



The following documentation is an electronically-submitted vendor response to an advertised solicitation from the *West Virginia Purchasing Bulletin* within the Vendor Self-Service portal at ***wvOASIS.gov***. As part of the State of West Virginia's procurement process, and to maintain the transparency of the bid-opening process, this documentation submitted online is publicly posted by the West Virginia Purchasing Division at ***WVPurchasing.gov*** with any other vendor responses to this solicitation submitted to the Purchasing Division in hard copy format.

Header 5

List View

[General Information](#) | [Contact](#) | [Default Values](#) | [Discount](#) | [Document Information](#) | [Clarification Request](#)
**Procurement Folder:** 776756

**Procurement Type:** Central Master Agreement

**Vendor ID:** VS0000014439 

**Legal Name:** Creative Bus Sales, Inc.

**Alias/DBA:**
**Total Bid:** \$4,714,545.00

**Response Date:** 11/04/2020 

**Response Time:** 11:30

**SO Doc Code:** CRFQ

**SO Dept:** 0805

**SO Doc ID:** PTR2100000005

**Published Date:** 10/29/20

**Close Date:** 11/4/20

**Close Time:** 13:30

**Status:** Closed

**Solicitation Description:** Addendum 1 - 156" WB DRW Narrow Body Cutaway





Department of Administration  
Purchasing Division  
2019 Washington Street East  
Post Office Box 50130  
Charleston, WV 25305-0130

State of West Virginia  
Solicitation Response

**Proc Folder:** 776756  
**Solicitation Description:** Addendum 1 - 156" WB DRW Narrow Body Cutaway  
**Proc Type:** Central Master Agreement

Solicitation Closes	Solicitation Response	Version
2020-11-04 13:30	SR 0805 ESR11042000000003369	1

**VENDOR**  
VS0000014439  
Creative Bus Sales, Inc.

**Solicitation Number:** CRFQ 0805 PTR2100000005  
**Total Bid:** 4714545  
**Response Date:** 2020-11-04  
**Response Time:** 11:30:54  
**Comments:**

**FOR INFORMATION CONTACT THE BUYER**  
Linda B Harper  
(304) 558-0468  
linda.b.harper@wv.gov

<b>Vendor</b>		
<b>Signature X</b>	<b>FEIN#</b>	<b>DATE</b>

All offers subject to all terms and conditions contained in this solicitation

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
1	156" WB DRW Narrow Body Cutaway	1.00000	EA	4714545.000000	4714545.00

Comm Code	Manufacturer	Specification	Model #
25101502			

Commodity Line Comments:

Extended Description:

156" WB DRW Narrow Body Cutaway - Vendors submitting bids online should enter the Total Bid Amount from the Exhibit A Pricing Page in the commodity line of wvOasis and attach a copy of the Exhibit A Pricing Page with their bid.

REQUEST FOR QUOTATION  
156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway

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**REQUIRED BID DOCUMENTATION CHECKLIST**

Model Year: 2021      Model: Glaval Commute

**Mandatory Bid Forms – must be submitted with bid:**

- ☒ Bid Form #1: Locations of Technical Service Representatives and Parts Distribution Centers
- ☒ Bid Form #2: Disadvantaged Business Enterprise Vendors/Manufacturers Certification  
**The vendor shall also supply with bid FTA TVM DBE Goal Concurrence for the Current Fiscal Year Approval Letter.**
- ☒ Bid Form #3: Buy America Certification Rolling Stock  
**Should the Vendor be declared responsive and low bid, pursuant to Pre-Award and Post Delivery Audit Requirements, the Division will require the Vendor to submit documentation (with the bid or prior to any award) that lists:**
  - 1) Component and sub-component parts of the rolling stock to be purchased identified by manufacturer of the parts, their country of origin and cost: and
  - 2) The location of the final assembly point for the rolling stock, including a description of the activities that will take place at the final assembly point and the cost of final assembly.
- ☒ Bid Form #4: Federal Motor Vehicle Safety Standards Certification  
**Vendor shall also supply with bid a breakdown of FMVSS standards to be met with proposed vehicle.**
- ☒ Bid Form #5: Certification of Primary Participant Regarding Debarment, Suspension, and Other Responsibility Matters
- ☒ Bid Form #6: Vendor's Certification of Understanding and Acceptance
- ☒ Bid Form #7: Certification of Restrictions on Lobbying
- ☒ Bid Form #8: Certification of Compliance with FTA's Vehicle Testing Requirements  
**A copy of the vehicle testing report (if available) shall be included with the bid.**
- ☒ Exhibit A Pricing Page (8)

**REQUEST FOR QUOTATION**  
**156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway**

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**DOCUMENTATION TO BE SUBMITTED WITH BID:**

**Section**  
**Referenced**

- |                 |   |
|-----------------|---|
| <u>✓</u> 3.2    | Chassis: product description, warranty information and product literature.  |
| <u>✓</u> 3.3    | Engine shall be 3.7 Liter V-6 gasoline engine: provide product description, warranty information and product literature.  |
| <u>✓</u> 3.17.1 | Radio: AM/FM/BT/SYNC Radio With 4" Display provide product description, Warranty information and product literature.  |
| <u>✓</u> 3.8    | Transmission: provide product description, warranty information and product literature.   |
| <u>✓</u> 3.5    | Radiator and Cooling System: provide product description, warranty information and product literature.  |
| <u>✓</u> 3.6    | High Idle System, provide product description, warranty information and product literature.   |
| <u>✓</u> 3.13   | Brakes: provide product description, warranty information and product literature.   |
| <u>✓</u> 3.11.4 | Tilt Wheel, Cruise Control and Power Steering: provide details of water testing procedures.   |
| <u>✓</u> 3.21   | Wheelbase: provide length of proposed wheelbase.  |
| <u>✓</u> 3.9.4  | Rear View Back-Up Camera: provide product description, warranty information and literature.   |
| <u>✓</u> 3.14   | Wheels: provide product description, warranty information and product literature.   |
| <u>✓</u> 3.15   | Tires: provide product description, warranty information and product literature   |
| <u>✓</u> 3.16.6 | Battery: provide product description, warranty information and product literature   |
| <u>✓</u> 3.16.5 | Alternator: provide product description, warranty information and product literature  |
| <u>✓</u> 3.26   | Front and Rear Heating and Air Conditioning: provide product description, warranty information, product literature.   |
| <u>✓</u> 3.19   | Body Specifications: provide a description of how conversion will take place and meet the specification requirements. Provide Actual Interior height and Body length of proposed vehicle. |
| <u>✓</u> 3.21   | Sealant, Rustproofing and Undercoating: provide product description, warranty information and product literature.   |

**REQUEST FOR QUOTATION**  
**156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway**

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- ✓ 3.19 Passenger Doors and Stepwells: Provide product description, dimensions, description of interlock system of all doors and locks to be provided.
- ✓ 3.29 Flooring: provide a description of product to be used, samples of floor covering, colors to be used and assembly process.
- ✓ 3.22 Seats, Grab Handles, Passenger restraints: provide product description, warranty information and product literature.
- ✓ 3.34 Mobility Aid/ Occupant Restraint Systems: provide product description, warranty information and product literature.
- ✓ 3.44 Training: submit letter of understanding to the terms in this Section.
- ✓ 3.35.4 Security Cameras System provide product description, warranty information and product literature.
- ✓ 4.12.2 Warranty on Complete Vehicle.
- ✓ 4.12.3 Warranty on Basic Vehicle Structure.
- ✓ 4.12.5 Warranty: warranties to be provide on subsystems and components.
- ✓ 7.3 Complete two (2) bids in binder form –one (1) marked for DPT.
- ✓ 9.2 A Complete mechanical description of vehicle, its construction and equipment including manufacturer's model name and / or number.
- ✓ 9.2 B Proposed interior floor plans, showing detailed dimensions including the location of the wheelchair securement system.
- ✓ 9.2 C Curb weight (empty weight) and gross vehicle weight rating (GVWR of vehicle.
- ✓ 9.2 D Exterior Vinyl Colors: provide samples/chart of available colors.
- ✓ 9.2 H Identification of the conversion location of the van and listing of activities to take place at the location.
- ✓ 9.2 I A list of five (5) users names, addresses, emails and telephone numbers who have been provided similar equipment.
- ✓ No Debt Affidavit
- ✓ Addendum Acknowledgement

**DESIGNATED CONTACT:** Vendor appoints the individual identified in this Section as the Contract Administrator and the initial point of contact for matters relating to this Contract.

Mike Wilson, Regional Sales Manager

(Name, Title)

(Printed Name and Title)

57475 County Road 3, Elkhart, IN 46517

(Address)

800-326-2877 / 574-830-0063

(Phone Number) / (Fax Number)

mikew@creativebussales.com

(email address)

**CERTIFICATION AND SIGNATURE:** By signing below, or submitting documentation through wvOASIS, I certify that I have reviewed this Solicitation in its entirety; that I understand the requirements, terms and conditions, and other information contained herein; that this bid, offer or proposal constitutes an offer to the State that cannot be unilaterally withdrawn; that the product or service proposed meets the mandatory requirements contained in the Solicitation for that product or service, unless otherwise stated herein; that the Vendor accepts the terms and conditions contained in the Solicitation, unless otherwise stated herein; that I am submitting this bid, offer or proposal for review and consideration; that I am authorized by the vendor to execute and submit this bid, offer, or proposal, or any documents related thereto on vendor's behalf; that I am authorized to bind the vendor in a contractual relationship; and that to the best of my knowledge, the vendor has properly registered with any State agency that may require registration.

Creative Bus Sales, Inc.

(Company)



(Authorized Signature) (Representative Name, Title)

Marcus Hoffman, Bid Manager

(Printed Name and Title of Authorized Representative)

11/3/2020

(Date)

800-326-2877 / 602-437-2758

(Phone Number) (Fax Number)

**REQUEST FOR QUOTATION**  
**156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway Vehicle**

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**17.2.3** Any other remedies available in law or equity.

**18. MISCELLANEOUS:**

- 18.1 No Substitutions:** Vendor shall supply only Vehicles as submitted in response to the Solicitation unless a contract modification is approved in accordance with the provisions contained in this Contract.
- 18.2 Vendor Supply:** Vendor must carry sufficient inventory of the Contract Items being offered to fulfill its obligations under this Contract. By signing its bid, Vendor certifies that it can supply the Contract Items contained in its bid response.
- 18.3 Contract Manager:** During its performance of this Contract, Vendor must designate and maintain a primary contract manager responsible for overseeing Vendor's responsibilities under this Contract. The Contract manager must be available during normal business hours to address any customer service or other issues related to this Contract. Vendor should list its Contract manager and his or her contact information below.

**Contract Manager:** Mike Wilson

**Telephone Number:** 800-326-2877

**Fax Number:** 574-830-0063

**Email Address:** mikew@creativebussales.com

STATE OF WEST VIRGINIA  
Purchasing Division  
**PURCHASING AFFIDAVIT**

**CONSTRUCTION CONTRACTS:** Under W. Va. Code § 5-22-1(i), the contracting public entity shall not award a construction contract to any bidder that is known to be in default on any monetary obligation owed to the state or a political subdivision of the state, including, but not limited to, obligations related to payroll taxes, property taxes, sales and use taxes, fire service fees, or other fines or fees.

**ALL CONTRACTS:** Under W. Va. Code §5A-3-10a, no contract or renewal of any contract may be awarded by the state or any of its political subdivisions to any vendor or prospective vendor when the vendor or prospective vendor or a related party to the vendor or prospective vendor is a debtor and: (1) the debt owed is an amount greater than one thousand dollars in the aggregate; or (2) the debtor is in employer default.

**EXCEPTION:** The prohibition listed above does not apply where a vendor has contested any tax administered pursuant to chapter eleven of the W. Va. Code, workers' compensation premium, permit fee or environmental fee or assessment and the matter has not become final or where the vendor has entered into a payment plan or agreement and the vendor is not in default of any of the provisions of such plan or agreement.

**DEFINITIONS:**

**"Debt"** means any assessment, premium, penalty, fine, tax or other amount of money owed to the state or any of its political subdivisions because of a judgment, fine, permit violation, license assessment, defaulted workers' compensation premium, penalty or other assessment presently delinquent or due and required to be paid to the state or any of its political subdivisions, including any interest or additional penalties accrued thereon.

**"Employer default"** means having an outstanding balance or liability to the old fund or to the uninsured employers' fund or being in policy default, as defined in W. Va. Code § 23-2c-2, failure to maintain mandatory workers' compensation coverage, or failure to fully meet its obligations as a workers' compensation self-insured employer. An employer is not in employer default if it has entered into a repayment agreement with the Insurance Commissioner and remains in compliance with the obligations under the repayment agreement.

**"Related party"** means a party, whether an individual, corporation, partnership, association, limited liability company or any other form or business association or other entity whatsoever, related to any vendor by blood, marriage, ownership or contract through which the party has a relationship of ownership or other interest with the vendor so that the party will actually or by effect receive or control a portion of the benefit, profit or other consideration from performance of a vendor contract with the party receiving an amount that meets or exceeds five percent of the total contract amount.

**AFFIRMATION:** By signing this form, the vendor's authorized signer affirms and acknowledges under penalty of law for false swearing (W. Va. Code §61-5-3) that: (1) for construction contracts, the vendor is not in default on any monetary obligation owed to the state or a political subdivision of the state, and (2) for all other contracts, that neither vendor nor any related party owe a debt as defined above and that neither vendor nor any related party are in employer default as defined above, unless the debt or employer default is permitted under the exception above.

**WITNESS THE FOLLOWING SIGNATURE:**

Vendor's Name: Creative Bus Sales, Inc.

Authorized Signature:  Date: 11/3/2020

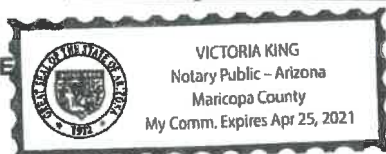
State of Arizona

County of Maricopa, to-wit:

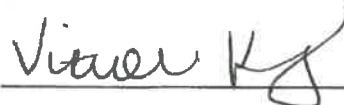
Taken, subscribed, and sworn to before me this 3rd day of November, 2020.

My Commission expires April 25th, 2020.

