burnished. For buses that have not completed Durability Testing, the brakes will be burnished according to the test procedure. Testing was performed when the bus was fully loaded at its GVW. All tires on each bus were representative of the tires on the production model vehicle and inflated to the bus manufacturer’s specified pressures.

The brake testing procedure is comprised of three phases:

1. Stopping distance tests
   - i. Dry surface (high-friction, Skid Number within the range of 70-76)
   - ii. Wet surface (low-friction, Skid Number within the range of 30-36)
2. Stability tests
3. Parking brake test

3.2-III. DISCUSSION

The results of the Stopping Distance phase of the Brake Test are available in table 3.2-2. There was no deviation from the test lane during the performance of the Stopping Distance phase.

During the Stability phase of Brake Testing the test bus experienced no deviation from the test lane during both approaches to the Split Friction Road surface.

The Parking Brake phase was completed with the test bus maintaining the parked position for the full five-minute period with no slip or roll observed in both the uphill and downhill positions.

Table 3.2-1. Braking Test Data Forms

Page 1 of 3

Bus Number: 2022-06-P	Date: 05/25/22
Personnel: F.T., S.R., T.G., M.R. & J.S.	
Amb. Temperature (°F): 65	Wind Speed (mph): 8
Wind Direction: SE	Pavement Temp (°F) Start: 88 End:94

TIRE INFLATION PRESSURE (psi): Tire Type: Front & Rear: Michelin XIncity 305 85R 22.5				
	Left Tire(s)		Right Tire(s)	
Front	120		120	
	Inner	Outer	Inner	Outer
Middle	N/A	N/A	N/A	N/A
Rear	120	120	120	120

AXLE LOADS (lb.)		
	Left	Right
Front	7,750	7,820
Middle	N/A	N/A
Rear	14,330	12,480

Table 3.2-2. Stopping Distance Test Results Form
(longest stopping distance in each test condition in bold)

Stopping Distance (ft)					
Vehicle Direction	CW	CW	CCW	CCW	
Speed (mph)	Stop 1	Stop 2	Stop 3	Stop 4	**Average**
20 (dry)	**28.63**	26.89	**28.63**	26.69	27.71
30 (dry)	50.90	**53.30**	51.72	52.05	51.99
40 (dry)	88.06	87.51	**91.64**	89.01	89.06
45 (dry)	109.02	112.76	111.55	**116.44**	112.44
20 (wet)	33.52	**34.11**	33.09	33.25	33.49

Table 3.2-3. Stability Test Results Form

Stability Test Results (Split Friction Road surface)			
Vehicle Direction	Attempt	Did test bus stay in 12' lane? (Yes/No)	Comments
Driver side on high friction	1	Yes	None noted.
	2	Yes	None noted.
Driver side on low friction	1	Yes	None noted.
	2	Yes	None noted.

Table 3.2-4. Parking Brake Test Form

PARKING BRAKE (Fully Loaded) – GRADE HOLDING						
Vehicle Direction	Attempt	Hold Time (min)	Slide (in)	Roll (in)	Did Hold	No Hold
Front up	1	5:00	0	0	✓	
	2	N/A	N/A	N/A	N/A	N/A
	3	N/A	N/A	N/A	N/A	N/A
Front down	1	5:00	0	0	✓	
	2	N/A	N/A	N/A	N/A	N/A
	3	N/A	N/A	N/A	N/A	N/A

Table 3.2-5. Record of All Braking System Faults/Repairs.

Date	Fault/Repair	Description
05/11/22	None noted.	None noted.

3.2 Safety - Bus Braking

PARKING BRAKE TEST
PARKING BRAKE HELD FOR 5 MINUTES IN BOTH 20% UP AND 20% DOWN POSITIONS

4. PERFORMANCE - AN ACCELERATION, GRADEABILITY, AND TOP SPEED TEST

4-I. TEST OBJECTIVE

The objective of this test is to determine the acceleration, gradeability, and top speed capabilities of the bus.

4-II. TEST DESCRIPTION

In this test, the bus was operated at SLW on a chassis dynamometer. The procedure dictates that the test bus be accelerated to a maximum "power-limited"/"governed" or maximum "safe" speed not exceeding 80 mph. The maximum power-limited/governed speed, if applicable, is the top speed as limited by the engine control system. The maximum safe speed is defined as the maximum speed that the dynamometer, the tires or other bus components are limited to. The test vehicle speed was measured using a speed encoder built in the chassis dynamometer. The time intervals between 10 mph increments were recorded using a Data Acquisitions System. Time-speed data and the top speed attained were recorded on the Performance Data Form. The recorded data was used to generate a percent grade versus speed table and a speed versus time curve. All the above are available in the following pages.

4-III. DISCUSSION

This test consisted of three runs from standstill to full throttle on the chassis dynamometer. Speed versus time data was obtained for each run and results are averaged to minimize test variability.

In hybrid mode, the test was performed up to a maximum governed speed of 59.1 mph. The calculated gradeability results are attached. The average time to reach 30 mph was 14.3 seconds. The maximum gradeablity at 10 mph was 21.02% and at 40 mph was 4.29%.

In EV mode, the test was performed up to a maximum governed speed of 34.3 mph. The calculated gradeability results are attached. The average time to reach 30 mph was 17.1 seconds. The maximum gradeablity at 10 mph was 17.61%. The bus did not reach 40 mph in EV mode. Therefore, there are no gradeability results at 40 mph.

Although the bus did not meet passing requirements in EV mode, it did meet the passing requirements while in hybrid mode. The manufacturer represented that the bus did not meet passing requirements in EV mode due to the vehicle EV functionality governing vehicle speed.

PERFORMANCE DATA FORM

Page 1 of 1

Bus Number: 2022-06-P – Hybrid Mode	Date: 06/02/22	
Personnel: S.I. & D.B.		
Temperature (°F): 79.6	Humidity (%): 89.3	
Barometric Pressure (inHg): 28.6		
		INITIALS:
Air Conditioning - OFF	✓Checked	D.B.
Heater pump motor - OFF	✓Checked	D.B.
Defroster - OFF	✓ Checked	D.B.
Exterior and interior lights - ON	✓ Checked	D.B.
Windows and doors - CLOSED	✓ Checked	D.B.

ACCELERATION, GRADEABILITY, TOP SPEED

Recorded Interval Times			
Speed	Run 1	Run 2	Run 3
10 mph	3.3	3.6	3.4
20 mph	7.3	7.6	7.5
30 mph	14.2	14.4	14.2
40 mph	22.8	22.9	22.7
50 mph	35.5	35.3	35.1
60 mph	N/A	N/A	N/A
70 mph	N/A	N/A	N/A

Maximum Speed (mph): 59.1 (maximum governed speed)

PERFORMANCE SUMMARY SHEET

Bus Number: 2022-06-P – Hybrid Mode	Date: 06/02/22
Personnel: S.I. & D.B.	

Test Conditions:

Temperature (°F): 79.6	Humidity (%): 89.3
Barometric Pressure (inHg): 28.6	

Test Results:

Vehicle Speed (MPH)	Time (SEC)	Acceleration (FT/SEC^2)	Max. Grade (%)
1.0	1.2	2.72	8.45
5.0	2.4	7.02	21.80
10.0	3.4	6.77	21.02
15.0	4.8	3.94	12.24
20.0	7.4	2.25	6.99
25.0	10.8	2.17	6.74
30.0	14.3	2.03	6.30
35.0	18.1	1.72	5.34
40.0	22.8	1.38	4.29
45.0	28.6	1.19	3.70
50.0	35.3	1.00	3.11
55.0	43.2	0.84	2.61
59.1	54.7	Maximum Speed	

PERFORMANCE DATA FORM

Page 1 of 1

Bus Number: 2022-06-P – EV Mode	Date: 06/02/22
Personnel: S.I. & D.B.	

Temperature (°F): 88.4	Humidity (%): 78.2
Barometric Pressure (inHg): 28.6	

		INITIALS:
Air Conditioning - OFF	✓Checked	D.B.
Heater pump motor - OFF	✓Checked	D.B.
Defroster - OFF	✓ Checked	D.B.
Exterior and interior lights - ON	✓ Checked	D.B.
Windows and doors - CLOSED	✓ Checked	D.B.

ACCELERATION, GRADEABILITY, TOP SPEED

Recorded Interval Times			
Speed	Run 1	Run 2	Run 3
10 mph	3.9	3.9	4.2
20 mph	8.9	8.8	9.1
30 mph	17.0	17.0	17.2
40 mph	--	--	--
50 mph	--	--	--
60 mph	--	--	--
70 mph	--	--	--

Maximum Speed (mph): 34.3 (maximum governed speed)

PERFORMANCE SUMMARY SHEET

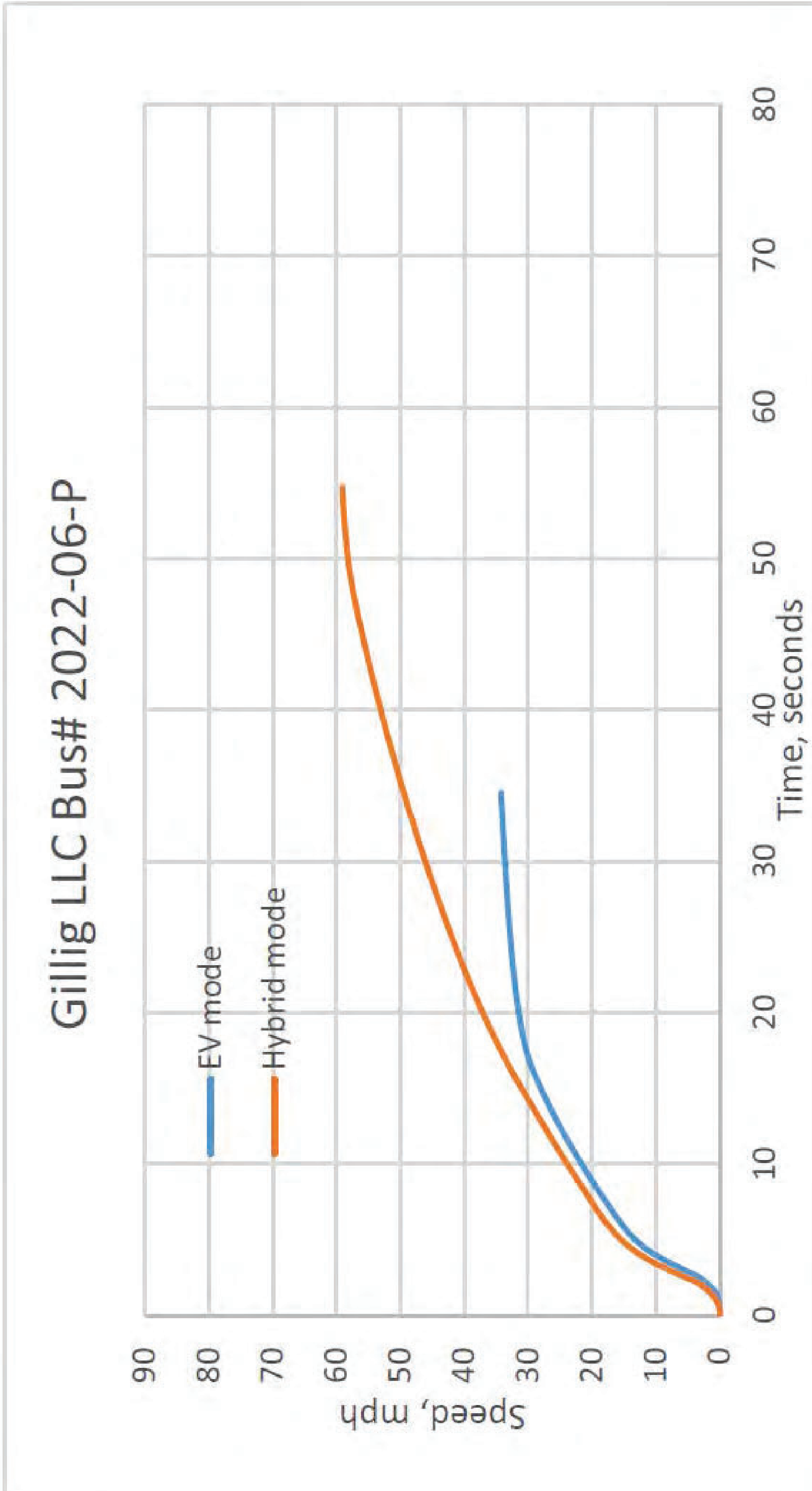
Bus Number: 2022-06 – EV Mode	Date: 06/02/22
Personnel: S.I. & D.B.	