AFFIX SEAL HERE



NOTARY PUBLIC



*Purchasing Affidavit (Revised 01/19/2018)*





## Proposer's Capability and Experience

### Responder Information

Creative Bus Sales, Inc.  
28293 Clay Street  
Elkhart, IN 46517

Mike Wilson | Regional Sales Manager  
Phone: 800.326.2877  
Fax: 574.830.0063  
Email: [mikew@CreativeBusSales.com](mailto:mikew@CreativeBusSales.com)

### 1. Background and Experience

Operating 18 full-service locations, Creative Bus Sales is the largest bus dealership in the United States representing over 20 major vehicle manufacturers. The Company's team of vehicle sales representatives possess over 560 years of cumulative vehicles sales experience, resulting in 5,000+ vehicles sold nationwide every year.

Creative Bus Sales is dedicated to servicing its customers at the highest possible level. Nationwide, the Company has in excess of 270 company operated service bays dedicated to pre-delivery inspections, warranty and service work. Green Alternative Systems (GAS), a division of Creative Bus Sales, has performed over 10,000 alternative fuel conversions (CNG, Propane, and Electric). Additionally, the Company is the only dealership in the nation to possess multiple Ford-certified, Qualified Vehicle Modifier (QVM) dealership locations.

Creative Bus Sales houses a dedicated customer service department to handle all pre- and post-sales needs of its customers. The Company has a team of 25+ dedicated outside and inside parts sales representatives responsible for handling all customer parts needs. Creative Bus Sales currently holds multiple State Purchasing Contracts, a partial listing of contracts is shown below.

#### **Nationwide Transit Contract Experience (a partial listing of significant projects)**

• Orange County Transit (OCTA)	Over 950 Paratransit Buses & Vans
• City of Los Angeles (LADOT)	Over 500 Paratransit Buses
• Caltrans/DGS	Over 5,000 Paratransit Buses & Vans
• RTC Las Vegas	Over 400 Paratransit & Transit Buses
• Access Services	Over 1,000 Paratransit Mini Vans
• Dallas DART	Over 400 Paratransit Buses
• Florida (FDOT)	Over 600 Paratransit Buses & Vans
• GSA	Over 350 Paratransit Buses
• Arizona Dept of Trans (ADOT)	Over 600 Paratransit Buses & Vans
• North Carolina (NCDOT)	Over 600 Paratransit Buses & Vans
• Texas (Multiple Contracts)	Over 1,200 Paratransit Buses & Vans
• Washington (WSDOT)	Over 650 Paratransit Buses & Vans
• Oregon (ODOT)	Over 300 Paratransit Buses & Vans
• Oklahoma (Multiple Contracts)	Over 400 Paratransit Buses & Vans
• New Mexico (NMDOT)	Over 450 Paratransit Buses & Vans



# Creative Bus Sales

THE NATION'S LARGEST BUS DEALER SINCE 1980

- Pennsylvania (Penn DOT) 324 (Delivered) 114 (Backlog) Paratransit Buses & Vans

Creative Bus Sales currently holds transit contracts and/or services customers in the following states: WA, OR, CA, NV, ID, MT, WY, UT, CO, AZ, NM, KS, OK, TX, IL, IN, AR, LA, MS, AL, GA, FL, NC, SC, PA, TN, MD, and MA.

## References

See attached Reference List

## Customer Service Capabilities

Creative Bus Sales' service locations are located within the contract requirements of all recipient's locations. The Creative Care and Technical team are available to assist immediately as needed. The Company has the authority to deploy internal and factory personnel from any discipline including engineering, manufacturing, parts, service and management in response to a customer's needs. No delay in problem resolution due to out of state factory personnel availability is experienced. Swift and accurate resolutions to issues and needs are achieved through factory personnel directly reviewing issues, "first hand", as they are presented.

Creative Bus Sales has excellent relations with all major component manufacturers. The Company's Service Technicians and supervisory team are certified by John Deere, Cummins, A/C Carrier, MCC, Trans Air, Thermo King, Freedman Seating, Ricon, and Braun amongst many others. Service Technicians are graduates of the Automotive Technical College and many are Automotive Service Excellence (ASE) Master Technicians.

Creative Bus Sales' Parts and Service Department is dedicated solely to the service and support of commercial and transit buses and does not service any other type of equipment, school buses or trucks. Such focus ensures an unmatched level of competency in the industry. Technical assistance can be provided immediately during business hours by contacting Creative Bus Sales service technicians. Complete description of warranty policy and procedures can be provided upon award.

With over 5,000 units sold annually, Creative Bus Sales has the largest "fleet" of vehicles in service in the nation. This gives the Company the most vehicle performance data in the industry. The Company is exposed to issues with vehicles across the country in a variety of operating conditions. This data allows the Company to recognize issues well in advance of smaller dealers that do not service the volume of vehicles Creative Bus Sales does. This translates to quicker warranty approvals and repair execution for customers, as many times the Company has already seen the issue prior to receiving the call. Additionally, our technical support team has an information sharing process that communicates common issues and repairs, resulting in reduced troubleshooting times frames and quicker repairs. All of this allows the Company to get customer vehicles back up and running in the quickest manner possible, minimizing downtime for customers.



# Creative Bus Sales

THE NATION'S LARGEST BUS DEALER SINCE 1980

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## List of Centers

One call to our dedicated Creative Care team will initiate immediate warranty service and technical response. Creative Bus Sales is an authorized repair facility for all products represented. The Company has the authority to make on the spot decisions regarding warranty repairs and approvals. In addition to the Company operated facilities, local warranty repair facilities will be authorized to perform the required repair on an as needed basis. The Company has attached a list of local shops we currently have long standing relationships with. Our intent is to make all warranty and service as local as possible while providing the customer with the best possible service. Our team of certified technical advisors are available to assist with any necessary troubleshooting efforts. This ensures less downtime and a better overall experience to the end users.

## Spare Parts and Inventory Levels

A critical part of the project is a quick response time to service assistance and parts supply. Creative Bus Sales operates dedicated parts warehousing operations with over 60,000 square feet of capacity and \$10,000,000 worth of inventory. The Company stocks significant parts supply at all its locations. In addition, the Company operates dedicated parts warehouses in Arizona, California, Florida, Indiana, Georgia, Pennsylvania, and Texas.

One call to our Parts Department will facilitate the end user's needs. With 25+ dedicated employees, Creative Bus Sales' Parts Department has over sixty years of cumulative experience in this field. Most parts can be shipped within twenty-four hours of order. Complete description of parts policy and procedures can be provided upon award.

## Inspection procedures

Due to Creative Bus Sales' proximity to manufacturers locations, the Company has inspectors on site during vehicle builds. The Company has a team of inspectors located in Elkhart, Indiana that visits manufacturer facilities on an ongoing basis. This allows the Company to catch any potential issues during the build process, prior to customer receipt. Once completed at the manufacturer, vehicles are delivered to a Company location for additional inspection. In many cases these vehicles flow through Creative Bus Sales' Elkhart inspection facility immediately following completion. The Elkhart facility is over 50,000 square feet and processes deliveries of approximately 1,500 vehicles yearly. Any issues identified can be repaired in house or sent back to the manufacturer for repair. Next, vehicles are shipped to one of the Company's local facilities for final PDI (Pre-Delivery Inspection). This additional inspection allows the Company to catch any issues that may have occurred during the initial driving period of the vehicle. Any deficiency noted shall be repaired before delivery. All documents required under the contract shall be provided upon delivery or pickup. The Company inspection processes mentioned above are all in addition to any inspections performed by the manufacturer and/or line inspectors hired by the end user.



# Creative Bus Sales

THE NATION'S LARGEST BUS DEALER SINCE 1980

## 2. Key Personnel and Experience

### Executive Management Team

- Tony Matijevich | President
- Terry McCrea | Chief Financial Officer
- TJ Matijevich | Vice President & General Manager
- Mike Wilson | Regional Sales Manager
- Marcus Hoffman | Bid Manager
- Carl Henderson | Service Manager

## 3. Fiscal Responsibility

With a 40 year history, 18 locations nationwide, and 350+ employees, Creative Bus Sales has the necessary longevity and financial stability to service any contract of any size. Since 1980, the Company has grown to service customers in nearly every state in the U.S. More than 50% of the Company's facilities are owned facilities, not leased properties, with significant investment in renovations, equipment, and employees.

Creative Bus Sales has long standing relationships with vehicle floorplan providers and banking partners. Floorplan relationships go back 20+ years and the same goes for its banking relationships. The Company has achieved increased revenue, sales, and transaction growth year over year for the past 10+ years.

## 4. Delivery Performance

Creative Bus Sales prides itself on delivering vehicles on time with all specifications met. The Company has not paid liquidated damages on any transit contract in the past five (5) years. Please see supplemental spreadsheet titled "Delivery Performance" for a detailed delivery performance history.

## 5. Ownership History and Statement Regarding Judgements and Violations

Originally founded in 1980 as Creative Transportation Systems (CTS), the Company was later renamed Creative Bus Sales in 1990. The current owner, Tony Matijevich, purchased the Company in 1993 and it has been family-owned and operated since.] Prior to purchasing Creative Bus Sales, Tony was the President of ElDorado National, the largest manufacturer of small and mid-size buses in the nation at the time. Under the current leadership and vision, Creative Bus Sales has become the largest-volume small, mid and large-size bus and van dealership in the United States. Over the past 40 years, the Company has expanded its scope through a combination of dealer acquisitions and organic growth.

Creative Bus Sales was incorporated in the State of California in 1993 under the current ownership. Creative Bus Sales has had no judgments, litigation, licensing violations or other violations outstanding or resolved against it within the past five (5) years.



# Creative Bus Sales

THE NATION'S LARGEST BUS DEALER SINCE 1980

## 6. Additional Information

### Creative Bus Sales Nationwide Locations:

- |                     |                          |
|---------------------|--------------------------|
| 1. Chino, CA        | 10. Charlotte, NC        |
| 2. San Diego, CA    | 11. Atlanta, GA          |
| 3. Sacramento, CA   | 12. Colorado Springs, CO |
| 4. Canby, OR        | 13. Albuquerque, NM      |
| 5. Mukilteo, WA     | 14. Phoenix, AZ          |
| 6. Murrysville, PA  | 15. Irving, TX           |
| 7. Elkhart, IN      | 16. Tyler, TX            |
| 8. Jacksonville, FL | 17. Tulsa, OK            |
| 9. Davie, FL        | 18. Springdale, AR       |

### Notices should be sent c/o

Mike Wilson	Creative Bus Sales, Inc.	28293 Clay St, Elkhart, IN 46517
Phone: 800.326.2877	Fax: 574.830.0063	Email: <a href="mailto:mikew@CreativeBusSales.com">mikew@CreativeBusSales.com</a>

### Preparer

Marcus Hoffman, Bid Manager for Creative Bus Sales, is the preparer of this proposal.

### Flexible Scope

Creative Bus Sales is committed to flexibility in the products and services offered in the contract upon request by the State.

### Independent Pricing

Creative Bus Sales certifies that in connection with this Contract the prices proposed have been arrived at without consultation, communication or agreement for the purpose of restricting competition.

### Signer(s)

Each person signing this proposal and/or addenda is the person responsible for or authorized to make decisions as to the prices quoted in the cost proposal and has not participated and will not participate in any action contrary to those stated above.

### Consent

If awarded a contract, Creative Bus Sales will not assign any part of its interest in the agreement without prior consent of the State.

### Acceptance of Terms

Creative Bus Sales accepts the Contract Terms and Conditions.



# Creative Bus Sales

THE NATION'S LARGEST BUS DEALER SINCE 1980

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## **Cutoff Dates**

Creative Bus Sales agrees to comply with this section. Model year cutoffs are well communicated by the OEM's and chassis dealers alike. We generally receive 60 – 90 day notice and will notify the agency promptly.

Sincerely,

**Marcus Hoffman | Bid Manager**

Creative Bus Sales, Inc.



**Creative Bus Sales**  
*THE NATION'S LARGEST BUS DEALER SINCE 1980*

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## References

Capital Area Rural Transportation System  
David Marsh- GM  
2010 East 6<sup>th</sup> Street  
Austin, TX 78702  
512-481-1011  
Dave@ridecarts.com

Houston Metro  
Michael Southwell- Procurement  
1900 Main Street  
Houston, TX 77208  
713-739-4803  
Michael.Soothwell@ridemetro.org

Capital Metro  
Andrew Murphy- Equipment Specialist 2910  
East 5<sup>th</sup> Street  
Austin, TX 78702  
512-389-7566  
Andrew.murphy@capmetro.org

Valley Metro- RPTA  
Dave Hyink  
Fleet Manager  
480-924-6653 x 243  
dhyink@valleymetro.org  
101 North First Ave Suite 1100  
Phoenix, AZ 85003

WY- DOT  
Rob Rodriguez  
Transit Program Specialist  
307-777-4181  
robert.rodriguez1@wyo.gov  
5300 Bishop Blvd.  
Cheyenne, WY 82009

Med Valet Corporation  
Larry Cranmer  
3535 NW 58<sup>th</sup> Street #920  
Oklahoma City, OK 73112  
405-848-7275  
larry@medvalet.biz



REQUEST FOR QUOTATION  
156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway Vehicle

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**BID FORM #1**

**MANDATORY BID FORM – MUST BE SUBMITTED WITH BID**

Location(s) of the Technical Service Representative(s) and parts distribution center(s) closest or in the State of West Virginia.

**Location(s) of the technical service representative(s).**

**Name:** Creative Bus Sales - Indiana

**Address:** 57475 County Road 3, Elkhart, IN 46517

**Telephone:** 800-326-2877

**Name:** Creative Bus Sales - Georgia

**Address:** 1525 Willingham Drive, Atlanta, GA 30344

**Telephone:** 770-422-8920

**Location(s) of parts distribution center(s).**

**Name:** Creative Bus Sales - Indiana

**Address:** 57475 County Road 3, Elkhart, IN 46517

**Telephone:** 800-326-2877

**Name:** Creative Bus Sales - Parts Distribution Warehouse

**Address:** 3632 E. LaSalle, Phoenix, AZ 85040

**Telephone:** 888-993-5040



REQUEST FOR QUOTATION  
156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway Vehicle

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**BID FORM #2**

**DISADVANTAGED VEHICLEINESS ENTERPRISE  
VENDORS/ MANUFACTURERS CERTIFICATION**

**MANDATORY BID FORM – MUST BE SUBMITTED WITH BID**

**(Check appropriate statement)**

☐ The Vendor, if a transit vehicle manufacturer, hereby certifies that it has complied with the requirements of 49 CFR Section 26.49 by submitting an annual DBE goal to the Federal Transit Administration (FTA). The goal has either been approved or not disapproved by FTA.

☒ The Vendor, if a non-manufacturing supplier, hereby certifies that the manufacturer of the transit vehicle to be supplied has complied with the above-referenced requirement of 49 CFR Section 26.49.

11/3/2020  
Date

  
Authorized Signature

Bid Manager  
Title

Creative Bus Sales, Inc.  
Company Name

REQUEST FOR QUOTATION  
156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway Vehicle

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**BID FORM #2**

**DISADVANTAGED VEHICLEINESS ENTERPRISE  
VENDORS/ MANUFACTURERS CERTIFICATION**

**MANDATORY BID FORM – MUST BE SUBMITTED WITH BID**

(Check appropriate statement)



The Vendor, if a transit vehicle manufacturer, hereby certifies that it has complied with the requirements of 49 CFR Section 26.49 by submitting an annual DBE goal to the Federal Transit Administration (FTA). The goal has either been approved or not disapproved by FTA.



The Vendor, if a non-manufacturing supplier, hereby certifies that the manufacturer of the transit vehicle to be supplied has complied with the above-referenced requirement of 49 CFR Section 26.49.

11/3/2020

Date



Authorized Signature

Government Bid Sales

Title

Glaval Bus Division of Forest River Inc.

Company Name



U.S. Department  
Of Transportation  
**Federal Transit  
Administration**

Headquarters

East Building, 5<sup>th</sup> Floor – TCR  
1200 New Jersey Avenue, SE  
Washington, DC 20590

November 25, 2019

Donall Hasty, DBELO  
Elkhart Coach, Glaval Bus,  
& Starcraft/StarTrans Bus  
2367 Century Drive  
Goshen, IN 46525

Re: TVM DBE Goal Concurrence/Certification Letter – Fiscal Year 2020

Dear Mr. Hasty:

This letter is to inform you that the Federal Transit Administration's (FTA) Office of Civil Rights has received Elkhart Coach, Glaval Bus, and Starcraft/StarTrans Bus' Disadvantaged Business Enterprise (DBE) goal and methodology for FY 2020 for the period of October 1, 2019–September 30, 2020. This goal submission is required by the U.S. Department of Transportation's DBE regulations at 49 CFR Part 26 and must be implemented in good faith.

We have reviewed your FY 2020 DBE goal and determined that it complies with DOT's DBE regulations. You are eligible to bid on FTA-funded transit contracts. This letter or a copy of the TVM listing on FTA's website may be used to demonstrate your compliance with DBE requirements when bidding on federally funded vehicle procurements.

FTA reserves the right to remove/suspend this concurrence if your DBE program or FY 2020 DBE goal is not implemented in good faith. In accordance with this good faith requirement, you must submit your DBE Uniform Report to FTA by December 1, 2019. This report should reflect all FTA-funded contracting activity for the second period of FY 2019 (i.e., from April 1 to September 30).

Please also be mindful that your FY 2021 DBE goal methodology must be submitted to FTA by August 1, 2020. Any significant updates to the program plan must be submitted to FTA as they occur. If you have any questions, please contact the FTA DBE Team via email at [FTATVMSubmissions@dot.gov](mailto:FTATVMSubmissions@dot.gov).

Sincerely,

  
John Day  
Program Manager  
Office of Civil Rights

REQUEST FOR QUOTATION  
156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway Vehicle

---

**BID FORM #3**

**BUY AMERICA CERTIFICATION  
ROLLING STOCK  
MANDATORY BID FORM – MUST BE SUBMITTED WITH BID**

**Certificate of Compliance**

The bidder or offeror hereby certifies that it will comply with the requirements of section 165(b) (3), of the Surface Transportation Assistance Act of 1982, as amended, and the applicable regulations of 49 CFR 661.11:

11/3/2020

Date



Authorized Signature

Creative Bus Sales, Inc.

Company Name

Marcus Hoffman

Name

Bid Manager

Title

**Certificate for Non-Compliance**

The bidder or offeror hereby certifies that it cannot comply with the requirements of section 165(b) (3) of the Surface Transportation Assistance Act of 1982, as amended, but may qualify for an exception to the requirement consistent with section 165(b) (2) or (b) (4) of the Surface Transportation Assistance Act, as amended, and the applicable regulations in 49 CFR 661.7.

Date

Authorized Signature

Company Name

Name

Title

REQUEST FOR QUOTATION  
156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway Vehicle

---

**BID FORM #3**

**BUY AMERICA CERTIFICATION  
ROLLING STOCK  
MANDATORY BID FORM – MUST BE SUBMITTED WITH BID**

**Certificate of Compliance**

The bidder or offeror hereby certifies that it will comply with the requirements of section 165(b) (3), of the Surface Transportation Assistance Act of 1982, as amended, and the applicable regulations of 49 CFR 661.11:

11/3/2020

Date



Authorized Signature

Glaval Bus Division of Forest River Inc.

Company Name

**Mark Barczak**

Name

Government Bid Sales

Title

**Certificate for Non-Compliance**

The bidder or offeror hereby certifies that it cannot comply with the requirements of section 165(b) (3) of the Surface Transportation Assistance Act of 1982, as amended, but may qualify for an exception to the requirement consistent with section 165(b) (2) or (b) (4) of the Surface Transportation Assistance Act, as amended, and the applicable regulations in 49 CFR 661.7.

Date

Authorized Signature

Company Name

Name

Title

REQUEST FOR QUOTATION  
156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway Vehicle

---

**BID FORM #4**

**FEDERAL MOTOR VEHICLE  
SAFETY STANDARDS CERTIFICATION**

**MANDATORY BID FORM – MUST BE SUBMITTED WITH BID**

The vendor hereby certifies that it shall submit, as required by Title 49 of the CFR, Part 663 - Subpart D, it's self-certification information stating that the vehicle(s) will comply with the relevant Federal Motor Vehicle Safety Standards issued by the National Highway Traffic Safety Administration in Title 49 of the Code of Federal Regulations, Part 571.

11/3/2020

Date



Authorized Signature

Bid Manager

Title

Creative Bus Sales, Inc.

Company Name

REQUEST FOR QUOTATION  
156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway Vehicle

---

**BID FORM #4**

**FEDERAL MOTOR VEHICLE  
SAFETY STANDARDS CERTIFICATION**

**MANDATORY BID FORM – MUST BE SUBMITTED WITH BID**

The vendor hereby certifies that it shall submit, as required by Title 49 of the CFR, Part 663 - Subpart D, its self-certification information stating that the vehicle(s) will comply with the relevant Federal Motor Vehicle Safety Standards issued by the National Highway Traffic Safety Administration in Title 49 of the Code of Federal Regulations, Part 571.

11/3/2020

Date



Authorized Signature

Government Bid Sales

Title

Glaval Bus Division of Forest River Inc.

Company Name

# 2020

## C/FMVSS Compliance Summary



This document gives a brief summary of how Glaval Bus meets all applicable federal regulations.

**NOTICE:** All required testing is on file and available upon request.

Regulation	Regulation Description	Compliance Summary
C/FMVSS 101	Controls and displays	Compliance deferred to chassis manufacturer.
C/FMVSS 102	Transmission shift lever sequence, starter interlock & transmission braking effect	Compliance deferred to chassis manufacturer.
C/FMVSS 103	Windshield defrosting & defogging systems	Compliance deferred to chassis manufacturer.
C/FMVSS 104	Windshield wiping & washing systems	Compliance deferred to chassis manufacturer.
C/FMVSS 105	Hydraulic brake systems	Stretched units meet test requirements, for non-stretched units compliance deferred to chassis manufacturer.
C/FMVSS 106	Brake hoses	Stretched units use OEM compliant hoses, for non-stretched compliance deferred to chassis manufacturer.
C/FMVSS 108	Lamps, reflective devices & associated equipment	All lighting and reflective devices are present and installed to this standard. OEM lighting compliance deferred to chassis manufacturer.
CMVSS 108.1	Alternative requirements for headlights	Glaval does not alter any headlight component. Headlights meet regulation by manufacturer.
C/FMVSS 111	Rear view mirrors	Glaval installs aftermarket compliant mirrors. OEM mirror compliance deferred to chassis manufacturer.
C/FMVSS 113	Hood latch systems	Compliance deferred to chassis manufacturer.
C/FMVSS 114	Theft protection	Compliance deferred to chassis manufacturer.
C/FMVSS 115	Vehicle identification number	Compliance deferred to chassis manufacturer.
C/FMVSS 116	Hydraulic brake fluids	Compliance deferred to chassis manufacturer.
C/FMVSS 118	Power operated window, partition, and roof panel systems (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
C/FMVSS 120	Tire selection and rim for motor vehicles with a GVWR of 4,536kg/10,000 lbs. or more	Compliance deferred to chassis manufacturer. Tire/weight label also applied by Glaval.
C/FMVSS 121	Air brake systems	Stretched units use OEM compliant parts, for non-stretched compliance deferred to chassis manufacturer.
C/FMVSS 124	Accelerator control systems	Compliance deferred to chassis manufacturer.
C/FMVSS 125	Warning devices	All vehicles are shipped with a compliant triangle safety kit.
C/FMVSS 201	Occupant protection in interior impact (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
C/FMVSS 202	Head restraints (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
C/FMVSS 203	Impact protection for the driver from the steering control system (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
C/FMVSS 204	Steering control rearward displacement	Compliance deferred to chassis manufacturer.
C/FMVSS 205	Glazing materials	Cab compliance deferred to chassis manufacturer, additional glazing materials meet standard.
C/FMVSS 206	Door locks and door retention devices (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
C/FMVSS 207	Seating system	Glaval exceeds testing and standard requirements; cab seats meet OEM testing requirements.
C/FMVSS 208	Occupant crash protection	Glaval follows OEM guidelines; compliance deferred to chassis manufacturer.
C/FMVSS 209	Seat belt assemblies	Glaval follows OEM guidelines; compliance deferred to chassis manufacturer. Added belts meet 209.
C/FMVSS 210	Seat belt assembly anchorage	Glaval exceeds testing and standard requirements; cab seats meet OEM testing requirements.
CMVSS 210.1	User-ready tether anchorages for restraint systems and booster seats (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
CMVSS 210.2	Lower universal anchorage systems for restraint systems and booster cushions (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
C/FMVSS 212	Windshield mounting (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
C/FMVSS 213	Child restraint systems	Glaval does offer integrated child seats that have been tested to meet 213.
C/FMVSS 216	Roof crush resistance (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
C/FMVSS 217	Bus window retention and release	Glaval exceeds testing and standard requirements.
C/FMVSS 219	Windshield zone intrusion (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.



2020

## C/FMVSS Compliance Summary



This document gives a brief summary of how Glaval Bus meets all applicable federal regulations.

**NOTICE:** All required testing is on file and available upon request.

Regulation	Regulation Description	Compliance Summary
C/FMVSS 220	School bus rollover testing	Glaval offers units built to this standard (when requested) which exceeds testing requirements.
C/FMVSS 221	School bus body joint strength	Glaval exceeds testing requirements to meet this standard. <b>**NOTE: Must use FRP skin option.**</b>
FMVSS 225	Child restraint anchorage systems (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
C/FMVSS 301	Fuel system integrity (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
C/FMVSS 302	Flammability of interior materials	Glaval exceeds testing requirements to meet this standard, cab materials defer to chassis manufacturer.
C/FMVSS 303	Fuel system integrity of compressed natural gas systems (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
C/FMVSS 304	Compressed natural gas fuel container integrity (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
C/FMVSS 305	Electrolyte spillage and electrical shock protection (under 10,000 lbs.)	Glaval does not build on units under 10K, regulation does not apply.
C/FMVSS 403	Platform lift system for motor vehicles	Compliance deferred to lift manufacturer.
C/FMVSS 404	Platform lift installation on motor vehicles	Glaval installs lifts according to lift manufacturer's instructions for compliance to this standard.
CMVSS 1106	Noise emissions	Glaval follows OEM guidelines and has additional testing performed to meet this standard.

Signed: Dale Hase  
 Title: Compliance and Customer Service Manager

Date: 1/02/2020

REQUEST FOR QUOTATION  
156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway Vehicle

---

**BID FORM #5**

**MANDATORY BID FORM – MUST BE SUBMITTED WITH BID**  
**CERTIFICATION OF PRIMARY PARTICIPANT REGARDING**  
**DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS**

The Primary Participant (applicant for an FTA grant or cooperative agreement, or potential contractor for a major third-party contract),

Creative Bus Sales, Inc. (COMPANY 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 of 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 application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

If the primary participant (applicant for an FTA grant, or cooperative agreement, or potential third-party contractor) is unable to certify to any of the statements in this certification, the participant shall attach an explanation to this certification.)

THE PRIMARY PARTICIPANT (APPLICANT FOR AN FTA GRANT OR COOPERATIVE AGREEMENT, OR POTENTIAL CONTRACTOR FOR A MAJOR THIRD-PARTY CONTRACT),

Creative Bus Sales, Inc., 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. SECTIONS 3801 ET SEQ. ARE APPLICABLE THERETO.

  
\_\_\_\_\_  
Bid Manager  
Signature and Title of Authorized Official

REQUEST FOR QUOTATION  
156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway

---

**BID FORM #6**  
**MANDATORY BID FORM – MUST BE SUBMITTED WITH BID**

***VENDOR'S CERTIFICATION OF  
UNDERSTANDING AND ACCEPTANCE***

The Vendor hereby certifies that all Technical Specifications and Contract Terms and Conditions have been carefully reviewed, are fully understood and shall be adhered to in performance and completion of any contract resulting from this bid.

11/3/2020  
Date

  
Authorized Signature

Bid Manager  
Title

Creative Bus Sales, Inc.  
Company Name

**SPECIFICATION COMPLIANCE**

**NOTE: Please check if what is offered is in exact compliance with specifications. Any discrepancies must be listed as an attachment to the bid proposal. Exact dimensions and/or descriptions must be provided as a part of the Vendor's bid proposal when submitted.**

\_\_\_\_\_ Bid proposal submitted meets and/or exceeds all specification requirements.