Test Conditions:

Temperature (°F): 88.4	Humidity (%): 78.2
Barometric Pressure (inHg): 28.6	

Test Results:

Vehicle Speed (MPH)	Time (SEC)	Acceleration (FT/SEC^2)	Max. Grade (%)
1.0	1.7	2.79	8.66
5.0	2.9	6.87	21.34
10.0	4.0	5.67	17.61
15.0	5.8	2.84	8.82
20.0	8.9	2.22	6.89
25.0	12.4	1.89	5.87
30.0	17.1	1.05	3.26
34.3	34.5	Maximum Speed	


Gillig LLC Bus# 2022-06-P
EV mode
Hybrid mode
Speed, mph
0
10
20
30
40
50
60
70
80
90
Time, seconds
0
10
20
30
40
50
60
70
80

6. FUEL ECONOMY TEST - A FUEL CONSUMPTION TEST USING AN APPROPRIATE OPERATING CYCLE – HYBRID MODE

6-I. TEST OBJECTIVE

The objective of this test is to provide accurate comparable fuel consumption data on transit buses produced by different manufacturers. This fuel economy test bears no relation to the calculations done by the Environmental Protection Agency (EPA) to determine levels for the Corporate Average Fuel Economy Program. EPA's calculations are based on tests conducted under laboratory conditions intended to simulate city and highway driving. This fuel economy test, as designated here, is a measurement of the fuel expended by a vehicle traveling a specified test operating profile, under specified operating conditions that are typical of transit bus operation. The results of this test may not represent actual mileage in transit service but will provide data that can be used by FTA Grantees to compare the efficiency of buses tested using this procedure.

6-II. TEST DESCRIPTION

This test was performed in the emissions bay of the LTI Vehicle Testing Laboratory. The Laboratory is equipped with a Schenk Pegasus 300 HP, large-roll (72-inch diameter) chassis dynamometer suitable for heavy-vehicle emissions testing. The driving cycles are the Manhattan cycle, a low average speed, highly transient urban cycle (Figure 1), the Orange County Bus Cycle, a medium average speed transient urban cycle (Figure 2), and the EPA HD-UDDS Cycle, which consists of urban and highway driving segments (Figure 3). A fuel economy test was comprised of two runs for the three different driving cycles, and the average value was reported.

The test procedure for liquid-fueled buses such as this one uses a calibrated flowmeter system and/or a calibrated fuel weighing scale. The flowmeter system utilizes a precise four-piston positive displacement flow meter. The weighing scale system includes heat exchangers to maintain temperature in diesel and common-rail injection systems.

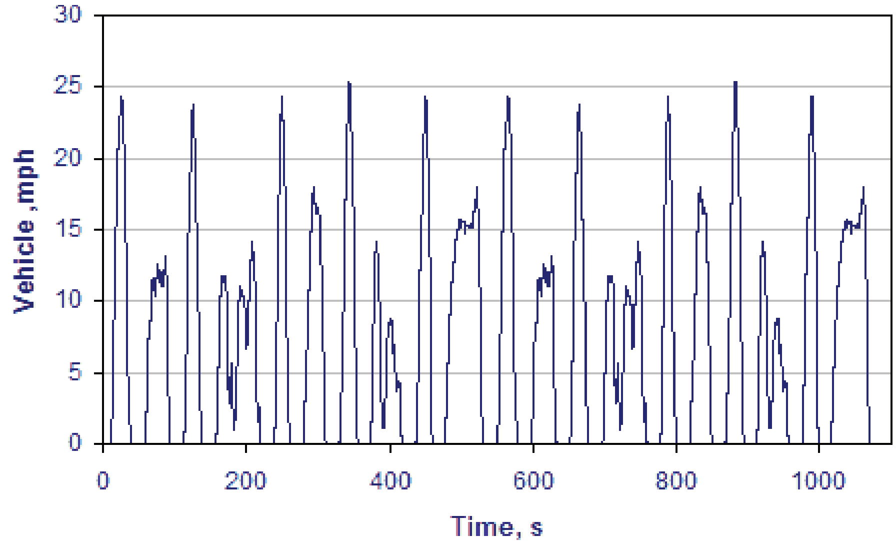


Figure 1. Manhattan Driving Cycle (duration 1089 sec, Maximum speed 25.4 mph, average speed 6.8 mph)

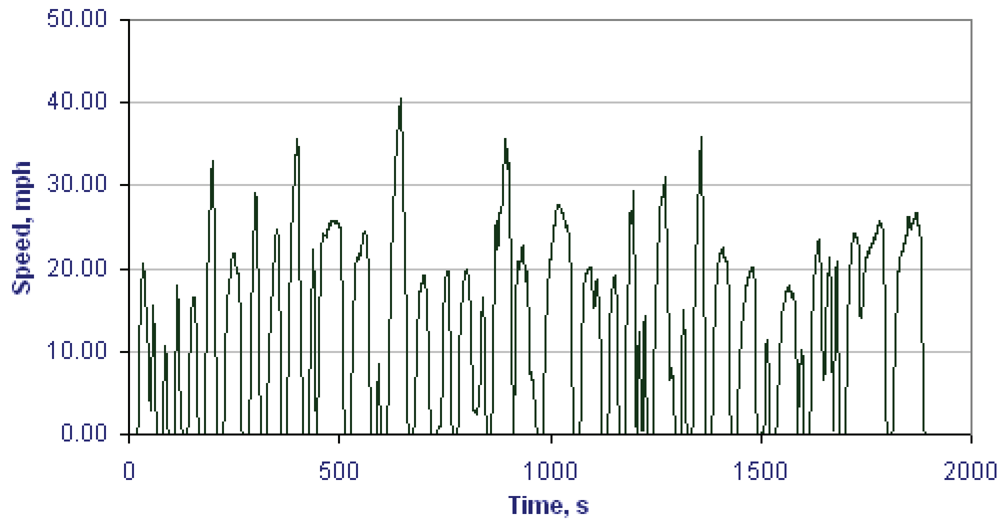


Figure 2. Orange County Bus Cycle (Duration 1909 Sec, Maximum Speed 41 mph, Average Speed 12 mph).

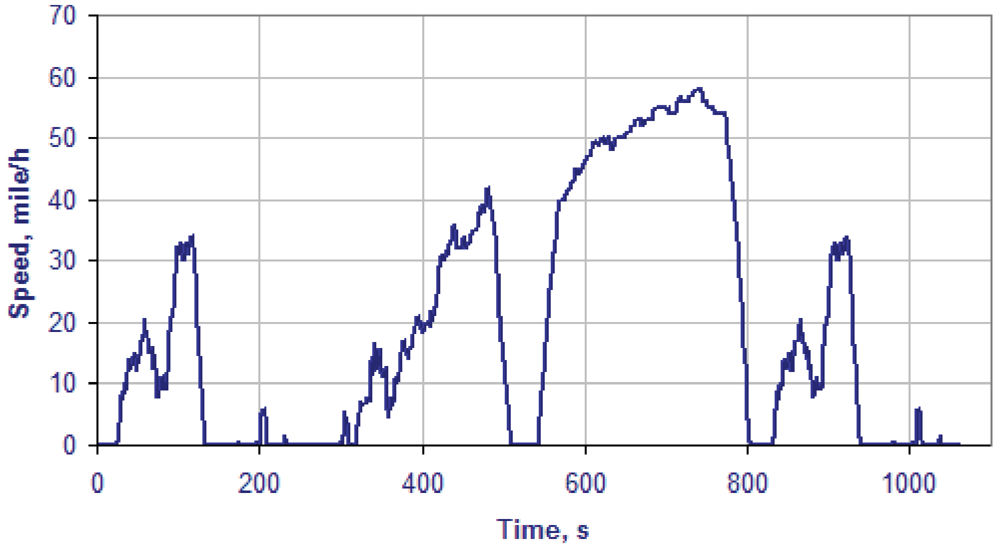


Figure 3. HD-UDDS Cycle (duration 1060 seconds, Maximum Speed 58 mph, Average Speed 18.86 mph).

6-III. DISCUSSION

The driving cycle consists of three simulated transit driving cycles: Manhattan, Orange County Bus Cycle and the HD-UDDS, as described in 6-II. The fuel consumption for each driving cycle and idle was measured.

An extensive pretest maintenance check was made including the replacement of all lubrication fluids. The details of the pretest maintenance are given in the first three Pretest Maintenance Forms. The fourth sheet shows the Pretest Inspection Form. Finally, the summary sheet provides the average fuel consumption for the three test cycles and for a 20-minute idle. **The average fuel consumption for the Manhattan, OCBC and the HD-UDDS were 4.32 mpg, 6.29 mpg and 6.43 mpg respectively. For idle, the fuel consumption was 0.52 gal/hr**.

FUEL ECONOMY/ENERGY ECONOMY
PRE-TEST MAINTENANCE FORM

Bus Number: 2022-06-P	Date: 05/31/22	SLW (lb.): 37,380
Personnel: R.M., S.R., F.T. & E.L.		

FUEL SYSTEM	OK
Install fuel measurement system	✓
Replace fuel filter	N/A
Check for fuel leaks	✓
Specify fuel type (Diesel)	✓
Remarks: None noted.	
BRAKES/TIRES	OK
Inspect hoses	✓
Inspect brakes	✓
Check tire inflation pressures (mfg. specs.)	✓
Check tire wear (less than 50%)	✓
Remarks: None noted.	
COOLING SYSTEM	OK
Check hoses and connections	✓
Check system for coolant leaks	✓
Remarks: None noted.	

FUEL ECONOMY/ENERGY ECONOMY
PRE-TEST MAINTENANCE FORM

Bus Number: 2022-06-P	Date: 05/31/22
Personnel: R.M., S.R., F.T. & E.L.	

ELECTRICAL SYSTEMS	OK
Check battery	✓
Inspect wiring	✓
Inspect terminals	✓
Check lighting	✓
Remarks: None noted.	

DRIVE SYSTEM	OK
Drain transmission fluid	N/A
Replace filter/gasket	N/A
Check hoses and connections	✓
Replace transmission fluid	N/A
Check for fluid leaks	✓
Remarks: Interval for transmission fluid change not reached.	

LUBRICATION	OK
Drain crankcase oil	N/A
Replace filters	N/A
Replace crankcase oil	N/A
Check for oil leaks	✓
Check oil level	✓
Lube all chassis grease fittings	✓
Lube universal joints	✓
Replace differential lube including axles	N/A
Remarks: Interval for oil/filter change not reached.	

FUEL ECONOMY/ENERGY ECONOMY
PRE-TEST MAINTENANCE FORM

Bus Number: 2022-06-P	Date: 05/31/22
Personnel: R.M., S.R., F.T. & E.L.	

EXHAUST/EMISSION SYSTEM	OK
Check for exhaust leaks	✓
Remarks: None noted.	
ENGINE	OK
Replace air filter	N/A
Inspect air compressor and air system	✓
Inspect vacuum system, if applicable	N/A
Check and adjust all drive belts	✓
Check cold start assist, if applicable	N/A
Remarks: None noted.	
STEERING SYSTEM	OK
Check power steering hoses and connectors	✓
Service fluid level	✓
Check power steering operation	✓
Remarks: None noted.	
	OK
Ballast bus to seated load weight	✓
TEST DRIVE	OK
Check brake operation	✓
Check transmission operation	✓
Remarks: None noted.	

FUEL ECONOMY/ENERGY ECONOMY
PRE-TEST INSPECTION FORM
Page 1 of 1

Bus Number: 2022-06-P	Date: 05/31/22
Personnel: S.R, R.M. & F.T.	

PRE-WARM-UP	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	S.R./F.T.
Cold tire pressure (psi): Front 120 Middle N/A Rear 120	F.T./R.M.
Engine oil level	F.T./R.M.
Engine coolant level	F.T./R.M.
Fuel economy instrumentation installed and working properly.	R.M./F.T.
Fuel line -- no leaks or kinks	R.M.
Bus is loaded to SLW during coast down	F.T.
WARM-UP	If OK, Initial
Air conditioning off	D.B.
Interior and exterior lights on	D.B.
Defroster off	D.B.
Windows and doors closed	D.B.
Do not drive with left foot on brake	D.B.

FUEL ECONOMY DATA FORM
(Gaseous and Liquid fuels)

Page 1 of 1

Bus Number: 2022-06-P	Manufacturer: Gillig	Date: 06/01/22
Fuel Type: Diesel	Personnel: S.I. & D.B.	
Temperature (°F): 93.5	Humidity (%): 76.8	Barometric Pressure (inHg): 28.6
SLW (lb.): 37,380		

Cycle	Manhattan	Orange County	HD-UDDS	Idle
Fuel Consumption (mpg)	4.32	6.29	6.43	0.52 G/hr

Comments: Hybrid mode.

6. ENERGY ECONOMY AND RANGE TEST – AN ENERGY CONSUMPTION AND RANGE TEST FOR BATTERY ELECTRIC BUSES USING APPROPRIATE OPERATING CYCLES – EV MODE

6-I. TEST OBJECTIVE

The objective of this test is to provide accurate comparable energy consumption data on battery electric transit buses produced by different manufacturers. This energy economy test bears no relation to the calculations done by the Environmental Protection Agency (EPA) to determine levels for the Corporate Average Fuel Economy Program. EPA's calculations are based on tests conducted under laboratory conditions intended to simulate city and highway driving. This energy economy test, as designated here, is a measurement of the energy consumed by a vehicle traveling a specified test operating profile, under specified operating conditions that are typical of transit bus operation. The results of this test will not represent actual energy usage but will provide data that can be used by FTA Grantees to compare buses tested using this procedure.