\_\_\_\_\_ Bid proposal submitted contains deviations from specification requirements.  
Detailed descriptions of these deviations have been provided with this bid proposal.

**BID FORM #7**  
**MANDATORY BID FORM – MUST BE SUBMITTED WITH BID**  
**CERTIFICATION OF RESTRICTIONS ON LOBBYING**

Revised 10/27/2014

**REQUEST FOR QUOTATION**  
**156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway**

---

**BID FORM #8**

**CERTIFICATION OF COMPLIANCE WITH FTA'S  
BUS TESTING REQUIREMENTS**

The undersigned (Vendor/Manufacturer) certifies that the vehicle offered in this procurement complies with 49 U.S.C. 5318, as amended by MAP-21, and FTA regulations, "Bus Testing," 49 CFR Part 665.

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 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.

11/3/2020

Date



Authorized Signature

Bid Manager

Title

Creative Bus Sales, Inc.

Company Name

REQUEST FOR QUOTATION  
156" Wheelbase Dual Rear Wheel (DRW) Narrow Body Cutaway

---

**BID FORM #8**

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11/3/2020

Date

Mark Barock

Authorized Signature

Government Bid Sales

Title

Glaval Bus Division of Forest River Inc.

Company Name



U.S. Department  
of Transportation  
**Federal Transit  
Administration**

1200 New Jersey Avenue SE  
Washington, D.C. 20590

March 13, 2017

Rob Froelich  
Engineer  
Glaval Bus, a Division of Forest River, Inc.  
914 County Road 1 North  
Elkhart, IN 46514  
(via email: [rfroelich@forestriverinc.com](mailto:rfroelich@forestriverinc.com))

Dear Mr. Froelich:

This is in response to your letter dated January 23, 2017, in which you requested assistance from the Federal Transit Administration (FTA) concerning the applicability of the Bus Testing Regulation (49 CFR Part 665) to the Commute bus model manufactured by Glaval on the Ford Transit chassis. Your letter states that:

- Glaval builds its Commute bus model on the Ford Transit chassis.
- Glaval's sister company, StarCraft, recently completed a 5-year STURAA test on the Ford Transit (Report No. LTI-BT-R1609).
- Glaval has tested its 84" narrow body as the Glaval Sport in the 5-year service life category (Report No. PTI-BT-R0805).
- Glaval has tested buses with 96" wide bodies including:
  - PTI-BT-R9910-13-99 – Ford E-450 (Glaval Universal) 5-Year.
  - PTI-BT-R0122 – Ford E-450 (Glaval Universal) Partial 7-Year.
  - PTI-BT-R0614 – GM 3500 (Glaval Titan II) 7-Year.

You have asked FTA to issue a "5-year grandfather" by combining results from StarCraft's STURAA test, report number LTI-BT-R1609, along with Glaval's test reports listed above.

Based on our review of the information provided and available to FTA, we have determined that **the Glaval Commute built on the gasoline-powered Ford Transit chassis may be sold to FTA grantees as a 5-year/150,000-mile service life category bus using a combination of Bus Testing Report numbers PTI-BT-R0805 and LTI-BT-R1609.** This determination is based on the following conclusions drawn from information provided by Glaval or contained in our files:

- Glaval's narrow-body bus has been tested as the Glaval Sport in the 5-year/150,000-mile service life category (Report No. PTI-BT-R0805).

- The gasoline-powered Ford Transit chassis has been tested in the 5-year/150,000-mile service life category (Report No. LTI-BT-R1609).
- Under FTA's "family of vehicles" concept, FTA generally permits a manufacturer of a bus body that has been tested on one unmodified third-party chassis to offer the same or closely related body built on another similar unmodified third-party chassis that has been tested at the Bus Testing Center (on one of its own buses or on a competitor's similar bus), without requiring additional testing. The family of vehicles concept only applies to buses offered in the 4-year/100,000-mile or 5-year/150,000-mile service life categories.

Partial test reports are valid only in connection with a baseline full testing report. Therefore, Bus Testing Report numbers PTI-BT-R0805 and LTI-BT-R1609 must both be provided to FTA grantees when purchasing the Glaval Commute as a "5-year" bus.

Your letter also asked FTA to authorize a Commute bus model built on the Ford Transit chassis to begin Altoona testing in the 7-year/200,000-mile service life category. The August 1, 2016 Bus Testing Regulation (<https://www.gpo.gov/fdsys/pkg/FR-2016-08-01/pdf/2016-17889.pdf>) introduced requirements for a number of additional elements of information before FTA can authorize a bus test to start. These requirements are primarily contained in sections 665.11 and 665.21. FTA is still finalizing guidance on the test authorization requirements, however I've attached an unofficial checklist listing information elements that should be sufficient to authorize a test to start. Please provide that information on the bus to be tested if you wish to proceed.

This determination is based on the changes detailed in your letter or mentioned above. Should you make any other changes to the vehicle, additional testing may be required. If you require any further assistance with this or other matters concerning Bus Testing, I encourage you to consult the resources provided at [www.transit.dot.gov/research-innovation/bus-testing](http://www.transit.dot.gov/research-innovation/bus-testing). If you still have questions after checking this website, please feel free to contact me.

Sincerely,



Marcel Belanger  
Bus Testing Program Manager  
Office of Technology, TRI-20  
[marcel.belanger@dot.gov](mailto:marcel.belanger@dot.gov)  
202-366-0725



# **FEDERAL TRANSIT BUS TEST**

**Performed for the Federal Transit Administration U.S. DOT  
In accordance with CFR 49, Volume 7, Part 665**

**Manufacturer: Starcraft Bus a Division  
of Forest River, Inc.  
Model: Starlite Transit**

**Submitted for Testing in Service-Life Category  
5 Year /150,000 Miles**

**SEPTEMBER 2016**

**Report Number: LTI-BT-R1609**

PENNS<sup>T</sup>ATE



**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 Old Route 220 North  
Duncansville, PA 16635  
(814) 695-3404**

# FEDERAL TRANSIT BUS TEST

Performed for the Federal Transit Administration U.S. DOT  
1200 New Jersey Avenue, SE  
Washington, DC 20590

In accordance with CFR 49, Volume 7, Part 665

Manufacturer: Starcraft Bus a Division  
of Forest River, Inc.  
Manufacturer's address: 2367 Century Drive  
Goshen, IN 46528

Model: Starlite Transit

Submitted for Testing in Service-Life Category  
5 Year /150,000 Miles

Report Number: LTI-BT-R1609



  
Quality Authorization

Director, Bus Research  
and Testing Center  
Title

9/23/16  
Date

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## EXECUTIVE SUMMARY

Starcraft Bus a Division of Forest River, Inc., submitted a model Starlite Transit, gasoline-powered 12 seat (including the driver) 23-foot bus, for a 5 yr/150,000 mile STURAA test. The odometer reading at the time of delivery was 32 miles. Testing started on May 31, 2016 and was completed on September 1, 2016. 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 April 11, 2016 and was completed on August 4, 2016.

The interior of the bus is configured with seating for 12 passengers including the driver plus 2 wheelchair positions. Note: this test bus is not designed to accommodate standing passengers, therefore GVW and SLW will be the same load. At 150 lbs per person and 600 lbs per wheelchair position, this load results in a measured gross vehicle weight of 10,290 lbs. The first segment of the Structural Durability Test, GVW, and the middle segment SLW were performed with the test bus loaded to 10,290 lbs. The final segment was performed at a curb weight of 7,590 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.

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 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 six reported failures, five were Class 3 and one was a 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 13.66 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 17.39' at 20 mph, 36.97' at 30 mph, 71.68' at 40 mph and 90.03' at 45 mph. The average stopping distance for the Uniform Low Friction Test was 22.41'. 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.

The Shakedown Test produced a maximum final loaded deflection of 0.105 inches with a permanent set ranging between -0.002 to 0.005 inches under a distributed static load of 5,700 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 test bus submitted for testing was not equipped with any type of tow eyes or tow hooks, therefore the Static Tow Test was not performed. 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 6.1 inches.

A Fuel Economy Test was run on simulated central business district, arterial, and commuter courses. The results were 9.94 mpg, 10.03 mpg, and 17.72 mpg respectively; with an overall average of 11.40 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
PSTT	- Penn State Test Track
PTI	- Pennsylvania Transportation Institute
rpm	- revolutions per minute
SAE	- Society of Automotive Engineers
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)
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 Starcraft Bus a Division of Forest River, Inc., model Starlite Transit. The bus has an O.E.M. driver's door and aftermarket passenger door rear of the front axle and a dedicated handicap entrance equipped with a BraunAbility model NCL917F1B3454HB-2 handicap lift rear of the rear axle. Power is provided by a gasoline-fueled, Ford Motor Co. model 3.7 L engine coupled to a Ford Motor Co. model 6-Speed Auto Select Shift with Overdrive transmission.

The measured curb weight is 3,020 lbs. for the front axle and 4,570 lbs. for the rear axle. These combined weights provide a total measured curb weight of 7,590 lbs. There are 12 seats including the driver and room for 2 wheelchair positions. Note; this test bus is not designed to accommodate standing passengers. Gross load is 150 lb. x 12 = 1,800 lbs. + 1,200 lbs. (2 wheelchair positions) = 3,000 lbs. At full capacity, the measured gross vehicle weight is 10,290 lbs

## VEHICLE DATA FORM

Page 1 of 7

Bus Number: 1609	Date: 03-31-16
Bus Manufacturer: Starcraft Bus a Division of Forest River, Inc.	Vehicle Identification Number (VIN): 1FDES8PM1GKA46308
Model Number: Starlite Transit	Chassis Mfr./Mod.#: Ford Motor Co./ Transit 350HD
Personnel: E.D. & S.R.	Starting Odometer Reading: 32

WEIGHT:

Individual Wheel Reactions:

Weights (lb)	Front Axle		Middle Axle		Rear Axle	
	Curb	Street	Curb	Street	Curb	Street
CW	1,490	1,530	N/A	N/A	2,400	2,170
SLW	1,270	1,780	N/A	N/A	3,580	3,660
GVW	1,270	1,780	N/A	N/A	3,580	3,660

Total Weight Details:

Weight (lb)	CW	SLW	GVW	GAWR
Front Axle	3,020	3,050	3,050	4,130
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	4,570	7,240	7,240	7,275
Total	7,590	10,290	10,290	GVWR: 10,360

Dimensions:

Length (ft/in)	23/5.75
Width (in)	87.0
Height (in)	109
Front Overhang (in)	40.75
Rear Overhang (in)	86.0
Wheel Base (in)	155
Wheel Track (in)	Front: 67.9
	Middle: N/A
	Rear: 66.2



# VEHICLE DATA FORM

Page 2 of 7

Bus Number: 1609	Date: 03-31-16
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## CLEARANCES:

Lowest Point Outside Front Axle	Location: Splash Guard	Clearance(in): 8.8
Lowest Point Outside Rear Axle	Location: Exhaust Clamp	Clearance(in): 10.1
Lowest Point between Axles	Location: Stepwell	Clearance(in): 8.0
Ground Clearance at the center (in)	9.8	
Front Approach Angle (deg)	19.5	
Rear Approach Angle (deg)	9.5	
Ramp Clearance Angle (deg)	5.8	
Aisle Width (in)	20.2	
Inside Standing Height at Center Aisle (in)	77.2	

## BODY DETAILS:

Body Structural Type	Integral		
Frame Material	Steel		
Body Material	Aluminum		
Floor Material	Plywood		
Roof Material	Composite		
Windows Type	<input checked="" type="checkbox"/> Fixed - Bottom	<input checked="" type="checkbox"/> Movable - Top	
Window Mfg./Model No.	ICI / 16CFR 1201 II ANSI Z97.1-2004 UA		
Number of Doors	<u>1</u> Front	<u>1</u> Rear (W/C)	<u>1</u> (Passenger)
Mfr. / Model No.	Ford/O.E.M.	Challenger Door MT CRWH-30	A&M Systems 213380A3G8
Dimension of Each Door (in)	Front: 27.3 x 59.5	Rear Pass: 78x29.9	Rear W/C: 69.2 x 44.3
Passenger Seat Type	<input type="checkbox"/> Cantilever	<input checked="" type="checkbox"/> Pedestal	<input type="checkbox"/> Other (explain)
Driver Seat Type	<input type="checkbox"/> Air	<input checked="" type="checkbox"/> Spring	<input type="checkbox"/> Other (explain)
Mfr. / Model No.	Ford / O.E.M.		
Number of Seats (including Driver)	12		

# VEHICLE DATA FORM

Page 3 of 7

Bus Number: 1609	Date: 03-31-16
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## BODY DETAILS (Contd.)

Free Floor Space ( ft <sup>2</sup> )	15.7				
Height of Each Step at Normal Position (in)	Front	1. 10.3	2. 9.0	3. 8.2	4. N/A
	Middle	1. N/A	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)	N/A				

## ENGINE

Type	<input type="checkbox"/> C.I.		<input type="checkbox"/> Alternate Fuel
	<input checked="" type="checkbox"/> S.I.		<input type="checkbox"/> Other (explain)
Mfr. / Model No.	Ford Motor Co. / 3.7 Liter		
Location	<input checked="" type="checkbox"/> Front	<input type="checkbox"/> Rear	<input type="checkbox"/> Other (explain)
Fuel Type	<input checked="" type="checkbox"/> Gasoline	<input type="checkbox"/> CNG	<input type="checkbox"/> Methanol
	<input type="checkbox"/> Diesel	<input type="checkbox"/> LNG	<input type="checkbox"/> Other (explain)
Fuel Induction Type	<input checked="" type="checkbox"/> Injected <input type="checkbox"/> Carburetion		
Alternator (Generator) Mfr. / Model No.	Ford / O.E.M.		
Maximum Rated Output (Volts / Amps)	12 / 220		
Air Compressor Mfr. / Model No.	N/A		
Maximum Capacity (ft <sup>3</sup> / min)	N/A		
Starter Type	<input checked="" type="checkbox"/> Electrical	<input type="checkbox"/> Pneumatic	<input type="checkbox"/> Other (explain)
Starter Mfr. / Model No.	Ford / O.E.M.		