6-II. TEST DESCRIPTION

This test is performed in the emissions bay of the LTI Vehicle Testing Laboratory. The Laboratory is equipped with a Schenk Pegasus 300 HP, large-roll (72 inch diameter) chassis dynamometer suitable for heavy-vehicle emissions testing. The driving cycles are the Manhattan cycle, a low average speed, highly transient urban cycle (Figure 1), the Orange County Bus Cycle which consists of urban and highway driving segments (Figure 2), and the EPA HD-UDDS Cycle (Figure 3). This test is conducted at seated load weight.

This test is conducted generally as per the methods described in the SAE standard J 1634-2017. The light-duty test cycles specified in this standard are replaced by transit bus test cycles mentioned above.

The Multi-Cycle test (MCT) procedure is adopted for this bus. The end of test is determined when the bus cannot maintain 50 miles per hour or earlier, as recommended by the bus manufacturer. The battery system is recharged to full SOC at the end of the test, following procedures specified in SAE J 1634-2017. During the recharge, the DC energy (into the battery system) and the AC energy (into the charger) are recorded. From these data, the average AC energy consumption, the range (miles) and the charger efficiency for each test cycle are reported.

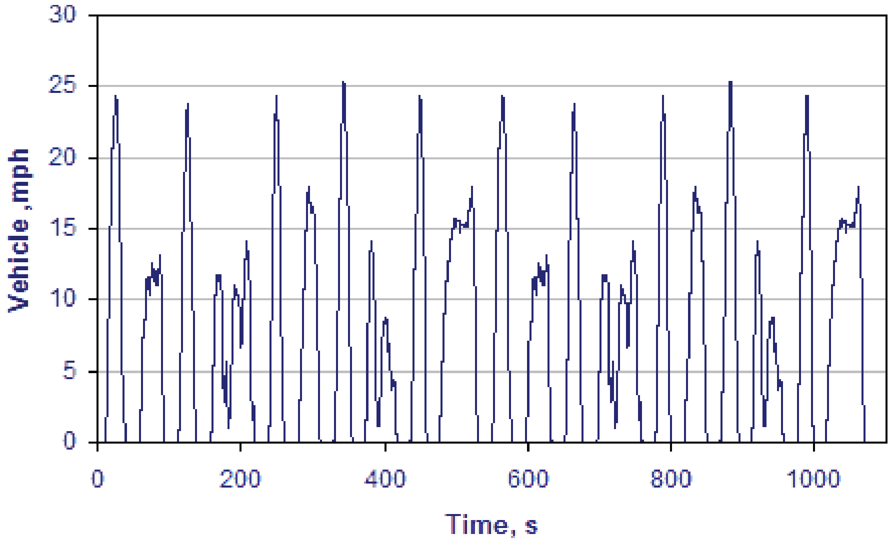


Figure 1. Manhattan Driving Cycle (duration 1089 sec, Maximum speed 25.4 mph, average speed 6.8 mph)

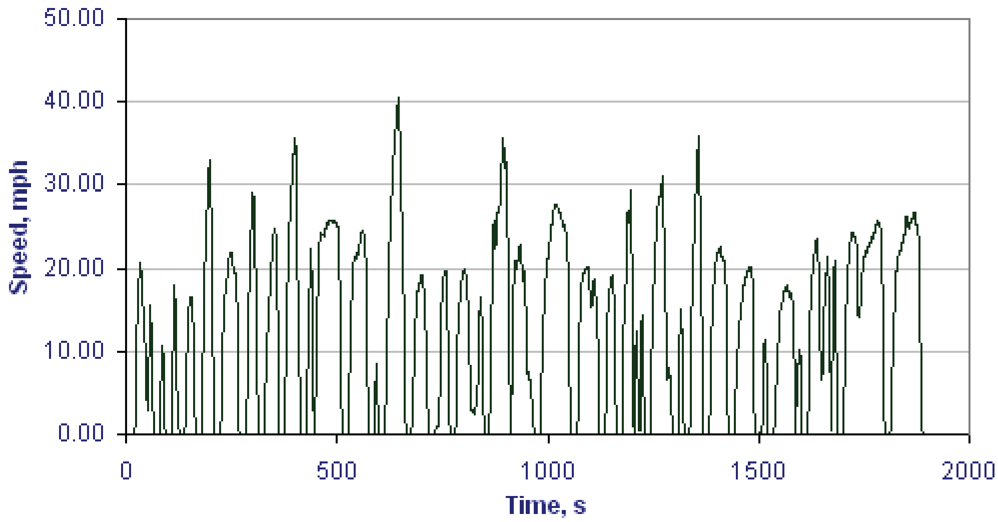


Figure 2. Orange County Bus Cycle (Duration 1909 Sec, Maximum Speed 41 mph, Average Speed 12 mph).

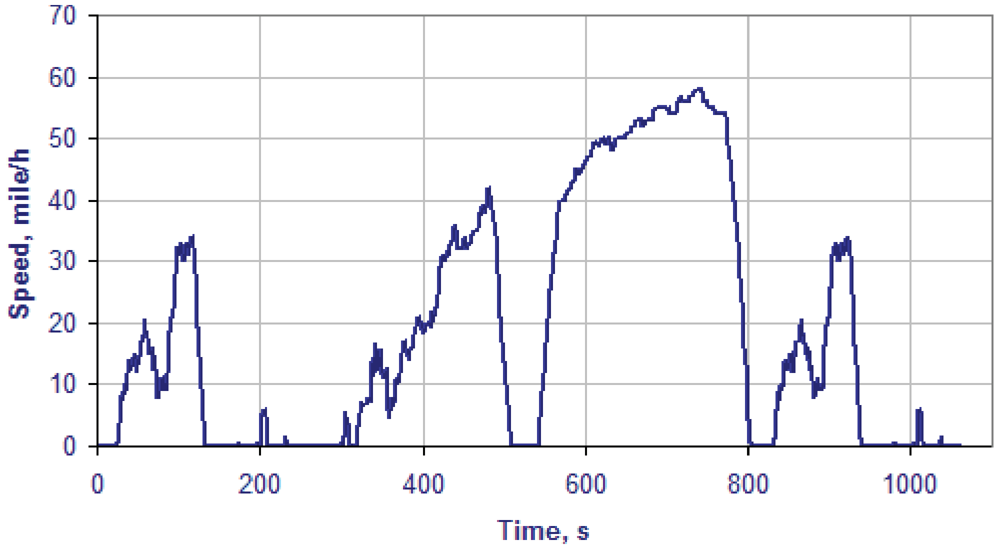


Figure 3. HD-UDDS Cycle (duration 1060 seconds, Maximum Speed 58 mph, Average Speed 18.86 mph).

6-III. DISCUSSION

The driving cycle consists of three simulated transit driving cycles: Manhattan, Orange County Bus Cycle and the HD-UDDS, as described in 6-II. The energy economy and range results for buses tested using these cycles are not directly comparable to buses tested under the earlier protocol that uses the CBD, Arterial and Commuter driving cycles.

An extensive pretest maintenance check is conducted including the replacement of all lubrication fluids, if applicable. The details of the pretest maintenance and inspection are given in the previous section – 6.0 Fuel economy – Hybrid Mode. The summary sheet provides the average energy consumption and range of bus for the three test cycles. The test was conducted at a seated load weight of 37,380 lbs. The average DC energy consumption for the Manhattan and OCBC were 3,675 Wh/mile and 2,807 Wh/mile. The range for those driving cycles were 2.49 miles and 3.27miles respectively. The maximum speed was 34.3 mph., therefore, the bus was not tested for the HD-UDDS cycle. This bus does not use an external (A/C) charger. The battery pack is internally charged by its diesel engine. Hence, AC energy measurements were not conducted.

ENERGY ECONOMY DATA FORM
(Battery Electric Buses)

Page 1 of 1

Bus Number: 2022-06-P	Manufacturer: Gillig	Date: 06/02/22
Fuel Type: Electric	Personnel: S.I. & D.B.	
Temperature (°F): 83.9	Humidity (%): 91	Barometric Pressure (inHg): 28.5
SLW (lb.): 37,380	Charger: N/A (Bus operated on EV mode)	

	Manhattan	**Orange County**	**HD-UDDS**
DC Energy (Wh/mile)	3,675	2,807	N/A
AC Energy (Wh/mile)	N/A	N/A	N/A
Range (miles)	2.49	3.27	N/A

Comments: 1. The maximum speed of the bus in EV mode was 34.3 mph. The bus was not
tested for the HD-UDDS cycle, as a significant part of the test cycle comprised of speeds above
the capability of the bus in EV mode.
2. The bus does not use an external (AC) charger. The battery pack is internally charged by its
diesel engine. Hence, AC measurements were not conducted.

7. NOISE

7.1 INTERIOR NOISE AND VIBRATION TESTS

7.1-I. TEST OBJECTIVE

The objective of these tests is to measure and record interior noise levels and check for audible vibration under various operating conditions.

7.1-II. TEST DESCRIPTION

During this series of tests, the interior noise level was measured at several locations with the bus operating under the following three conditions:

1. With the bus stationary, a white noise generating system provided a uniform sound pressure level equal to 80 dB(A) on the left, exterior side of the bus. The engine and all accessories were switched off and all openings including doors and windows were closed. This test was performed at the LTI Test Track Facility.

2. The bus was accelerated at full throttle from a standing start to 35 mph on a level pavement. All openings were closed and all accessories were operating during the test. This test was performed on the track at the LTI Test Track Facility.

3. The bus was operated at various speeds from 0 to 55 mph with and without the air conditioning and accessories on. Any audible vibration or rattles were noted. This test was performed on the test segment between the LTI Test Track and the Bus Testing Center.

All tests were performed in an area free from extraneous sound-making sources or reflecting surfaces. The ambient sound level as well as the surrounding weather conditions were recorded in the test data.

7.1-III. DISCUSSION

For the first part, with the bus in hybrid mode, the overall average of the six measurements was 51.0 dB(A); ranging from 50.4 dB(A) in line with the front speaker and at the rear passenger seats to 53.0 dB(A) at the driver's seat. With the bus in EV mode, the overall average of the six measurements was 50.0 dB(A); ranging from 49.5 dB(A) in line with the rear speaker and at the rear passenger seats to 51.6 dB(A) at the driver's seat. The interior ambient noise level for these tests was less than 30 dB(A).

For the second part, with the bus in hybrid mode, the interior noise level ranged from 75.5 dB(A) at the front passenger seats to 78.3 dB(A) at the rear passenger seats. The overall average was 76.8 dB(A). With the bus in EV mode, the interior noise level ranged from 66.6 dB(A) at the driver's seat to 67.7 dB(A) at the rear passenger seats. The overall average was 67.0 dB(A). The interior ambient noise level for these tests was less than 30 dB(A).

No vibrations or rattles were noted during the third part of this test in either hybrid mode or EV mode.

INTERIOR NOISE TEST DATA FORM
Test Condition 1: 80 dB(A) Stationary White Noise – Hybrid Mode
Page 1 of 3

Bus Number: 2022-06-P – Hybrid Mode	Date: 06/10/22
Personnel: F.T. & R.M.	
Temperature (°F): 58	Humidity (%): 81
Wind Speed (mph): 5	Wind Direction: WSW
Barometric Pressure (inHg): 29.92	
Interior Ambient Noise Level dB(A): less than 30	Exterior Ambient Noise Level dB(A): 35.2
Microphone Height During Testing (in): 46.2	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	53.0
Front Passenger Seats	51.1
In Line with Front Speaker	50.4
In Line with Middle Speaker	50.8
In Line with Rear Speaker	50.5
Rear Passenger Seats	50.4

Comments: None noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 2: 0 to 35 mph Acceleration Test – Hybrid Mode
Page 2 of 3

Bus Number: 2022-06-P – Hybrid Mode	Date: 06/06/22
Personnel: S.R., F.T. & T.G.	
Temperature (°F): 75	Humidity (%): 50
Wind Speed (mph): 10	Wind Direction: S
Barometric Pressure (inHg): 29.98	
Interior Ambient Noise Level dB(A): Less than 30	Exterior Ambient Noise Level dB(A): 40.0
Microphone Height During Testing (in): 46.2	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	77.9
Front Passenger Seats	75.5
Middle Passenger Seats	75.6
Rear Passenger Seats	78.3

Comments: None noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 3: Audible Vibration Test – Hybrid Mode
Page 3 of 3

Bus Number: 2022-06-P – Hybrid Mode	Date: 05/26/22
Personnel: S.R., F.T., T.G. & G.C.	
Temperature (°F): 70	

Describe the following possible sources of noise and give the relative location on the bus.

Source of Noise	Location	Description of Noise
Engine and Accessories	N/A	N/A
Windows and Doors	N/A	N/A
Seats and Wheelchair lifts	N/A	N/A
Other	N/A	N/A

Comment on any other vibration or noise source which may have occurred
that is not described above: None noted.
Comments: None noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 1: 80 dB(A) Stationary White Noise – EV Mode

Bus Number: 2022-06-P – EV Mode	Date: 06/08/22
Personnel: F.T., E.L. & R.M.	
Temperature (°F): 63	Humidity (%): 76
Wind Speed (mph): 6	Wind Direction: N
Barometric Pressure (inHg): 29.97	
Interior Ambient Noise Level dB(A): less than 30	Exterior Ambient Noise Level dB(A): 34.8
Microphone Height During Testing (in): 46.2	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	51.6
Front Passenger Seats	49.4
In Line with Front Speaker	49.7
In Line with Middle Speaker	50.3
In Line with Rear Speaker	49.5
Rear Passenger Seats	49.5

Comments: None noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 2: 0 to 35 mph Acceleration Test – EV Mode

Bus Number: 2022-06-P – EV Mode	Date: 06/07/22
Personnel: F.T. & E.L.	
Temperature (°F): 63	Humidity (%): 71
Wind Speed (mph): 9	Wind Direction: SSW
Barometric Pressure (inHg): 29.92	
Interior Ambient Noise Level dB(A): less than 30	Exterior Ambient Noise Level dB(A): 40.7
Microphone Height During Testing (in): 46.2	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	66.6
Front Passenger Seats	66.8
Middle Passenger Seats	67.0
Rear Passenger Seats	67.7

Comments: Needed to regen on S mode, three times to complete test. Nothing
Noted during test. Test was completed in electric mode.

INTERIOR NOISE TEST DATA FORM
Test Condition 3: Audible Vibration Test – EV Mode

Bus Number: 2022-06-P – EV Mode	Date: 06/16/22
Personnel: F.T., R.M. & A.Z.	
Temperature (°F): 79	

Describe the following possible sources of noise and give the relative location on the bus.

Source of Noise	Location	Description of Noise
Engine and Accessories	N/A	None noted.
Windows and Doors	N/A	None noted.
Seats and Wheelchair lifts	N/A	None noted.
Other	N/A	None noted.

Comment on any other vibration or noise source which may have occurred that is not described above: None noted.

Comments: In EV mode, but only reached 35 mph for a short distance before switching back to hybrid mode. Odometer does not read mileage on EV Mode.

7.1 INTERIOR NOISE TEST

TEST BUS SET-UP FOR 80 dB(A)
INTERIOR NOISE TEST

7.2 EXTERIOR NOISE TESTS

7.2-I. TEST OBJECTIVE

The objective of this test is to record exterior noise levels when a bus is operated under various conditions.

7.2-II. TEST DESCRIPTION

In the exterior noise tests, the bus was operated at a SLW in three different conditions using a smooth, straight and level roadway:

1. Accelerating at full throttle from a constant speed starting from 35 mph.

2. Accelerating at full throttle from standstill.

3. Stationary, with the engine at low idle, high idle, and wide-open throttle, where applicable. In addition, the bus was tested with and without the air conditioning operating.

The test site is at the Larson Transportation Institute Test Track and the test procedures were performed in accordance with SAE Standards SAE J366b, Exterior Sound Level for Heavy Trucks and Buses. The test site is an open space free of large reflecting surfaces. A noise meter placed at a specified location outside the bus was used to measure the noise level.

During the test, special attention was paid to:

1. The test site characteristics regarding parked vehicles, signboards, buildings, or other sound-reflecting surfaces
2. Proper usage of all test equipment including set-up and calibration
3. The ambient sound level

7.2-III. DISCUSSION

The Exterior Noise Test determines the noise level generated by the vehicle under different driving conditions and at stationary low and high idle, with and without air conditioning and accessories operating. The test site is a large, level, bituminous paved area with no reflecting surfaces nearby.

With an outside ambient noise level of 38.9 dB(A), the average of the two highest readings obtained while accelerating from a constant speed was 68.1 dB(A) on the right side and 72.1 dB(A) on the left side while operating in hybrid mode. While operating in EV mode, with an outside ambient noise level of 46.1 dB(A), the average of the two highest readings obtained while accelerating from a constant speed was 62.1 dB(A) on the right side and 63.5 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 39.9dB(A), the average of the two highest readings obtained were 68.2 dB(A) on the right side and 68.9 dB(A) on the left side while in hybrid mode. When in EV mode, with an exterior ambient noise level of 46.0 dB(A), the average of the two highest readings obtained were 63.2 dB(A) on the right side and 63.0 dB(A) on the left side.

While in hybrid mode, with the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 58.4 dB(A) at low idle, 61.1 dB(A) at high idle and 69.0 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 57.4 dB(A) at low idle, 61.0 dB(A) at high idle and 68.9 dB(A) at wide open throttle. The exterior ambient noise level measured during this test was 39.6 dB(A). With the bus in EV mode, the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 48.4 dB(A). With the accessories and air conditioning off, the readings averaged 47.2 dB(A). There is no high idle or wide open throttle in EV mode. The exterior ambient noise level was 45.8 dB(A) while the bus was undergoing this test in EV mode.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed - Hybrid Mode

Bus Number: 2022-06-P – Hybrid Mode	Date: 06/06/22
Personnel: S.R., F.T. & T.G.	
Temperature (°F): 70	Humidity (%): 50
Wind Speed (mph): 7	Wind Direction: S
Barometric Pressure (inHg): 30.00	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■	
Initial Sound Level Meter Calibration: 93.9 dB(A)	
Exterior Ambient Noise Level: 38.9 dB(A)	

Accelerating from Constant Speed Curb (Right) Side		Accelerating from Constant Speed Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	66.5	1	68.5
2	67.7	2	69.7
3	68.4	3	71.8
4	N/A	4	72.3
5	N/A	5	71.8
6	N/A	6	N/A
7	N/A	7	N/A
8	N/A	8	N/A
9	N/A	9	N/A
10	N/A	10	N/A
Average of two highest actual noise levels = 68.1 dB(A)		Average of two highest actual noise levels = 72.1 dB(A)	

Final Sound Level Meter Calibration Check: 93.9 dB(A)
Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill – Hybrid Mode

Bus Number: 2022-06-P – Hybrid Mode	Date: 06/06/22
Personnel: S.R., F.T. & T.G.	
Temperature (°F): 72	Humidity (%): 51
Wind Speed (mph): 9	Wind Direction: S
Barometric Pressure (inHg): 30.00	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■	
Initial Sound Level Meter Calibration: 93.9 dB(A)	
Exterior Ambient Noise Level: 39.9 dB(A)	

Accelerating from Standstill Curb (Right) Side		Accelerating from Standstill Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	68.0	1	68.7
2	68.3	2	69.0
3	N/A	3	N/A
4	N/A	4	N/A
5	N/A	5	N/A
6	N/A	6	N/A
7	N/A	7	N/A
8	N/A	8	N/A
9	N/A	9	N/A
10	N/A	10	N/A
Average of two highest actual noise levels = 68.2 dB(A)		Average of two highest actual noise levels = 68.9 dB(A)	

Final Sound Level Meter Calibration Check: 93.9 dB(A)

Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Stationary – Hybrid Mode

Bus Number: 2022-06-P – Hybrid Mode	Date: 06/06/22
Personnel: S.R., F.T., T.G. & A.Z.	
Temperature (°F): 72	Humidity (%): 51
Wind Speed (mph): 9	Wind Direction: S
Barometric Pressure (inHg): 30.00	
Initial Sound Level Meter Calibration: 93.9 dB(A)	
Exterior Ambient Noise Level: 39.6 dB(A)	

Air Conditioning ON

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	720	58.0	58.8
High Idle	1000	60.3	61.8
Wide Open Throttle	2000	70.7	68.9

Air Conditioning OFF

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	720	59.0	55.7
High Idle	1000	64.1	57.8
Wide Open Throttle	2000	70.4	67.4

Final Sound Level Meter Calibration Check: 93.9 dB(A)

Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed - EV Mode

Bus Number: 2022-06-P – EV Mode	Date: 06/07/22
Personnel: F.T. & E.L.	
Temperature (°F): 64	Humidity (%): 62
Wind Speed (mph): 7	Wind Direction: SSW
Barometric Pressure (inHg): 29.93	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■	
Initial Sound Level Meter Calibration: 94.0 dB(A)	
Exterior Ambient Noise Level: 46.1 dB(A)	

Accelerating from Constant Speed Curb (Right) Side		Accelerating from Constant Speed Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	61.5	1	62.4
2	61.4	2	63.7
3	62.7	3	63.3
4	N/A	4	N/A
5	N/A	5	N/A
6	N/A	6	N/A
7	N/A	7	N/A
8	N/A	8	N/A
9	N/A	9	N/A
10	N/A	10	N/A
Average of two highest actual noise levels = 62.1 dB(A)		Average of two highest actual noise levels = 63.5 dB(A)	

Final Sound Level Meter Calibration Check: 94.0 dB(A)

Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill – EV Mode

Bus Number: 2022-06-P – EV Mode	Date: 06/07/22
Personnel: F.T. & E.L.	
Temperature (°F): 64	Humidity (%): 65
Wind Speed (mph): 7	Wind Direction: SW
Barometric Pressure (inHg): 29.96	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■	
Initial Sound Level Meter Calibration: 94.0 dB(A)	
Exterior Ambient Noise Level: 46.0 dB(A)	

Accelerating from Standstill Curb (Right) Side		Accelerating from Standstill Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	63.0	1	62.8
2	63.4	2	63.2
3	N/A	3	N/A
4	N/A	4	N/A
5	N/A	5	N/A
6	N/A	6	N/A
7	N/A	7	N/A
8	N/A	8	N/A
9	N/A	9	N/A
10	N/A	10	N/A
Average of two highest actual noise levels = 63.2 dB(A)		Average of two highest actual noise levels = 63.5 dB(A)	

Final Sound Level Meter Calibration Check: 94.0 dB(A)
Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Stationary – EV Mode

Page 3 of 3

Bus Number: 2022-06-P- EV Mode	Date: 06/07/22
Personnel: F.T. & E.L.	
Temperature (°F): 64	Humidity (%): 71
Wind Speed (mph): 9	Wind Direction: SSW
Barometric Pressure (inHg): 29.95	
Initial Sound Level Meter Calibration: 94.0dB(A)	
Exterior Ambient Noise Level: 45.8 dB(A)	

Air Conditioning ON

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	N/A	48.3	48.5
High Idle	N/A	N/A	N/A
Wide Open Throttle	N/A	N/A	N/A

Air Conditioning OFF

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	N/A	47.5	46.8
High Idle	N/A	N/A	N/A
Wide Open Throttle	N/A	N/A	N/A

Final Sound Level Meter Calibration Check: 94.0 dB(A)

Comments: Bus ran in electric mode only one reading due to no high idle and/or wide open throttle.

7.2 EXTERIOR NOISE TESTS

TEST BUS UNDERGOING EXTERIOR NOISE TESTING

8.0 EMISSIONS TEST – DYNAMOMETER-BASED EMISSIONS TEST USING TRANSIT DRIVING CYCLES

8-I. TEST OBJECTIVE

The objective of this test is to provide comparable emissions data on transit buses produced by different manufacturers. This chassis-based emissions test bears no relation to engine certification testing performed for compliance with the Environmental Protection Agency (EPA) regulation. EPA's certification tests are performed on an engine by itself on a dynamometer operating under the Federal Test Protocol.

The Bus Testing Center emissions test is a measurement of the gaseous engine emissions CO, CO2, NOx, HC and particulates (diesel vehicles) produced by a complete vehicle operating on a large-roll chassis dynamometer. The test is performed for three differed driving cycles intended to simulate a range of transit operating environments. The test is performed under laboratory conditions in compliance with EPA 1065 and SAE J2711. The results of this test may not represent actual in-service vehicle emissions but will provide data that can be used by recipients to compare the emissions of buses tested under a range of consistent operating conditions.

8-II. TEST DESCRIPTION

This test was performed in the emissions bay of the LTI Vehicle Testing Laboratory. The Laboratory is equipped with a Schenk Pegasus 300 HP, large-roll (72-inch diameter) chassis dynamometer suitable for heavy-vehicle emissions testing. The emissions laboratory provides capability for testing heavy-duty diesel, gasoline, and alternative-fueled buses for a variety of tailpipe emissions including particulate matter, oxides of nitrogen, carbon monoxide, carbon dioxide, and hydrocarbons. It is equipped with a Horiba full-scale dilution tunnel and a constant volume sampling (CVS) emissions measurement system. The system includes Horiba Mexa 7400 Series gas analyzers and a Horiba HF47 Particulate Sampling System. Test operation is automated using Horiba CDTCS software. The computer-controlled dynamometer is capable of simulating over-the-road operation for a variety of vehicles and driving cycles.