**VEHICLE DATA FORM**

Page 4 of 7

Bus Number: 1609	Date: 03-31-16
------------------	----------------

**TRANSMISSION**

Transmission Type	<input type="checkbox"/> Manual	<input checked="" type="checkbox"/> Automatic	<input type="checkbox"/> Load Sensing Adaptive
Mfr. / Model No.	Ford / 6 – Speed Auto Select Shift with Overdrive		
Control Type	<input checked="" type="checkbox"/> Mechanical	<input type="checkbox"/> Electrical	<input type="checkbox"/> Other
Integral Retarder	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	

**SUSPENSION**

Number of Axles	2		
Front Axle Type	<input checked="" type="checkbox"/> Independent	<input type="checkbox"/> Beam Axle	
Mfr. / Model No.	Ford / O.E.M.		
Axle Ratio (if driven)	N/A		
Suspension Type	<input type="checkbox"/> Air	<input checked="" type="checkbox"/> Spring	<input type="checkbox"/> Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Ford / BK31-18045-BC		
Middle Axle Type	<input type="checkbox"/> Independent	<input type="checkbox"/> Beam Axle	
Mfr. / Model No.	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type	<input type="checkbox"/> Air	<input type="checkbox"/> Spring	<input type="checkbox"/> Other (explain)
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	<input type="checkbox"/> Independent	<input checked="" type="checkbox"/> Beam Axle	
Mfr. / Model No.	Ford / O.E.M.		
Axle Ratio (if driven)	4.10		
Suspension Type	<input type="checkbox"/> Air	<input checked="" type="checkbox"/> Spring	<input type="checkbox"/> Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Ford / FK41-18080-FA		

**VEHICLE DATA FORM**

Page 5 of 7

Bus Number: 1609	Date: 03-31-16
------------------	----------------

**WHEELS & TIRES**

Front	Wheel Mfr./ Model No.	Ford / 16 x 6
	Tire Mfr./ Model No.	Hankook Dyna Pro HT
Rear	Wheel Mfr./ Model No.	Ford / 16 x 6
	Tire Mfr./ Model No.	Hankook Dynapro HT

**BRAKES**

Front Axle Brakes Type	<input type="checkbox"/> Cam	<input checked="" type="checkbox"/> Disc	<input type="checkbox"/> Other (explain)
Mfr. / Model No.	Ford / CK4Z-2001-A		
Middle Axle Brakes Type	<input type="checkbox"/> Cam	<input type="checkbox"/> Disc	<input type="checkbox"/> Other (explain)
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	<input type="checkbox"/> Cam	<input checked="" type="checkbox"/> Disc	<input type="checkbox"/> Other (explain)
Mfr. / Model No.	Ford / CK4Z-2200-A		

**HVAC**

Heating System Type	<input type="checkbox"/> Air	<input checked="" type="checkbox"/> Water	<input type="checkbox"/> Other
Capacity (Btu/hr)	Not available.		
Mfr. / Model No.	Ford / O.E.M.		
Air Conditioner	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	
Location	Front dash & rear ceiling		
Capacity (Btu/hr)	Dash - O.E.M.    Rear ceiling – 45,000		
A/C Compressor Mfr. / Model No.	Dash – Not available.    Rear ceiling – Trans/Air / TA 712 T1		

**STEERING**

Steering Gear Box Type	Hydraulic Power Rack & Pinion		
Mfr. / Model No.	Ford / O.E.M.		
Steering Wheel Diameter	14.7"		
Number of turns (lock to lock)	3.5		
Control Type	<input type="checkbox"/> Electric	<input checked="" type="checkbox"/> Hydraulic	<input type="checkbox"/> Other (expain)

## VEHICLE DATA FORM

Page 6 of 7

Bus Number: 1609	Date: 03-31-16
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### OTHERS

Wheel Chair Ramps	Location: N/A	Type: N/A
Wheel Chair Lifts	Location: Rear	Type: Lift
Mfr. / Model No.	BraunAbility / NCL917F1B3454HB-2	
Emergency Exit	Location: Door Windows	Number: 1 3

### CAPACITIES

Fuel Tank Capacity (gallons)	25
Engine Crankcase Capacity (quarts)	6.0
Transmission Capacity (quarts)	13.1
Differential Capacity (quarts)	3.0
Cooling System Capacity (quarts)	16.4
Power Steering Fluid Capacity (quarts)	Not available.

## Page 7 of 7

Bus Number: 1609	Date: 03-31-16
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**List all spare parts, tools and manuals delivered with the bus.**

[illegible]

**COMPONENT/SUBSYSTEM INSPECTION FORM**

Page 1 of 1

Bus Number: 1609	Date: 3/31/16
------------------	---------------

Subsystem	Checked	Initials	Comments
Air Conditioning Heating and Ventilation	✓	E.D.	N/A
Body and Sheet Metal	✓	E.D.	N/A
Frame	✓	E.D.	N/A
Steering	✓	E.D.	N/A
Suspension	✓	E.D.	N/A
Interior/Seating	✓	E.D.	N/A
Axles	✓	E.D.	N/A
Brakes	✓	E.D.	N/A
Tires/Wheels	✓	E.D.	N/A
Exhaust	✓	E.D.	N/A
Fuel System	✓	E.D.	N/A
Power Plant	✓	E.D.	N/A
Accessories	✓	E.D.	N/A
Lift System	✓	E.D.	N/A
Interior Fasteners	✓	E.D.	N/A
Batteries	✓	E.D.	N/A

## CHECK - IN



**STARTCRAFT BUS A DIVISION OF FOREST RIVER, INC.,  
MODEL STARLITE TRANSIT**





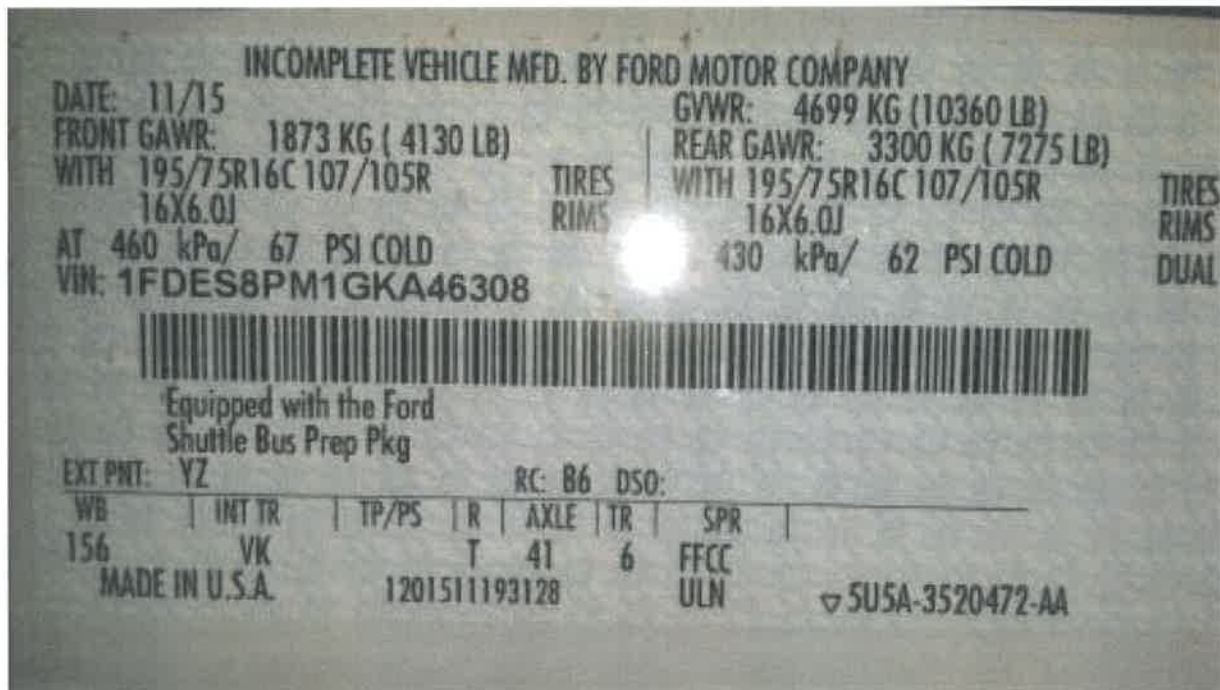
## **CHECK - IN CONT.**



**STARTCRAFT BUS A DIVISION OF FOREST RIVER, INC.,  
MODEL STARLITE TRANSIT EQUIPPED WITH A  
BRAUNABILITY MODEL NCL917F1B3454HB-2 HANDICAP  
PLATFORM LIFT**



## CHECK - IN CONT.



## VIN TAG



## ENGINE COMPARTMENT

## CHECK - IN CONT.



## OPERATOR'S AREA



## 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

Page 1 of 2

Bus Number: 1609	Date: 8-30-16
------------------	---------------

Component	Checked	Comments
<b>ENGINE :</b>		
Oil Dipstick	✓	None noted.
Oil Filler Hole	✓	None noted.
Oil Drain Plug	✓	None noted.
Oil Filter	✓	None noted.
Fuel Filter	✓	None noted.
Air Filter	✓	None noted.
Belts	✓	None noted.
Coolant Level	✓	None noted.
Coolant Filler Hole	✓	None noted.
Coolant Drain	✓	None noted.
Spark / Glow Plugs	N/A	None noted.
Alternator	✓	None noted.
Diagnostic Interface Connector	✓	None noted.
<b>TRANSMISSION :</b>		
Fluid Dip-Stick	N/A	None noted.
Filler Hole	✓	Not customer accessible.
Drain Plug	N/A	None noted.
<b>SUSPENSION :</b>		
Bushings	✓	None noted.
Shock Absorbers	✓	None noted.
Air Springs	N/A	None noted.
Leveling Valves	N/A	None noted.
Grease Fittings	N/A	None noted.

# ACCESSIBILITY DATA FORM

Page 2 of 2

Bus Number: 1609	Date: 8-30-16
------------------	---------------

Component	Checked	Comments
<b>HVAC :</b>		
A/C Compressor	✓	None noted.
Filters	✓	None noted.
Fans	✓	None noted.
<b>ELECTRICAL SYSTEM :</b>		
Fuses	✓	None noted.
Batteries	✓	None noted.
Voltage regulator	✓	Internal regulator.
Voltage Converters	N/A	None noted.
Lighting	✓	None noted.
<b>MISCELLANEOUS :</b>		
Brakes	✓	None noted.
Handicap Lifts/Ramps	✓	None noted.
Instruments	✓	None noted.
Axles	✓	None noted.
Exhaust	✓	None noted.
Fuel System	✓	None noted.
<b>OTHERS :</b>		

## **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. 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.



(Page 1 of 1)  
**SCHEDULED MAINTENANCE**  
**STARCRAFT #1609**

<b>DATE</b>	<b>TEST MILES</b>	<b>SERVICE</b>	<b>ACTIVITY</b>	<b>MAN HOURS</b>	<b>DOWN TIME</b>
04-26-16	1,029	P.M./Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
05-04-16	1,389	P.M./Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
06-03-16	3,096	P.M./Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
06-14-16	4,292	P.M./Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
06-30-16	4,875	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

## 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.

	<u>MAN HOURS</u>
Both rear sway bar links.	4.00
Exhaust tailpipe hanger.	1.00
Right side rear sway bar bolt.	1.00

At the end of the test, the remaining items on the list were removed and replaced. The transmission assembly took 10.00 man-hours (two men 5.00 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
Transmission	10.00 man hours
Wiper Motor	0.50 man hours
Starter	0.50 man hours
Alternator	1.75 man hours
Batteries	1.00 man hours

### **1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS**



**TRANSMISSION REMOVAL AND REPLACEMENT  
(10.00 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  
(0.50 MAN HOURS)**



**ALTERNATOR REMOVAL AND REPLACEMENT  
(1.75 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 five Class 3 failures, three involved the suspension system and two occurred with the body. These, and the one remaining Class 4 failure is available for review in the Unscheduled Maintenance List, located in Section 5.7 Structural Durability.

**RELIABILITY DATA FORM**

Bus Number: 1609	Date Completed: 8-4-16
Personnel: B.R.	

	Failure Type					
	Class 4 Bad order	Class 3 Bus Change	Class 2 Road Call	Class 1 Physical Safety		
Subsystem	Mileage	Mileage	Mileage	Mileage	Man hours	Down Time
Suspension		1,029			4.00	88.00
		3,096			1.00	1.00
		4,292			4.00	136.00
Body/Doors/Mirrors	1,029				1.00	1.00
		4,292			4.00	4.00
		2,138			1.00	1.00



### **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

Page 1 of 1

Bus Number: 1609	Date: 5-17-16
Personnel: T.S., T.G. & C.S.	

Temperature (°F): 64	Humidity (%): 51
Wind Direction: SW	Wind Speed (mph): 5
Barometric Pressure (in.Hg): 28.90	

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
<b>Comments of the position of the bus during the lane change:</b>	
A safe profile was maintained through all portions of testing.	
<b>Comments of the tire/ground contact patch:</b>	
Tire/ground contact was maintained through all portions of testing.	

### 3. SAFETY



#### RIGHT - HAND APPROACH



#### LEFT - HAND APPROACH

## **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 13.66 seconds.

# PERFORMANCE DATA FORM

Page 1 of 1

Bus Number: 1609		Date: 5-17-16	
Personnel: T.S., S.R., E.D. & C.S.			
Temperature (°F): 66		Humidity (%): 48	
Wind Direction: W		Wind Speed (mph): 6	
Barometric Pressure (in.Hg): 28.87			
		<b>INITIALS:</b>	
Air Conditioning - OFF	✓Checked	T.G.	
Ventilation fans - ON HIGH	✓Checked	T.G.	
Heater pump motor - OFF	✓Checked	T.G.	
Defroster - OFF	✓Checked	T.G.	
Exterior and interior lights - ON	✓Checked	T.G.	
Windows and doors - CLOSED	✓Checked	T.G.	
<b>ACCELERATION, GRADEABILITY, TOP SPEED</b>			
Counter Clockwise Recorded Interval Times			
Speed	Run 1	Run 2	Run 3
10 mph	2.01	2.01	1.82
20 mph	4.27	4.44	4.41
30 mph	6.19	6.60	6.50
40 mph	10.09	10.14	10.14
Top Test Speed(mph) 50	13.70	13.76	13.51
Clockwise Recorded Interval Times			
Speed	Run 1	Run 2	Run 3
10 mph	1.82	1.84	1.84
20 mph	4.03	4.06	4.25
30 mph	6.44	6.82	6.01
40 mph	10.26	10.45	10.00
Top Test Speed(mph) 50	13.87	13.77	13.34

# PERFORMANCE SUMMARY SHEET

BUS MANUFACTURER :Starcraft Bus                      BUS NUMBER :1609  
 BUS MODEL                :Starlite Transit                TEST DATE :05-17-16

## TEST CONDITIONS :

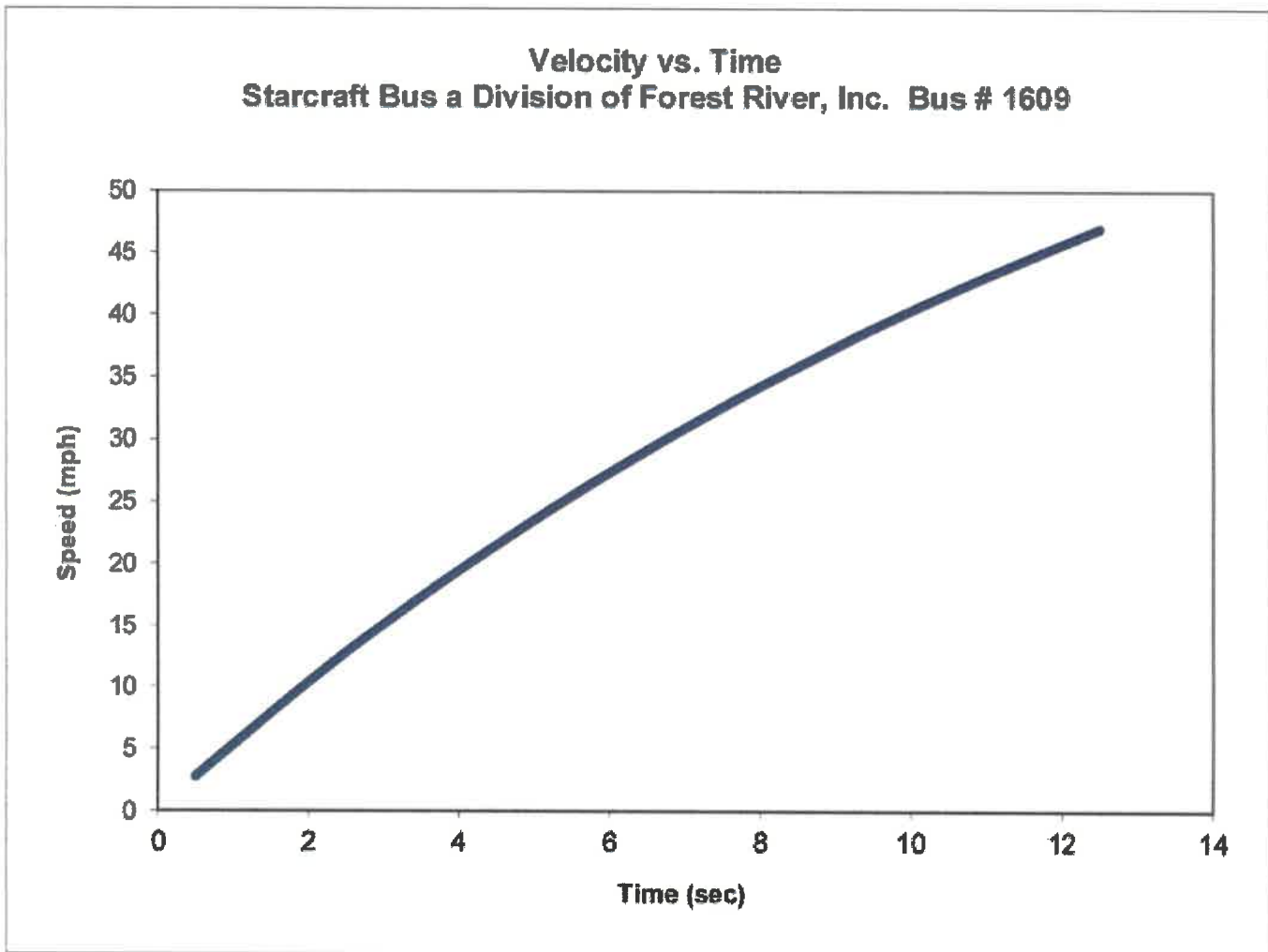
-----  
 TEMPERATURE (DEG F )                : 66.0  
 WIND DIRECTION                        : W  
 WIND SPEED (MPH)                     : 6.0  
 HUMIDITY (%)                          : 48  
 BAROMETRIC PRESSURE (IN. HG) : 28.9

(MPH)	AVERAGE TIME (SEC)		
	CCW DIRECTION	CW DIRECTION	TOTAL
10.0	1.95	1.83	1.89
20.0	4.37	4.11	4.24
30.0	6.43	6.42	6.43
40.0	10.12	10.24	10.18
50.0	13.66	13.66	13.66

## TEST SUMMARY :

VEHICLE SPEED (MPH)	TIME (SEC)	ACCELERATION (FT/SEC^2)	MAX. GRADE (%)
1.0	.18	8.1	25.9
5.0	.93	7.7	24.5
10.0	1.91	7.2	22.8
15.0	2.98	6.6	21.1
20.0	4.13	6.1	19.4
25.0	5.38	5.6	17.8
30.0	6.74	5.1	16.2
35.0	8.24	4.7	14.7
40.0	9.89	4.2	13.2
45.0	11.72	3.8	11.9
50.0	13.76	3.4	10.6

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.



## 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 17.39' at 20 mph, 36.97' at 30 mph, 71.68' at 40 mph and 90.03' at 45 mph. The average stopping distance for the Uniform Low Friction Test was 22.41'. 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 4.2-6. Braking Test Data Forms

Page 1 of 3

Bus Number: 1609	Date: 04-15-16
Personnel: T.S., S.R., E.D. & C.S.	
Amb. Temperature (°F): 60	Wind Speed (mph): 5
Wind Direction: S	Pavement Temp (°F) Start: 81 End: 95

TIRE INFLATION PRESSURE (psi):				
Tire Type: Front: Hankook DynaPro HT 195 75R16C				
Rear: Hankook DynaPro HT 195 75R16C				
	Left Tire(s)		Right Tire(s)	
Front	67		67	
	Inner	Outer	Inner	Outer
Rear	N/A	N/A	N/A	N/A
Rear	N/A	62	N/A	62

AXLE LOADS (lb)		
	Left	Right
Front	1,780	1,270
Rear	N/A	N/A
Rear	3,660	3,580

**Table 4.2-7. Record of All Braking System Faults/Repairs.**

Page 2 of 3

<b>Date</b>	<b>Fault/Repair</b>	<b>Description</b>
4/15/16	None noted.	None noted.

**Table 4.2-8.1. Stopping Distance Test Results Form**

Page 3 of 3

Stopping Distance (ft)					
Vehicle Direction	CW	CW	CCW	CCW	
Speed (mph)	Stop 1	Stop 2	Stop 3	Stop 4	Average
20 (dry)	18.70	14.71	16.88	19.27	17.39
30 (dry)	37.76	38.49	33.37	38.27	36.97
40 (dry)	71.91	73.64	68.64	72.53	71.68
45 (dry)	93.22	89.68	89.26	87.98	90.03
20 (wet)	20.63	24.84	21.40	22.80	22.41

**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)	Comments
Drivers side on high friction	1	Yes	None noted
	2	Yes	None noted
Drivers side on low friction	1	Yes	None noted
	2	Yes	None noted

**Table 4.2-8.3. 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	X	
	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	X	
	2	N/A	N/A	N/A	N/A	N/A
	3	N/A	N/A	N/A	N/A	N/A

## 4.2 Performance - Bus Braking



**20% UPHILL GRADE**



**20% DOWNHILL GRADE**

## 5.1 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 12 people including the driver plus 2 wheelchair positions. The resulting test load is  $12 \times 375 \text{ lb.} = 4,500 \text{ lbs.} + 1,200 \text{ lbs. (2 wheelchair positions)} = 5,700 \text{ lbs.}$  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 0.105 Inches at reference point 7. The maximum permanent deflection after the final loading sequence ranged from -0.002 Inches at reference point 6 to 0.005 inches at reference point 7.

# STRUCTURAL SHAKEDOWN DATA FORM

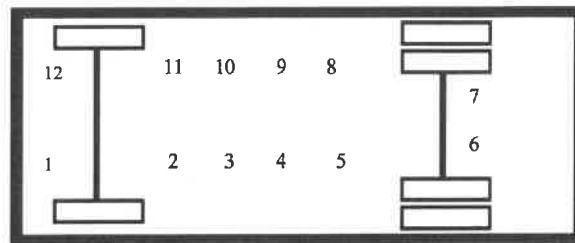
Page 1 of 2

Bus Number: 1609	Date: 04-05-16
Personnel: S.R., E.D., E.L., T.G., P.D. & T.S.	Temperature (°F): 65
Loading Sequence: <input checked="" type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 (check one)	
Test Load (lbs): 5,700 (12 passengers x 375 + 2 W/C @ 600 lbs. each)	

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	-.022	-.022	-.014	-.014
2	0	.071	.071	.010	.010
3	0	.095	.095	.015	.015
4	0	.109	.109	.018	.018
5	0	.112	.112	.019	.019
6	0	.139	.139	.041	.041
7	0	.099	.099	.061	.061
8	0	.069	.069	.013	.013
9	0	.060	.060	.010	.010
10	0	.047	.047	.010	.010
11	0	.028	.028	.006	.006
12	0	-.065	-.065	-.008	-.008

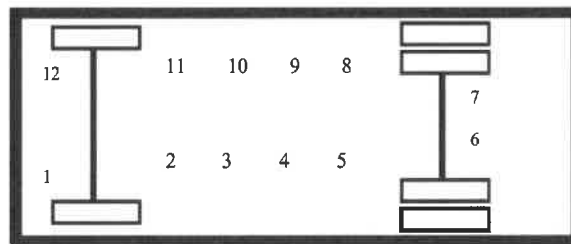
**STRUCTURAL SHAKEDOWN DATA FORM**  
Page 2 of 2

Bus Number: 1609	Date: 04-05-16
Personnel: S.R., E.D., E.L., P.D. & T.G.	Temperature (°F): 65
Loading Sequence: <input type="checkbox"/> 1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 (check one)	
Test Load (lbs): 5,700 (12 passengers x 375 + 2 W/C @ 600 lbs. each)	

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	-.014	-.027	-.013	-.015	-.001
2	.010	.069	.059	.011	.001
3	.015	.095	.080	.018	.003
4	.018	.108	.090	.020	.002
5	.019	.111	.092	.021	.002
6	.041	.145	.104	.039	-.002
7	.061	.166	.105	.066	.005
8	.013	.071	.058	.016	.003
9	.010	.061	.051	.013	.003
10	.010	.049	.039	.012	.002
11	.006	.030	.024	.008	.002
12	-.008	-.064	-.056	-.008	.000



## 5.1 STRUCTURAL SHAKEDOWN TEST



**DIAL INDICATORS IN POSITION**



**BUS LOADED TO 2.5 TIMES GVL  
(5,700 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)  
 Page 1 of 10

Bus Number: 1609	Date: 04-11-16
Personnel: T.S., E.D., S.R. & P.D.	Temperature(°F): 48

Wheel Position : (check one)		
All wheels level	<input checked="" type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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)  
 Page 2 of 10

Bus Number: 1609	Date: 04-11-16
Personnel: T.S., E.D., S.R. & P.D.	Temperature(°F): 48

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input checked="" type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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)  
 Page 3 of 10

Bus Number: 1609	Date: 04-11-16
Personnel: T.S., E.D., S.R. & P.D.	Temperature(°F): 48

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input checked="" type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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)

Page 4 of 10

Bus Number: 1609	Date: 04-11-16
Personnel: T.S., E.D., S.R. & P.D.	Temperature(°F): 48

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input checked="" type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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)

Page 5 of 10

Bus Number: 1609	Date: 04-11-16
Personnel: T.S., E.D., S.R. & P.D.	Temperature(°F): 48

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input checked="" type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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)  
 Page 6 of 10

Bus Number: 1609	Date: 04-11-16
Personnel: T.S., E.D., S.R. & P.D.	Temperature(°F): 48

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input checked="" type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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)  
 Page 7 of 10

Bus Number: 1609	Date: 04-11-16
Personnel: T.S., E.D., S.R. & P.D.	Temperature(°F): 48

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input checked="" type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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)  
 Page 8 of 10

Bus Number: 1609	Date: 04-11-16
Personnel: T.S., E.D., S.R. & P.D.	Temperature(°F): 48

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input checked="" type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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)  
 Page 9 of 10

Bus Number: 1609	Date: 04-11-16
Personnel: T.S., E.D., S.R. & P.D.	Temperature(°F): 48

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input checked="" type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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)  
 Page 10 of 10

Bus Number: 1609	Date: 04-11-16
Personnel: T.S., E.D., S.R. & P.D.	Temperature(°F): 48

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input checked="" type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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**



**LEFT 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 test bus submitted for testing was not equipped with any type of tow eyes or tow hooks, therefore the Static Tow Test was not performed.

## **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

Page 1 of 1

Bus Number: 1609	Date: 7-28-16
Personnel: T.S. & E.D.	

Temperature (°F): 79	
Wind Direction: SSW	Wind Speed (mph): 1

<b>Inspect tow equipment-bus interface.</b>
<b>Comments:</b> A safe and adequate connection was made between the tow equipment and the bus.
<b>Inspect tow equipment-wrecker interface.</b>
<b>Comments:</b> A safe and adequate connection was made between the tow equipment and the wrecker.
<b>Towing Comments:</b> A front lift tow was performed incorporating a hydraulic under lift wrecker.
<b>Description and location of any structural damage:</b> None noted.
<b>General Comments:</b> No problems with the towing interface or towing procedures were encountered.



## 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 jack 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 6.1 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.