The driving cycles are the Manhattan cycle, a low average speed, highly transient urban cycle (Figure 1), the Orange County Bus Cycle, a medium average speed transient urban cycle (Figure 2), and the EPA HD-UDDS Cycle, which consists of urban and highway driving segments (Figure 3). An emissions test was comprised of two runs for each of the three different driving cycles, and the average values were reported. Test results reported include the average grams per mile value for each of the gaseous emissions of carbon dioxide, carbon monoxide, oxides of nitrogen, total hydrocarbons and non-methane hydrocarbons. In addition, emissions of particulate matter will also be reported for diesel fuel buses. Testing is performed in accordance with EPA CFR49, Part 1065 and SAE J2711 as practically determined by the FTA Emissions Testing Protocol developed by West Virginia University and Penn State University.

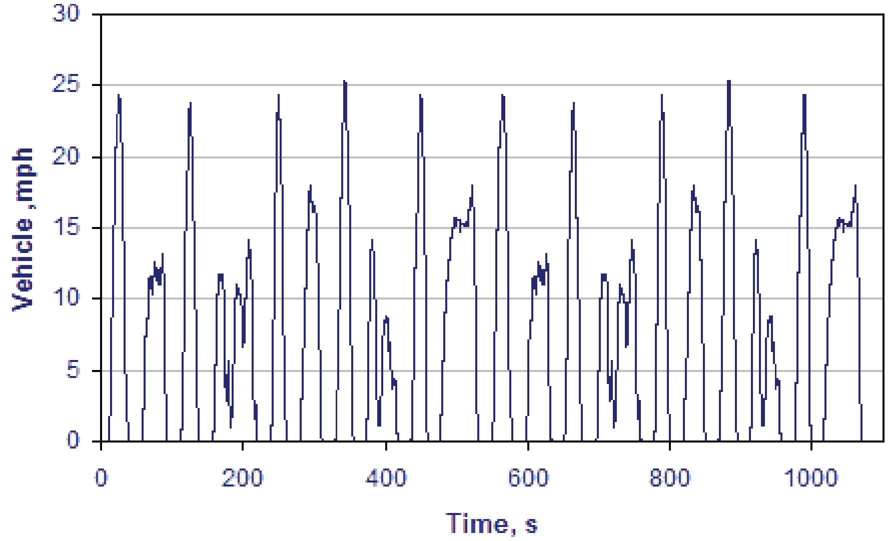


Figure 8.1. *Manhattan Driving Cycle (Duration 1089 sec, Maximum Speed 25.4 mph, Average Speed 6.8 mph)*

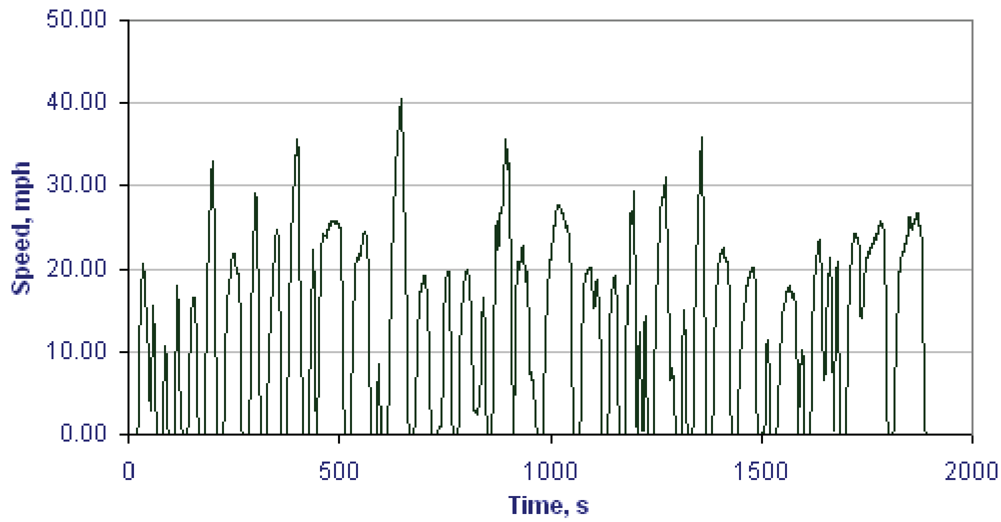


Figure 8.2. *Orange County Bus Cycle (Duration 1909 Sec, Maximum Speed 41 mph, Average Speed 12 mph)*

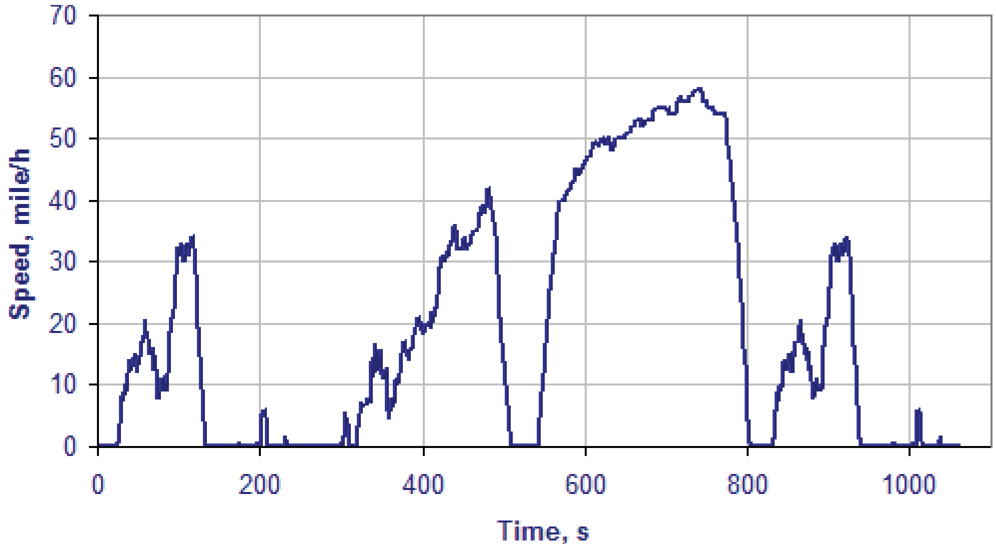


Figure 8.3. *HD-UDDS Cycle (Duration 1060 seconds, Maximum Speed 58 mph, Average Speed 18.86 mph)*

8-III. TEST ARTICLE

The test article is a Gillig LLC Low Floor model transit bus equipped with a diesel fueled Cummins B6.7 280 hp engine. The bus was tested on June 1, 2022 with the odometer reading 3,286 miles.

8-IV. TEST EQUIPMENT

Testing was performed in the LTI Vehicle Testing Laboratory emissions testing bay. The test bay is equipped with a Schenk Pegasus 72-inch, large-roll chassis dynamometer. The dynamometer is electronically controlled to account for vehicle road-load characteristics and for simulating the inertia characteristics of the vehicle. Power to the roller is supplied and absorbed through an electronically controlled 3-phase ac motor. Absorbed power is returned to the electrical grid.

Vehicle exhaust is collected by a Horiba CVS, full-flow dilution tunnel. The system has separate tunnels for diesel and gasoline/natural gas fueled vehicles. In the case of diesel vehicles, particulate emissions are measured gravimetrically using 47mm Teflon filters. These filters are housed in a Horiba HF47 particulate sampler, per EPA 1065 test procedures. Heated gaseous emissions of hydrocarbons and NOx are sampled by Horiba heated oven analyzers.

Gaseous emissions for CO, CO2 and cold NOx are measured using a Horiba Mexa 7400 series gas analyzer. System operation, including the operation of the chassis dynamometer, and all calculations are controlled by a Dell workstation running Horiba CDCTS test control software. Particulate Filters are weighed in a glove box using a Sartorius microbalance accurate to 1 microgram.

8-V. TEST PREPARATION AND PROCEDURES

The test bus was prepared for emissions testing in accordance with the Fuel Economy Pre-Test Maintenance Form. (In the event that fuel economy test was performed immediately prior to emissions testing this step does not have to be repeated.) This is done to ensure that the bus is tested in optimum operating condition. The manufacturer-specified preventive maintenance shall be performed before this test. The ABS system is disabled for operation on the chassis dynamometer. Any manufacturer-recommended changes to the pre-test maintenance procedure must be noted on the revision sheet. The Fuel Economy Pre-Test Inspection Form will also be completed before performing the Emissions test. Both the Fuel Economy Pre-Test Maintenance Form and the Fuel Economy Pre-Test Inspection Form are found in section 6, Fuel Economy Test.

Prior to performing the emissions test, each bus is evaluated to determine its road-load characteristics using coast-down techniques in accordance with SAE J1263. This data is used to program the chassis dynamometer to accurately simulate over-the-road operation of the bus.

Warm-up consisted of driving the bus for 20 minutes at approximately 40 mph on the chassis dynamometer. During emissions testing, the test driver followed the prescribed driving cycle by watching the speed trace and instructions on the Horiba Drivers-Aid monitor which is placed in front of the windshield. The CDCTS computer monitored the test and collected data for calculation of emissions at the end of the test.

This bus was tested for emissions at seated load weight. The emissions data was obtained at the following conditions:

1. Air conditioning off
2. Heater off
3. Defroster off
4. Exterior and interior lights on
5. Windows and Doors closed
6. Seated load weight

The test tanks or the bus fuel tank(s) were filled prior to the fuel economy test with diesel fuel.

8-VI. DISCUSSION

Table 8.1 provides the emissions testing results on a grams per mile basis for each of the exhaust constituents measured and for each driving cycle performed.

TABLE 8.1 Emissions Test Results

Test Completed at SLW: 37,380 lb.			
Driving Cycle	**Manhattan**	**Orange County Bus**	**UDDS**
CO_2, gm/mi	2,333	1,728	1,357
CO, gm/mi	0.19	0.10	0.06
THC, gm/mi	0.17	0.01	0.01
NMHC, gm/mi	0.06	0.01	0.01
NO_x, gm/mi	1.34	0.22	0.03
Particulates. gm/mi	0.02	0.03	0.03

8. EMISSIONS TEST

BUS TESTED ON CHASSIS DYNAMOMETER FOR PERFORMANCE, FUEL/ENERGY ECONOMY AND EMISSIONS

Certification

The proposed bus model fully complies with the side impact crash test requirements that are detailed in the UMTA (FTA) Baseline Advanced Design Transit Coach White Book specifications (Section 2.1.2.10 Crashworthiness).

Background

The following report, including pre and post crash pictures, shows the results of the testing conducted at a private test facility in Ohio. The test was conducted on a specially built "worst-case" forty foot (40') Low Floor built in late 1997. The bus was first subjected to the full Altoona Bus Test prior to the crash test in 1998.

Results Summary

The test requires a 4,000lb car to be crashed into the side of the bus at 25mph. The impact is to cause no more than 3" of permanent structural deformation at the seated passengers' hip height and should not produce any sharp edges protruding into the interior of the bus.

The test results found that the impact caused no more than ½" deformation at the H-point and there were no sharp edges or protrusions.

Conclusion

- Actual deformation was less than 17% of that allowed
- Damage was so insignificant that structural repair was not required
- Damage was essentially confined to two quick-change skirt panels and their lower anchor plates
- Total repair time was estimated at less than 1 hour for a 3M mechanic. No welding was required; skirt panels were unbolted from their anchor plates and were pulled from the mid-rail channel. The anchor plates were replaced and new, pre-painted skirt panels were installed
- Total repair cost was estimated at less than $750, parts and labor

These results are unmatched by any competing vehicle and are a testimony to GILLIG's superior design knowledge and technology as well as an acknowledgment of the vehicle's structural strength and build integrity. These results are proof of the value and durability built into each GILLIG bus.

TR-98009

Gillig Corporation
UMTA Side Impact Testing of a
1997 Gillig Lowfloor Transit Bus
TRC Test No. 980513

Prepared by:

Transportation Research Center Inc.

10820 State Route 347

East Liberty, OH 43319

Final Report

May-June 1998

Prepared for:

Gillig Corporation

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<u>Notice</u>

Transportation Research Center Inc. does not endorse or certify products of manufacturers. The manufacturer's name appears solely to identify the test article. Transportation Research Center Inc. assumes no liability for the report or use thereof. It is responsible for the facts and the accuracy of the data presented herein. This report does not constitute a standard, specification, or regulation.

Report Prepared by:

Michael S. Postle Date 6/8/98

Michael S. Postle
Engineering Technician

Report Approved By:

Jeffrey W. Sankey Date 6/8/98

Jeffery W. Sankey
Manager, Project Operations

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Section 1.0

Purpose and Test Procedure

Purpose

This 25 mph bullet vehicle into transit coach impact test was conducted for the Gillig Corporation by Transportation Research Center Inc. The purpose of this test was to evaluate the performance of the subject vehicle, a 1997 Gillig Lowfloor Transit Bus with the lower horizontal sidewall extrusions removed, relative to the performance requirements of the Urban Mass Transportation Administration (UMTA), "Baseline Advanced Design Transit Coach Specification," paragraph 2.1.2.10, Crashworthiness.

Test Procedure

This test was conducted using the Urban Mass Transportation Administration (UMTA), "Baseline Advanced Design Transit Coach Specification," paragraph 2.1.2.10, Crashworthiness, as a guideline.

The crash event was recorded by one (1) real-time panning motion picture camera and five (5) high-speed motion picture cameras. The pre-test and post-test conditions were recorded by one (1) real time motion picture camera.

The vehicle interior sidewall deformation data is presented in Section 3.0. Camera information is presented in Section 4.0. Appendix A contains the still photographic prints.

Section 2.0

Test Summary

Test Summary

This bullet vehicle into transit bus side impact test was conducted at TRC on May 13, 1998.

The test vehicle, a 1997 Gillig Lowfloor Transit Bus with the lower horizontal sidewall extrusions removed, appeared to comply with the performance requirements of the Urban Mass Transportation Administration (UMTA), "Baseline Advanced Design Transit Coach Specification," paragraph 2.1.2.10, Crashworthiness.

The test vehicle was equipped with a 10.8 liter, 6 cylinder diesel engine, 4-speed automatic transmission, power steering, and air brakes. The transit bus test weight was 26,130 pounds. The bullet vehicle's test weight was 4004 pounds. The bullet vehicle's impact speed was 25.2 mph. The test vehicle was positioned so that the longitudinal centerline of the bullet vehicle was 102.75 inches rearward of the front axle centerline.

The vehicle's maximum interior intrusion at seated passenger hip height was 0.50 inches. There were no sharp edges or protrusions into the coach interior.

Table 1 Crash Test Summary

Test Type:	Bullet Vehicle into Left Side of Transit Bus	
Test Date:	05/13/98	
Test Time:	2043	
Ambient Temperature:	74° F	
Vehicle:	1997 Gillig Lowfloor Transit Bus with lower horizontal extrusions removed	
Vehicle Test Weight:	26,130 lbs	
Bullet Vehicle:	1985 Oldsmobile Delta 88 Royale 4-door sedan	
Bullet Vehicle Test Weight:	4004 lbs	
Impact Angle[1]:	270°	
Impact Velocity[2]:	Primary = 25.2 mph Secondary = 25.2 mph	
Maximum Deformation at Seated Passenger H-Point:	0.50 in.	
Dummies:	Driver - N/A	Passenger - N/A
Type:	N/A	N/A
Location:	N/A	N/A
Restraint:	N/A	N/A
Number of Cameras:	High-speed 5 Real-time 1	

[1] Clockwise from front centerline of test vehicle.
[2] Speed trap measurement (± .05 mph accuracy)

Table 2 Test Vehicle Information

Original Vehicle Manufacturer:	Gillig Corporation
Vehicle Altered by:	N/A
Make/Model:	40/102TB M11
VIN:	15GGD2110V1070002
Serial Number:	70002
Body Style:	Lowfloor Transit Bus
Model Year:	1997
Color:	White
Engine Data:	
Type:	Diesel
Cylinders:	6
Displacement:	10.8 liters
Transmission Data:	_4_ speed, __manual, _x_ automatic, __fwd, _x_ rwd, __4wd
Date Vehicle Received:	N/A
Odometer Reading:	21,512 miles
Dealer's Name and Address:	N/A

Accessories:

Power Steering	Yes	Automatic Transmission	Yes
Power Brakes	Air	Automatic Speed Control	No
Power Seats	No	Tilting Steering Wheel	Yes
Power Windows	No	Telescoping Steering Wheel	Yes
Tinted Glass	Yes	Air Conditioning	Yes
Radio	No	Anti-skid Brake	No
Clock	No	Rear Window Defroster	No
Other	None	Power Door Locks	No

Table 2 Test Vehicle Information, Cont'd.

Certification Data from Vehicle's Label:

Vehicle Manufactured by:	Gillig Corporation
Date of Manufacture:	4/15/97
VIN:	15GGD2110V1070002
GVWR:	39,600 lbs
GAWR:	Front: 14,600 lbs, Rear: 25,000 lbs

Tire Information

Vehicle Tire Size:	Goodyear, Metro Miler, B305/85R22.5 LR J
Recommended Cold Tire Pressure:	Front: 115 psi; Rear: 105 psi

Test Vehicle Attitudes:

Pre-test Attitude:	LF: 46.8 in	RF: 47.8 in	LR: 47.9 in	RR: 48.6 in
Post-test Attitude:	LF: 46.5 in	RF: 48.2 in	LR: 47.6 in	RR: 48.6 in

Section 3.0

Vehicle Sidewall Deformation Data

Table 3 Vehicle Interior Profiles and Static Intrusion
Zero Distance at Projected Impact Point*

Location	42	36	30	24	18	12	6	0	6	12	18	24	30	36	42
Pre-test profile (distance in inches from reference plane**)															
H-Point +6 in.	67.8	67.7	67.7	67.8	67.8	67.8	67.8	67.8	67.9	67.8	67.9	67.9	67.9	67.9	68.0
H-Point	67.9	67.9	67.8	67.8	67.8	67.8	67.8	67.8	67.9	68.0	67.8	67.9	67.8	68.0	67.9
Bus Floor	63.1	63.1	63.0	63.0	63.0	62.8	62.9	63.0	63.0	63.0	63.0	63.0	62.9	63.0	63.0
Post-test profile (distance in inches from reference plane**)															
H-Point +6 in.	68.0	67.7	67.8	67.8	67.8	67.6	67.7	67.6	67.8	67.5	67.6	67.6	67.8	68.0	67.9
H-Point	67.9	67.8	67.8	67.8	67.8	67.8	67.8	67.6	67.6	67.5	67.5	67.7	67.6	67.8	67.8
Bus Floor	63.0	63.1	63.0	63.0	63.0	62.9	62.8	62.9	62.9	63.0	62.9	62.8	62.8	62.8	62.8
Static crush (in.)															
H-Point +6 in.	-0.2	0.0	-0.1	0.0	0.0	0.2	0.1	0.2	0.1	0.3	0.3	0.3	0.1	-0.1	0.1
H-Point	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.5	0.3	0.2	0.2	0.2	0.1
Bus Floor	0.1	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.1	0.0	0.1	0.2	0.1	0.2	0.2

* Projected impact point is the centerline of the striking vehicle on the bus side and is 102.75 inches rearward of the front axle centerline.
** Reference plane is parallel to and 20.0 inches from the vehicle's longitudinal centerline.
Column readings are front to rear from right to left.

Section 4.0

Camera Information

Figure 1 Camera Positions

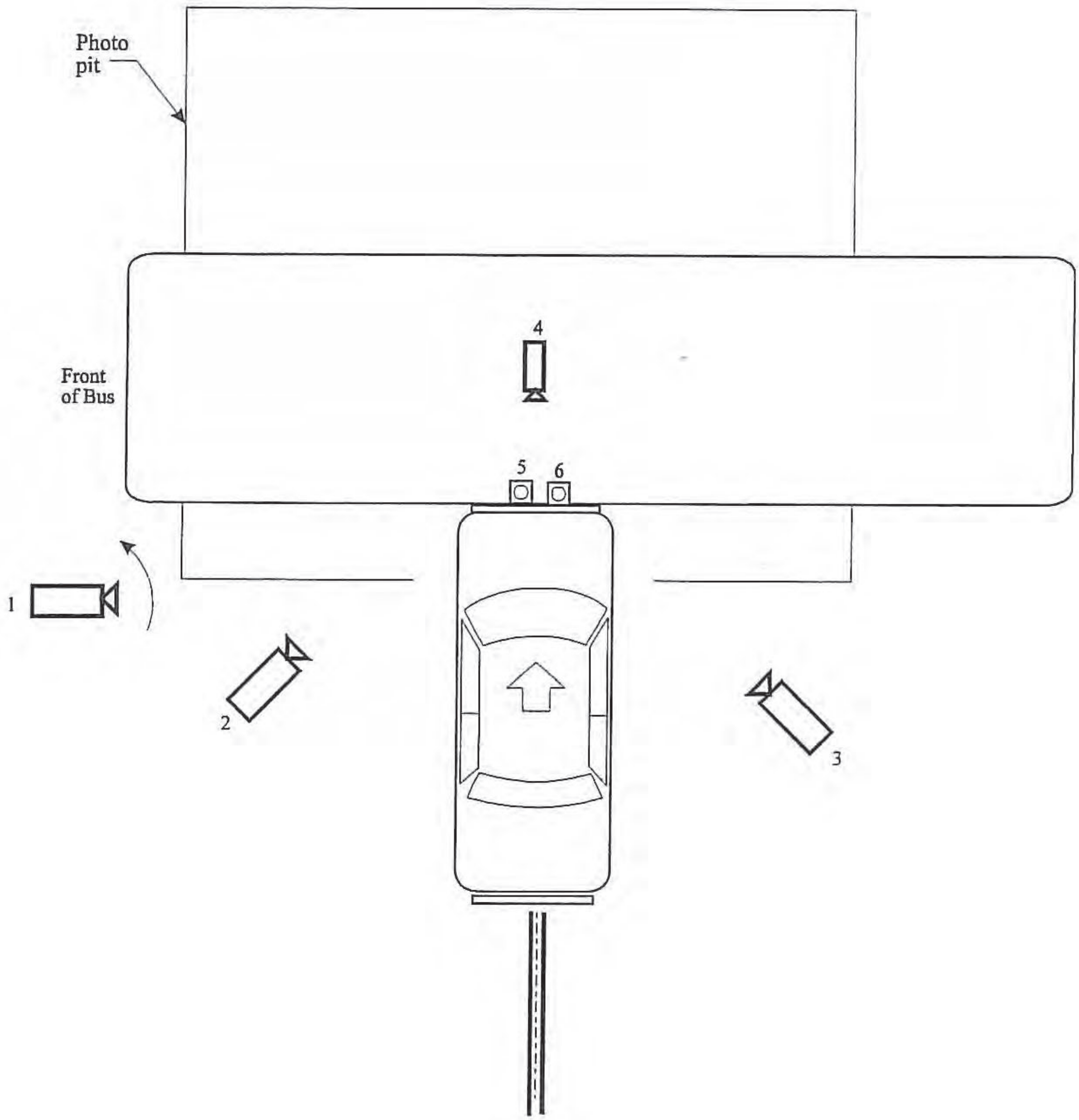

Table 4 Camera Information

Camera Number	Location	Type	Lens (mm)	Speed (fps)	Purpose of Camera Data
1	Real-time panning	Bolex	16	24	Vehicle dynamics
2	Left tight	Photosonic	13	262	Vehicle dynamics
3	Right tight	Photosonic	13	250	Vehicle dynamics
4	Onboard	Photosonic	13	498	Interior Intrusion
5	Pit tight	Photosonic	25	488	Vehicle crush
6	Pit tight	Photosonic	25	500	Vehicle crush