### JACKING CLEARANCE SUMMARY

Condition	Frame Point Clearance
Front axle – one tire flat	6.1"
Rear axle – one tire flat	10.4"
Rear axle – two tires flat	8.9"

# JACKING TEST DATA FORM

Page 1 of 1

Bus Number: 1609	Date: 04-01-16
Personnel: E.D. & S.R.	Temperature (°F): 61

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	8.2" I 6.1" D	10.2" I 7.4" D	Body & Axle
Left front	11.7" I 9.1" D	9.9" I 7.3" D	Body & Axle
Right rear—outside	11.9" I 11.5" D	14.2" I 13.9" D	Body & Suspension
Right rear—both	11.9" I 9.6" D	14.2" I 12.4" D	Body & Suspension
Left rear—outside	10.7" I 10.4" D	13.7" I 13.5" D	Body & Suspension
Left rear—both	10.7" I 8.9" D	13.7" I 12.1" 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
<b>Additional comments of any deformation or difficulty during jacking:</b>			
None noted.			

## **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 tag axle and rear end of the bus. The procedure is then repeated for the front, tag axle 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

Page 1 of 1

Bus Number: 1609	Date: 04-04-16
Personnel: E.D., S.R. & E.L.	Temperature (°F): 62

<b>Comments of any structural damage to the jacking pads or axles while both the front wheels are supported by the jack stands:</b>
None noted
<b>Comments of any structural damage to the jacking pads or axles while both the rear wheels are supported by the jack stands:</b>
None noted
<b>Comments of any structural damage to the jacking pads or axles while both the tag axle wheels are supported by the jack stands:</b>
N/A
<b>Comments of any structural damage to the jacking pads or axles while both the front and rear wheels are supported by the jack stands:</b>
None noted
<b>Comments of any problems or interference placing wheel hoists under wheels:</b>
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 5,050 miles; approximately 3,750 miles on the PSBRTF Durability Test Track and approximately 1,300 miscellaneous other miles. The test will be conducted with the bus operated under three different loading conditions. The first segment will consist of approximately 2,125 miles with the bus operated at GVW. The second segment will consist of approximately 1,300 miles with the bus operated at SLW. The remainder of the test, approximately 2,125 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 April 11, 2016 and was conducted until August 4, 2016. The first 2,125 miles were performed at a GVW of 10,290 lbs. and completed on May 10, 2016. This test bus is not designed to accommodate standing passengers; therefore, GVW and SLW are the same 10,290 lbs. The 1,300 mile SLW segment was performed at the same 10,290 lbs and completed on May 31, 2016. The final 2,125 mile segment was performed at a CW of 7,590 lbs and completed on August 4, 2016.

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.

Starcraft Bus #1609

MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
04/11/16 TO 04/17/16	318.00	87.00	405.00
04/18/16 TO 04/24/16	523.00	22.00	545.00
04/25/16 TO 05/01/16	138.00	101.00	239.00
05/02/16 TO 05/08/16	456.00	116.00	572.00
05/09/16 TO 05/15/16	570.00	26.00	596.00
05/16/16 TO 05/22/16	82.00	70.00	152.00
05/26/16 TO 05/29/16	38.00	367.00	405.00
05/30/16 TO 06/05/16	244.00	39.00	283.00
06/06/16 TO 06/12/16	622.00	126.00	748.00
06/13/16 TO 06/19/16	287.00	60.00	347.00
06/20/16 TO 06/26/16	472.00	66.00	538.00
06/27/16 TO 07/03/16	0.00	88.00	88.00
07/04/16 TO 07/10/16	0.00	15.00	15.00
07/11/16 TO 07/17/16	0.00	0.00	0.00

**Starcraft Bus #1609**

**MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS**

<b>DATE</b>	<b>TOTAL DURABILITY TRACK</b>	<b>TOTAL OTHER MILES</b>	<b>TOTAL</b>
07/18/16 TO 07/24/16	0.00	0.00	0.00
07/25/16 TO 07/31/16	0.00	0.00	0.00
08/01/16 TO 08/07/16	0.00	117.00	117.00
<b>TOTAL</b>	<b>3750.00</b>	<b>1300.00</b>	<b>5050.00</b>



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
Shift 2	7:50 am	F
	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
Shift 3	3:40 pm	C
	3:50 pm	F
	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

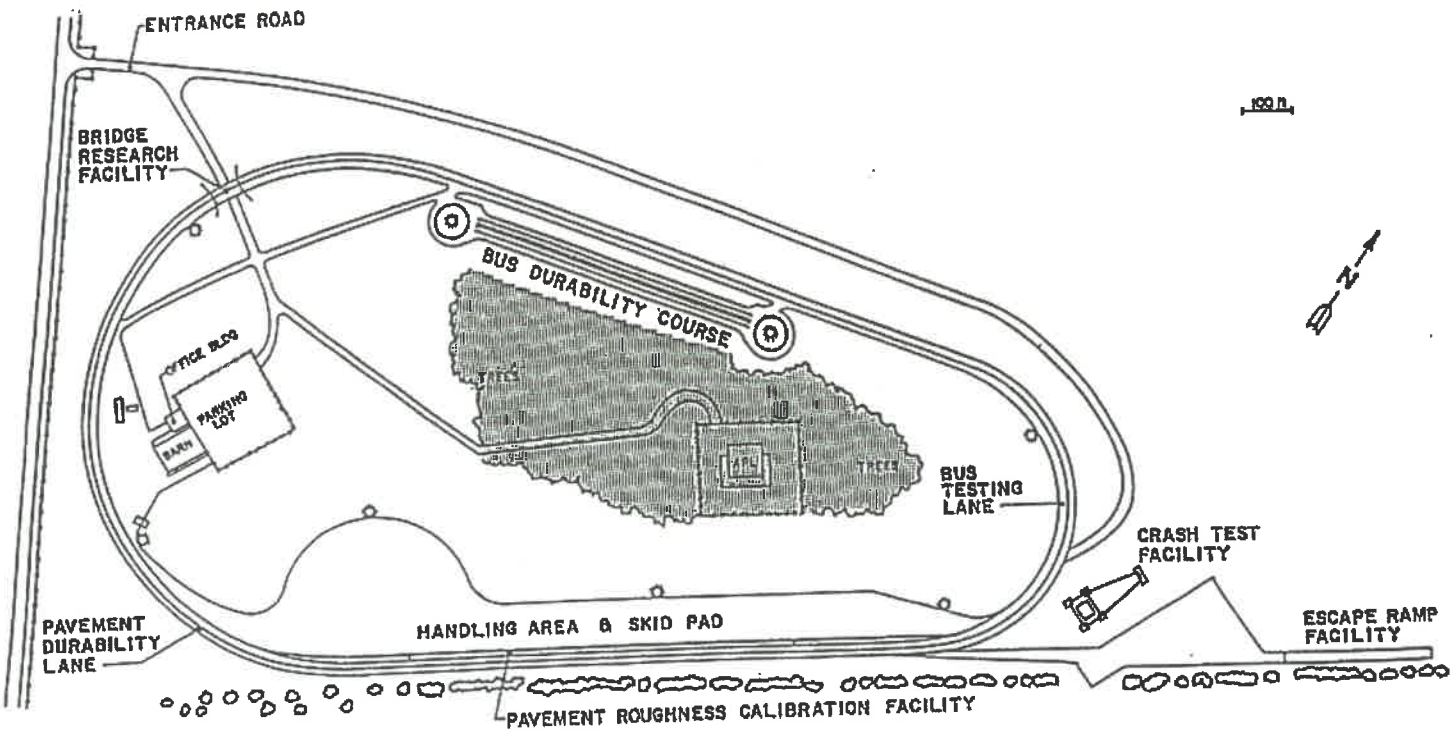
B—Break

C—Cycle all systems five times, visual inspection, driver's log entries

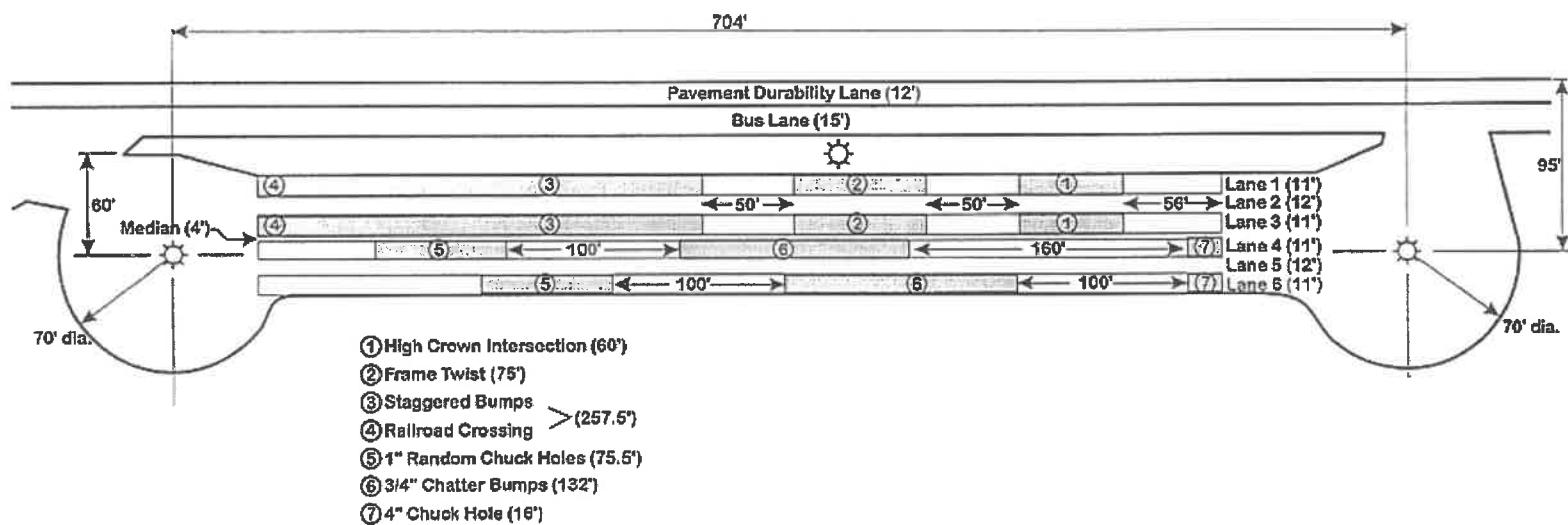
D—Drive bus as specified by procedure

F—Fuel bus, complete driver's log shift entries

# “PLAN VIEW OF PENN STATE BUS TESTING AND RESEARCH FACILITY”



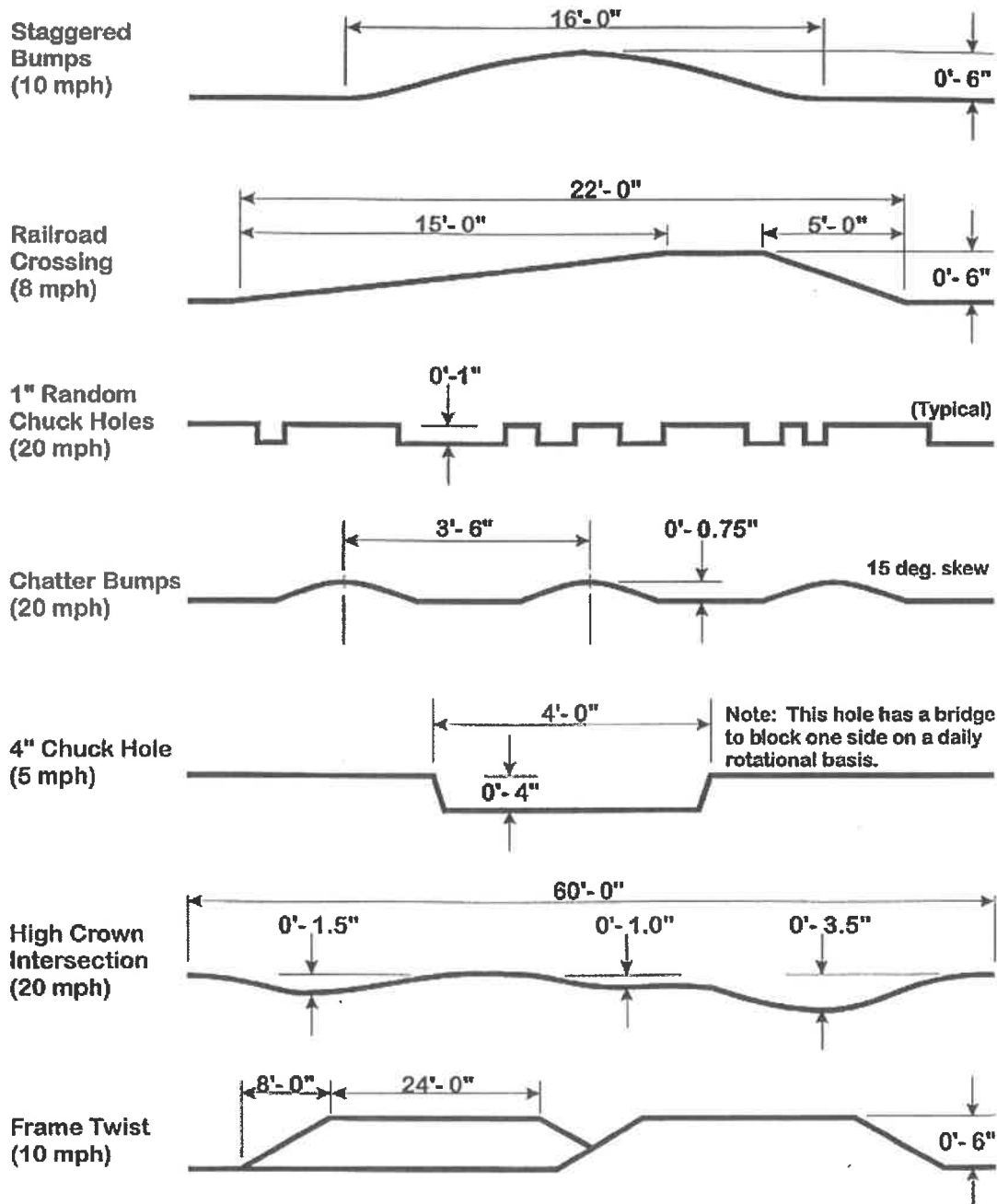
**BUS TESTING AND RESEARCH TEST TRACK  
UNIVERSITY PARK, PA**