Figure A-1 Pre-Test Front View

Figure A-2 Post-Test Front View

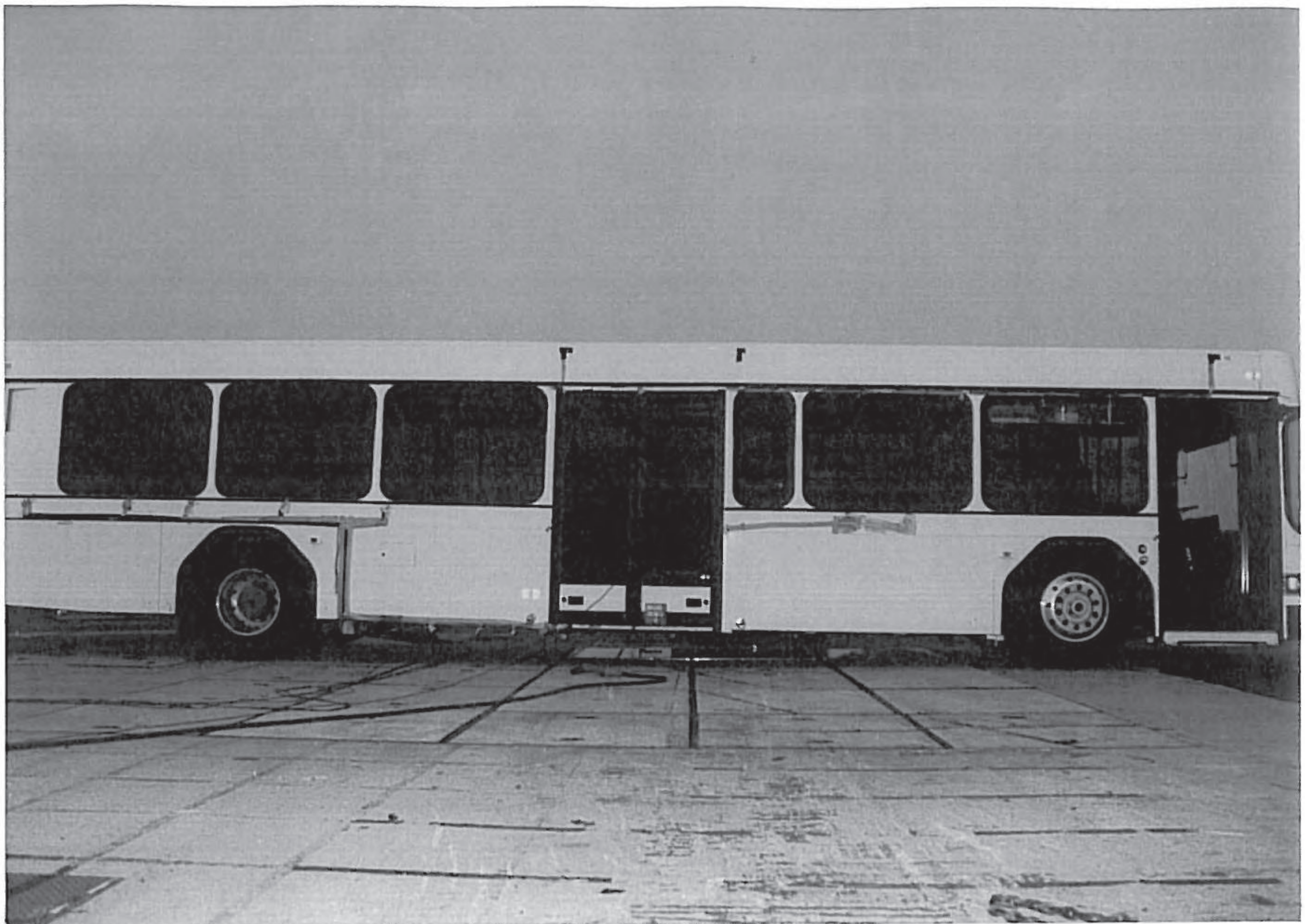

Figure A-3 Pre-Test Right Side View

Figure A-4 Post-Test Right Side View

Figure A-5 Pre-Test Rear View

Figure A-6 Post-Test Rear View

Figure A-7 Pre-Test Left Side View

Figure A-8 Post-Test Left Side View

Figure A-9 Pre-Test Right Three-Quarter Impact Area View

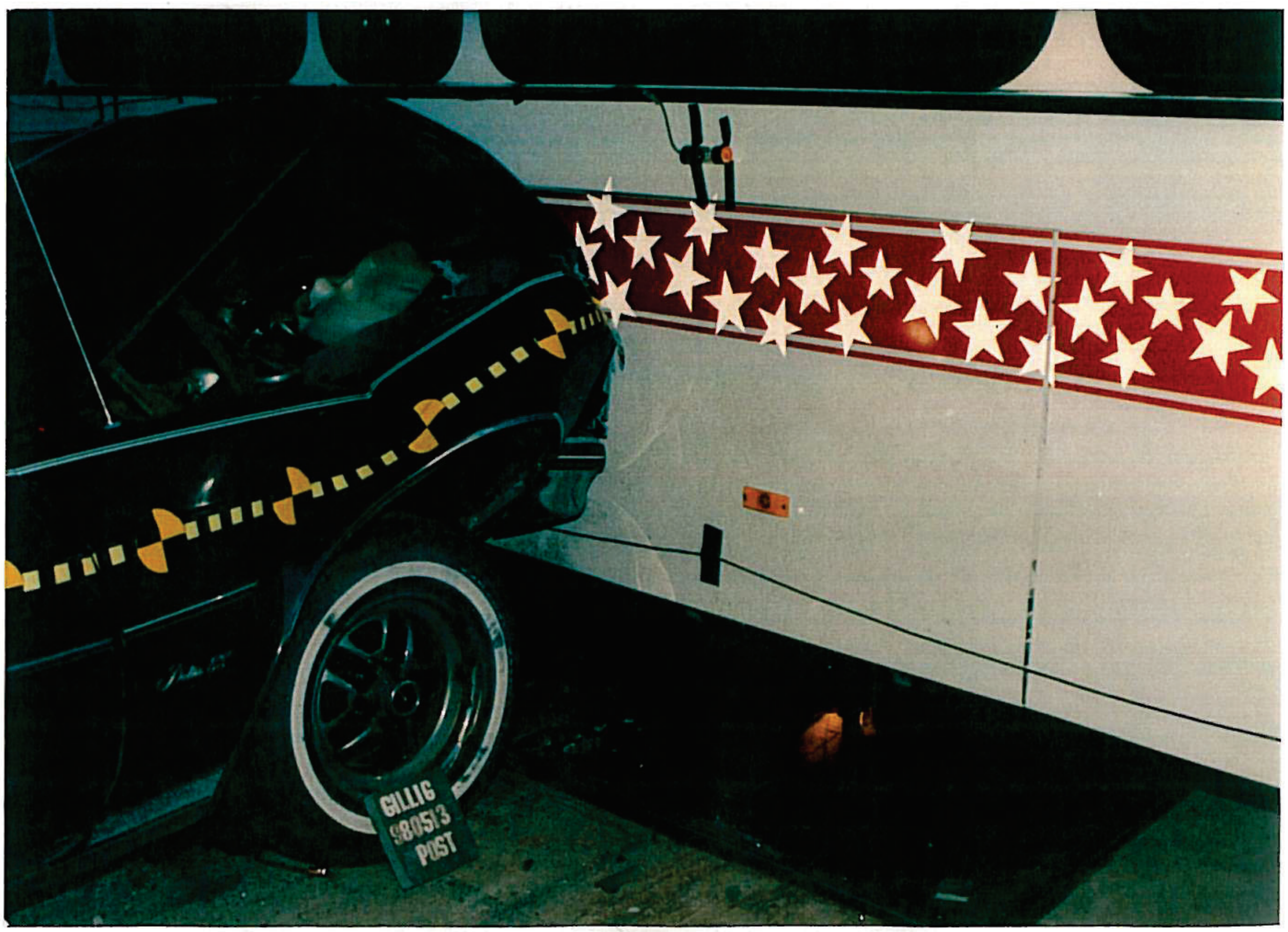

Figure A-10 Post-Test Right Three-Quarter Impact Area View

Figure A-11 Pre-Test Left Three-Quarter Impact Area View

Figure A-12 Post-Test Left Three-Quarter Impact Area View

Figure A-13 Pre-Test Impact Area Close-Up View

Figure A-14 Post-Test Impact Area Close-Up View

Figure A-15 Pre-Test Bullet Vehicle Left Three-Quarter View

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Figure A-16 Pre-Test Bullet Vehicle Front View

Figure A-17 Post-Test Bullet Vehicle Front View

Figure A-18 Post-Test Impact Area w/Exterior Panels Removed View 1

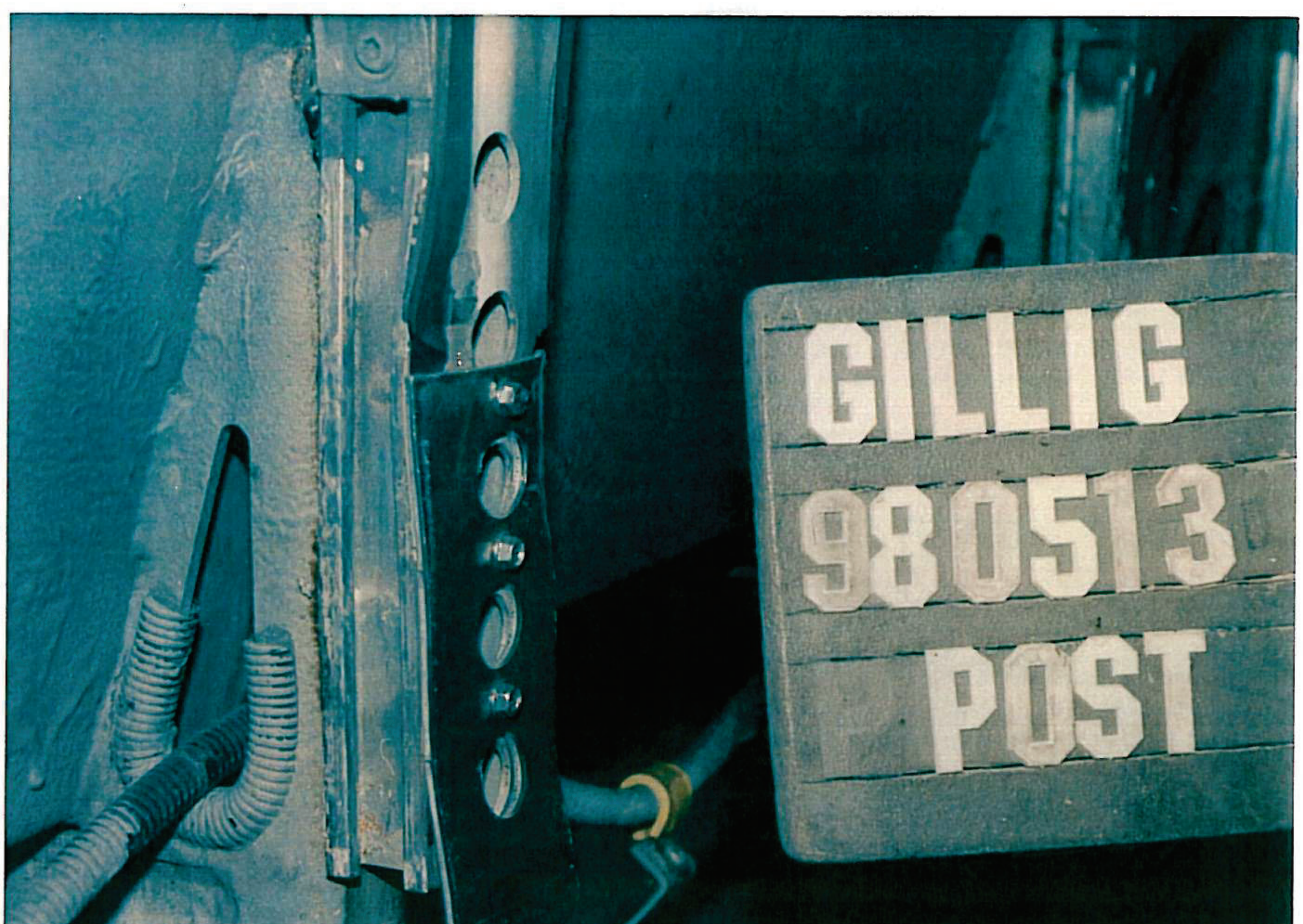

Figure A-19 Post-Test Impact Area w/Exterior Panels Removed View 2

Figure A-20 Post-Test Interior Impact Area View 1

Figure A-21 Post-Test Interior Impact Area View 2

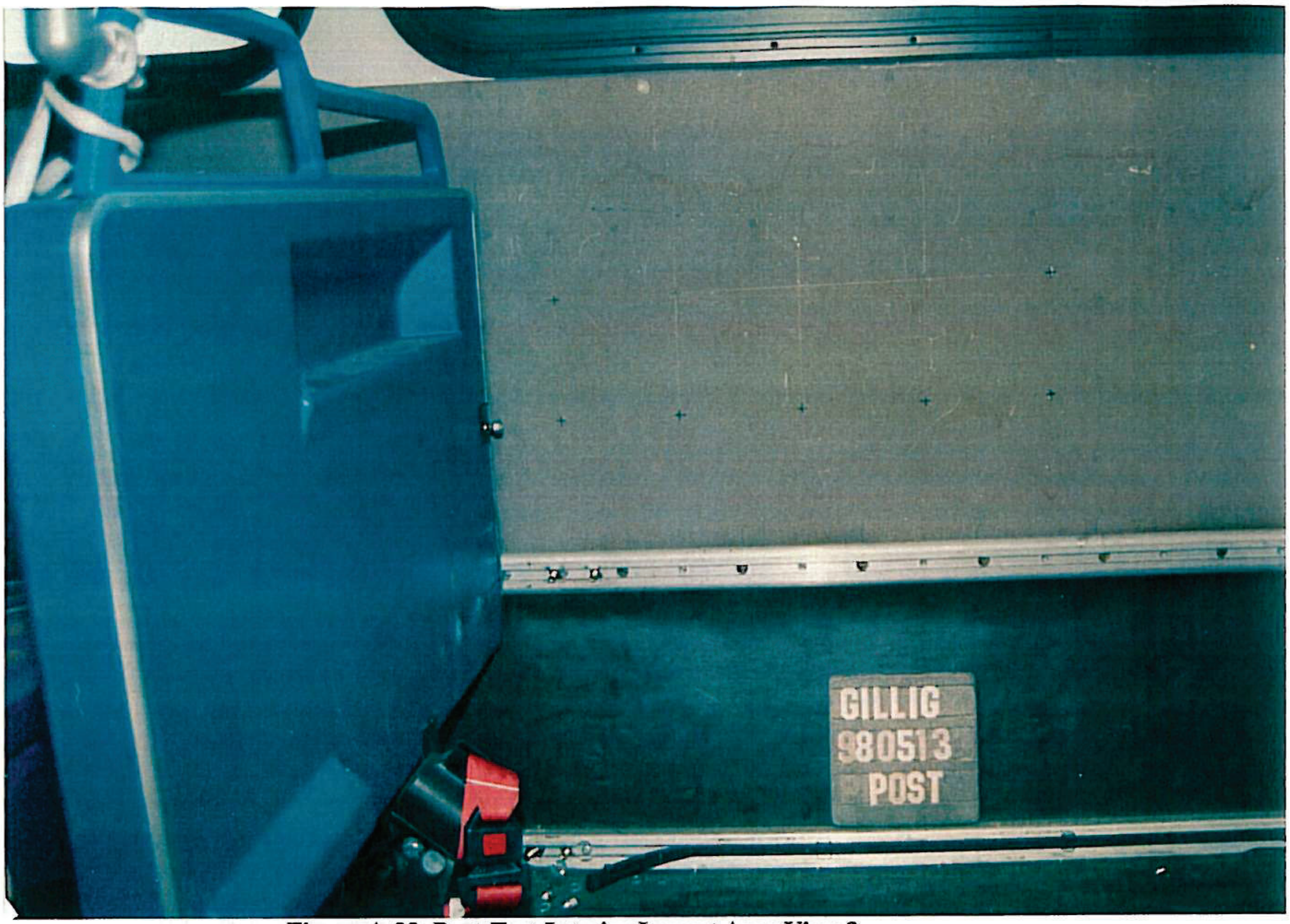

Figure A-22 Post-Test Interior Impact Area View 3

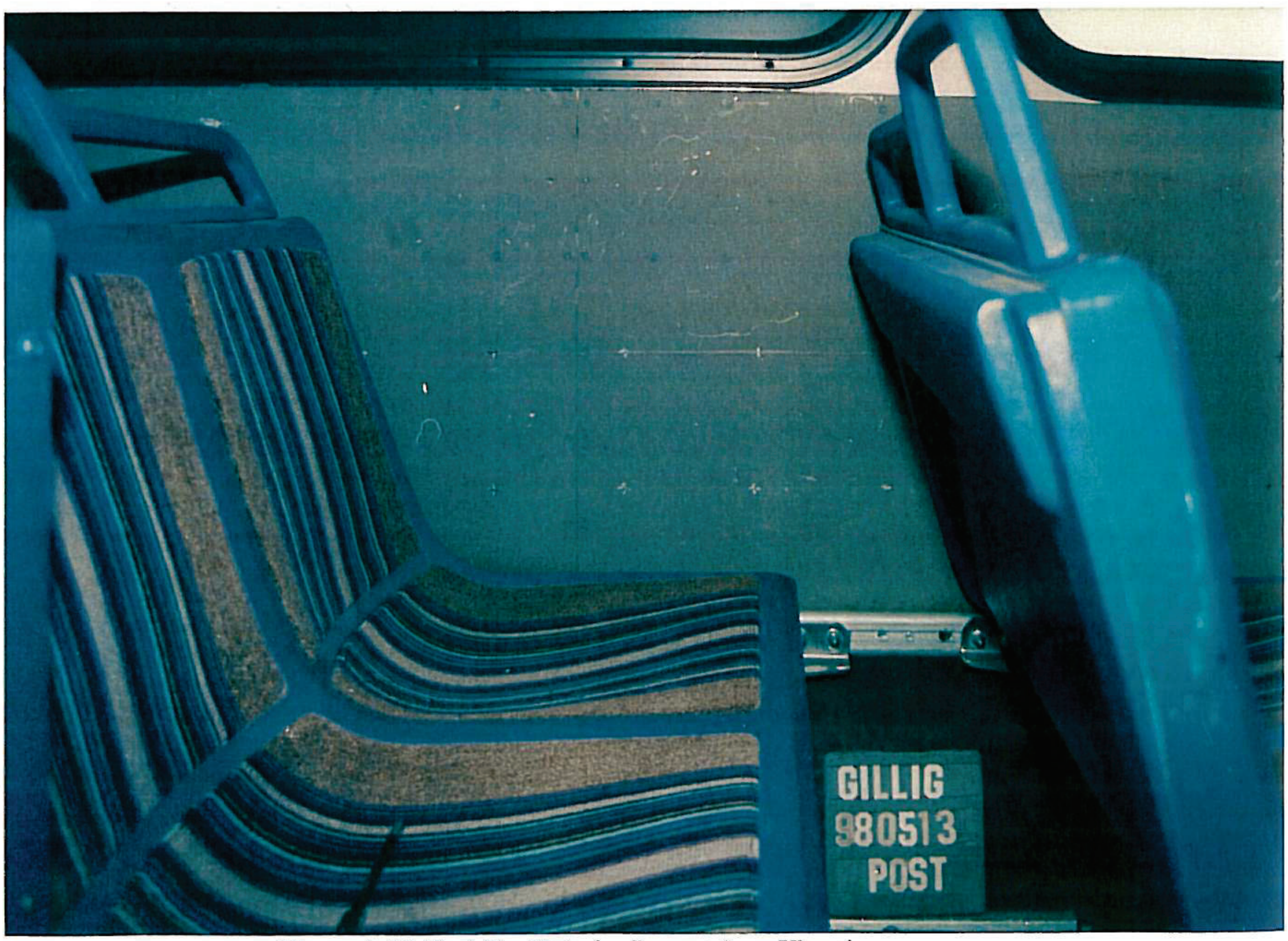

Figure A-23 Post-Test Interior Impact Area View 4

Figure A-24 Post-Test Windshield Damage View

Figure A-25 Post-Test Windshield Damage Close-Up View

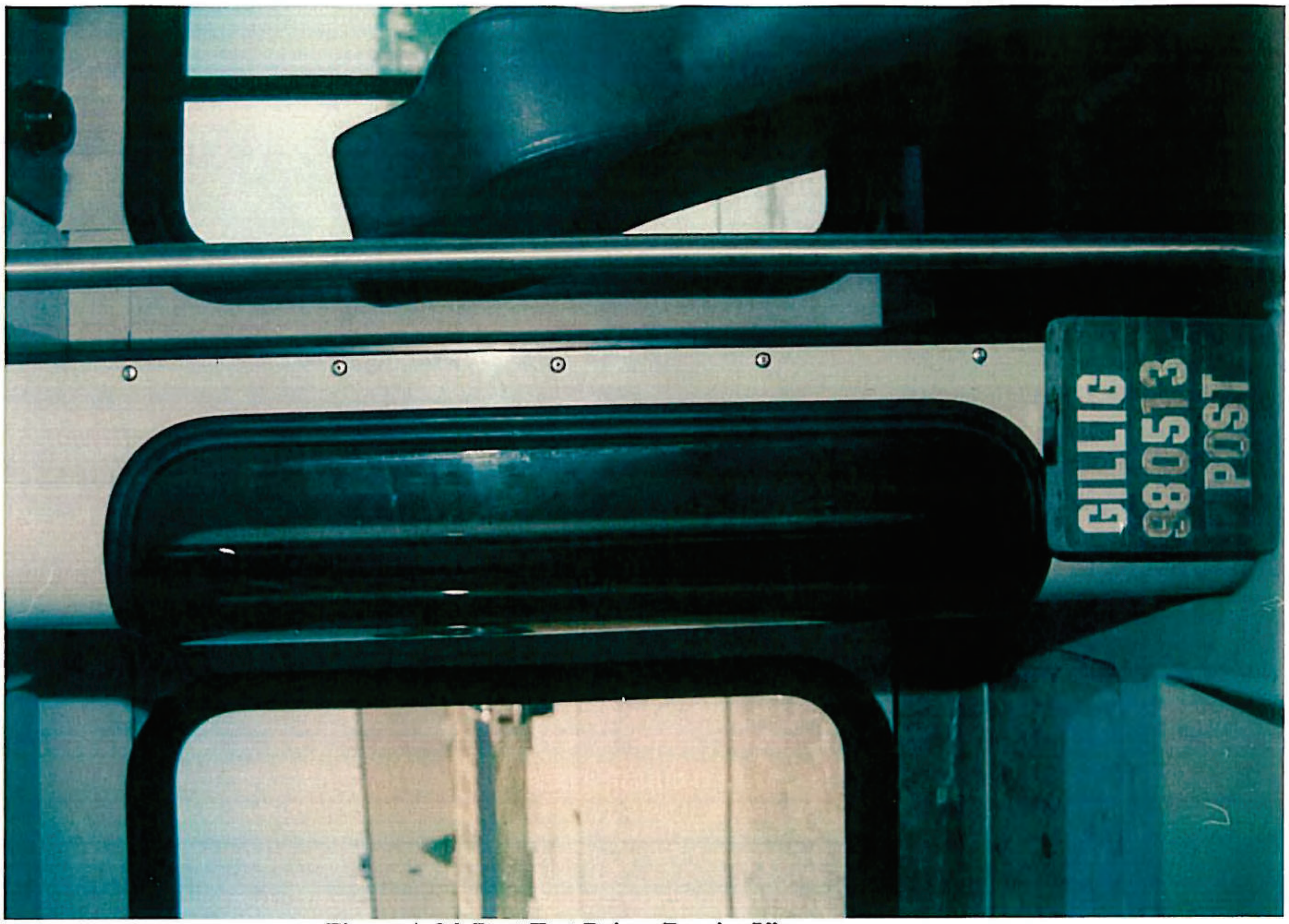

Figure A-26 Post-Test Driver Barrier View

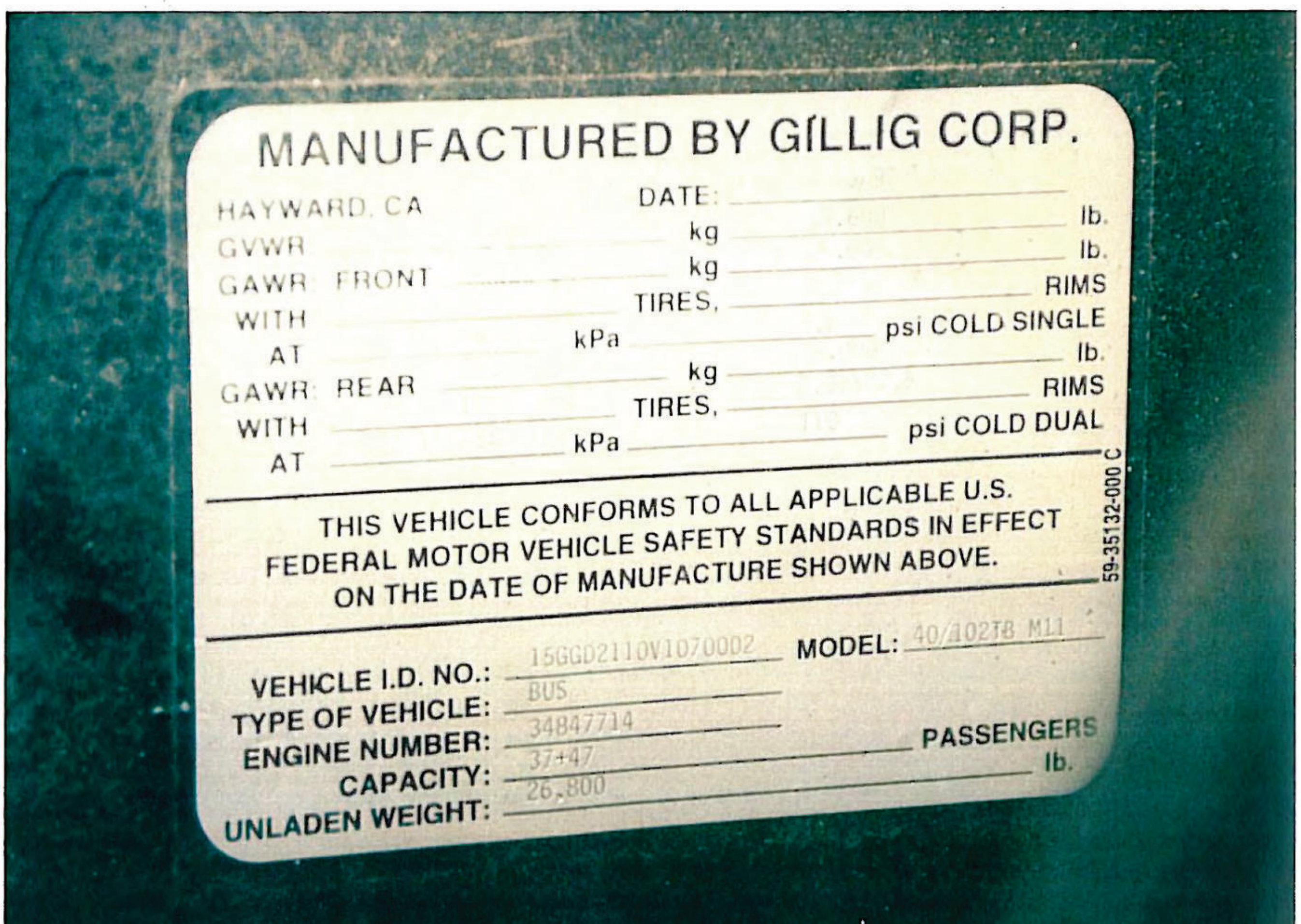

Figure A-27 Pre-Test Vehicle Chassis/Tire Information Label View