Plan View

# Vehicle Durability Test Track

The Pennsylvania Transportation Institute  
Penn State



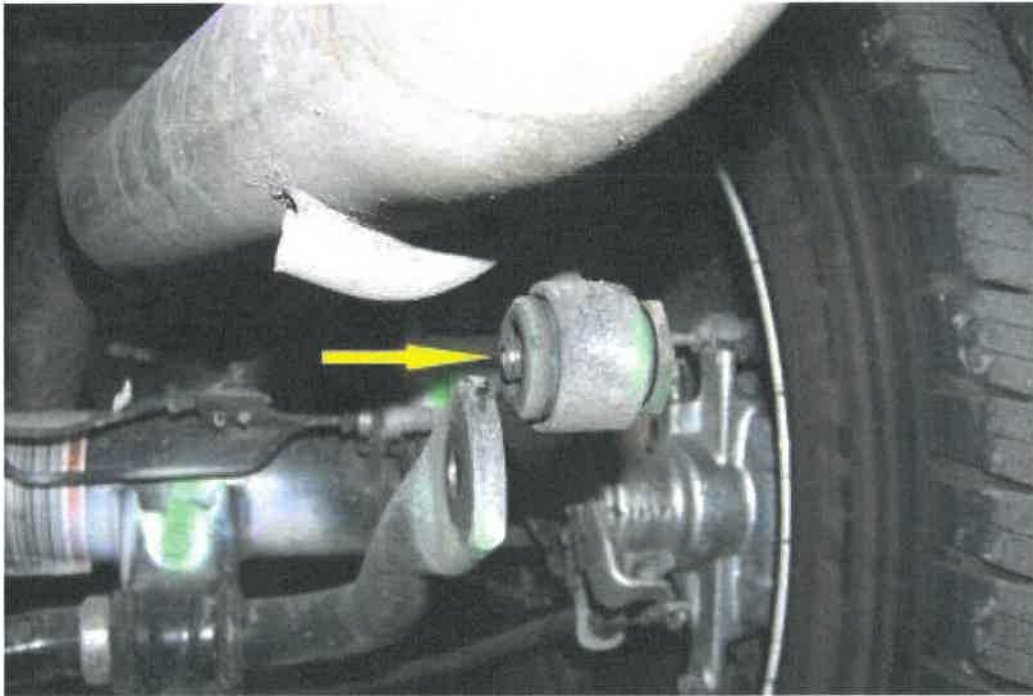
## Durability Element Profiles

The Pennsylvania Transportation Institute  
 Penn State

(Page 1 of 1)  
**UNSCHEDULED MAINTENANCE**  
**STARCRAFT #1609**

DATE	TEST MILES	SERVICE	ACTIVITY	MAN HOURS	DOWN TIME
04-25-16	1,029	The right side, outside rear view mirror fasteners are loose.	Fasteners tightened.	1.00	1.00
04-29-16	1,029	The right rear, lower bolt is broken on the sway bar link. Parts ordered.	Both rear sway bar links replaced.	4.00	88.00
05-11-16	2,138	The exhaust tailpipe hanger is broken.	Exhaust tailpipe hanger replaced.	1.00	1.00
06-03-16	3,096	The right side sway bar bolt is broken on the rear sway bar.	Broken bolt replaced.	1.00	1.00
06-14-16	4,292	The rear bumper mounting brackets are broken.	Mounting brackets welded/repared.	4.00	4.00
06-22-16	4,292	The rear sway bar link mounting holes are egged out. Parts ordered.	Rear sway bar and links replaced.	4.00	136.00

## UNSCHEDULED MAINTENANCE



**BROKEN RIGHT REAR SWAY BAR BOLT  
(1,029 TEST MILES)**



**BROKEN RIGHT REAR SWAY BAR BOLT  
(3,096 TEST MILES)**

## **UNSCHEDULED MAINTENANCE CONT.**



**BROKEN REAR BUMPER BRACKET  
(4,292 TEST MILES)**



**REAR SWAY BAR MOUNTING HOLES EGGED OUT  
(4,292 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, 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

<u>phase</u>	<u>miles per phase</u>	<u>total miles per run</u>
CBD	1.9097	5.7291
ART	1.9097	3.8193
COM	3.8193	3.8193

$$FE_{mi/lb} = \text{Observed fuel economy} = \frac{\text{miles}}{\text{lb of fuel}}$$

- 2.) Convert the observed fuel economy to miles per gallon [mpg] by multiplying by the specific gravity of the test fuel  $G_s$  (referred to water) at 60°F and multiply by the density of water at 60°F

$$FE_{\text{mpg}} = FE_{\text{cml/lb}} \times G_s \times G_w$$

where  $G_s$  = Specific gravity of test fuel at 60°F (referred to water)

$G_w$  = 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.

$$FE_c = FE_{\text{mpg}} \times \frac{Q}{H}$$

where

$H$  = Volumetric heating value of test fuel [BTU/gal]

$Q$  = Volumetric heating value of standard reference fuel

Combining steps 1-3 yields

$$\Rightarrow FE_c = \frac{\text{miles}}{\text{lbs}} \times (G_s \times G_w) \times \frac{Q}{H}$$

- 4.) Convert 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<sup>6</sup>.

$E_q$  = Energy equivalent of converting mpg to mile/BTUx10<sup>6</sup>.

$$E_q = ((\text{mpg})/(H)) \times 10^6$$

## 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  $T=60^\circ\text{F}$ ). These combine to give a fuel economy in miles per lb. The energy equivalent (mile/BTUx10<sup>6</sup>) 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

$$\text{FEo}_{\text{mi/scf}} = \text{Observed fuel economy} = \frac{\text{miles}}{\text{scf of fuel}}$$

- 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<sup>3</sup>).

**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.**

$$\text{FEo}_{\text{mi/lb}} = \text{FEo} / \text{Gm}$$

where Gm = Density of test fuel at standard conditions

- 3.) Convert the observed fuel economy (FEomi/lb) to an energy equivalent of (miles/BTUx10<sup>6</sup>) by dividing the observed fuel economy (FEomi/lb) by the heating value of the test fuel at standard conditions.

$$\text{Eq} = ((\text{FEomi/lb})/\text{H}) \times 10^6$$

where

Eq = Energy equivalent of miles/lb to mile/BTUx10<sup>6</sup>

H = Volumetric heating value of test fuel at standard conditions

### 6-III. DISCUSSION

This is a comparative test of fuel economy using gasoline fuel with a heating value of 19,303.0 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 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 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 – 9.94 mpg, ART – 10.03 mpg, and COM – 17.72 mpg. Average fuel consumption at idle was 0.31 gph.

## FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Page 1 of 3

Bus Number: 1609	Date: 06-29-16	SLW (lbs): 10,290
Personnel: T.S., P.D., S.R. & E.D.		

<b>FUEL SYSTEM</b>	<b>OK</b>
Install fuel measurement system	✓
Replace fuel filter	✓
Check for fuel leaks	✓
Specify fuel type (refer to fuel analysis)	Gasoline
Remarks: None noted	
<b>BRAKES/TIRES</b>	<b>OK</b>
Inspect hoses	✓
Inspect brakes	✓
Relube wheel bearings	✓
Check tire inflation pressures (mfg. specs.)	✓
Check tire wear (less than 50%)	✓
Remarks: None noted	
<b>COOLING SYSTEM</b>	<b>OK</b>
Check hoses and connections	✓
Check system for coolant leaks	✓
Remarks: None noted	

# FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Page 2 of 3

Bus Number: 1609	Date: 06-29-16
Personnel: T.S., P.D., S.R. & E.D.	
<b>ELECTRICAL SYSTEMS</b>	<b>OK</b>
Check battery	✓
Inspect wiring	✓
Inspect terminals	✓
Check lighting	✓
Remarks: None noted	
<b>DRIVE SYSTEM</b>	<b>OK</b>
Drain transmission fluid	✓
Replace filter/gasket	✓
Check hoses and connections	✓
Replace transmission fluid	✓
Check for fluid leaks	✓
Remarks: None Noted	
<b>LUBRICATION</b>	<b>OK</b>
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: None noted	

## FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Page 3 of 3

Bus Number: 1609	Date: 06-29-16
Personnel: T.S., P.D., S.R. & E.D.	
EXHAUST/EMISSION SYSTEM	OK
Check for exhaust leaks	✓
Remarks: None noted	
ENGINE	OK
Replace air filter	✓
Inspect air compressor and air system	N/A
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 PRE-TEST INSPECTION FORM

Page 1 of 1

Bus Number: 1609	Date: 06-30-16
Personnel: S.R. & T.S.	
<b>PRE WARM-UP</b>	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	S.R.
Cold tire pressure (psi): Front <u>67</u> Middle <u>N/A</u> Rear <u>62</u>	S.R./M.H.
Engine oil level	S.R./M.H.
Engine coolant level	S.R./M.H.
Interior and exterior lights on, evaporator fan on	S.R./M.H.
Fuel economy instrumentation installed and working properly.	S.R.
Fuel line -- no leaks or kinks	S.R.
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	S.R.
<b>WARM-UP</b>	If OK, Initial
Bus driven for at least one hour warm-up	S.R./M.H.
No extensive or black smoke from exhaust	S.R./M.H.
<b>POST WARM-UP</b>	If OK, Initial
Warm tire pressure (psi): Front <u>80</u> Middle <u>N/A</u> Rear <u>75</u>	S.R.
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.R.

# FUEL ECONOMY DATA FORM (Liquid Fuels)

Page 1 of 4

Bus Number: 1609		Manufacturer: Starcraft		Date: 6-30-16			
Run Number: 1		Personnel: S.R., T.S. & M.H.					
Test Direction: <input type="checkbox"/> CW or <input checked="" type="checkbox"/> CCW		Temperature (°F): 68		Humidity (%): 53			
SLW (lbs): 10,290		Wind Speed (mph) & Direction: 5 S		Barometric Pressure (in.Hg): 30.10			
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	8:46	8:46	26.9	0	.198	.198
ART #1	0	4:04	4:04	26.8	0	.197	.197
CBD #2	0	8:39	8:39	27.5	0	.199	.199
ART #2	0	4:00	4:00	27.0	0	.197	.197
CBD #3	0	8:32	8:32	26.5	0	.199	.199
COMMUTER	0	5:59	5:59	25.4	0	.227	.227
Total Fuel = 1.217 gals							
20 minute idle : Total Fuel Used = .106 gals							
Heating Value = 19,303 BTU/LB							
Comments: None noted							

# **FUEL ECONOMY DATA FORM (Liquid Fuels)**

Page 2 of 4

Bus Number: 1609		Manufacturer: Starcraft		Date: 6-30-16	
Run Number: 2		Personnel: S.R., T.S. & M.H.			
Test Direction: <input checked="" type="checkbox"/> CW or <input type="checkbox"/> CCW		Temperature (°F): 72		Humidity (%): 53	
SLW (lbs): 10,290		Wind Speed (mph) & Direction: 6 N		Barometric Pressure (in. Hg): 30.10	

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Flow Meter Reading (gals)		Fuel Used (gals)
	Start	Finish			Start	Finish	
CBD #1	0	8:42	8:42	27.8	0	.199	.199
ART #1	0	4:01	4:01	27.9	0	.201	.201
CBD #2	0	8:39	8:39	29.9	0	.202	.202
ART #2	0	4:02	4:02	30.2	0	.201	.201
CBD #3	0	8:35	8:35	30.9	0	.202	.202
COMPUTER	0	6:01	6:01	32.0	0	.229	.229
Total Fuel = 1.234 gals							

20 minute Idle : Total Fuel Used = N/A gals
Heating Value = 19,303 BTU/LB
Comments: None noted

**FUEL ECONOMY DATA FORM (Liquid Fuels)**

Page 3 of 4

Bus Number: 1609		Manufacturer: Starcraft		Date: 6-30-16			
Run Number: 3		Personnel: S.R., T.S. & M.H.					
Test Direction: <input type="checkbox"/> CW or <input checked="" type="checkbox"/> CCW		Temperature (°F): 77		Humidity (%): 43			
SLW (lbs): 10,290		Wind Speed (mph) & Direction: 4 N		Barometric Pressure (in.Hg): 30.10			

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	8:34	8:34	32.7	0	.203	.203
ART #1	0	4:02	4:02	28.2	0	.203	.203
CBD #2	0	8:33	8:33	29.3	0	.205	.205
ART #2	0	4:02	4:02	28.6	0	.201	.201
CBD #3	0	8:34	8:34	30.4	0	.204	.204
COMMUTER	0	5:59	5:59	28.4	0	.234	.234
Total Fuel = 1.250 gals							
20 minute idle : Total Fuel Used = N/A gals							
Heating Value = 19,303 BTU/LB							
Comments: None noted							

## FUEL ECONOMY DATA FORM (Liquid Fuels)

Page 4 of 4

Bus Number: 1609		Manufacturer: Starcraft		Date: 6-30-16			
Run Number: 4		Personnel: S.R., T.S. & M.H.					
Test Direction: <input checked="" type="checkbox"/> CW or <input type="checkbox"/> CCW		Temperature (°F): 80		Humidity (%): 42			
SLW (lbs): 10,290		Wind Speed (mph) & Direction: Calm		Barometric Pressure (in.Hg): 30.10			

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	8:42	8:42	31.5	0	.206	.206
ART #1	0	4:00	4:00	32.9	0	.202	.202
CBD #2	0	8:33	8:33	32.9	0	.202	.202
ART #2	0	4:00	4:00	33.0	0	.197	.197
CBD #3	0	8:41	8:41	33.8	0	.201	.201
COMMUTER	0	6:02	6:02	33.3	0	.216	.216
Total Fuel = 1.224 gals							
20 minute idle : Total Fuel Used = .109 gals							
Heating Value = 19,303 BTU/LB							
Comments: None noted							

# FUEL ECONOMY SUMMARY SHEET

BUS MANUFACTURER: Starcraft                      BUS NUMBER: 1609  
 BUS MODEL                      : Starlite Transit                      TEST DATE : 06/30/16

FUEL TYPE                      : GASOLINE  
 SP. GRAVITY                      : .7382  
 HEATING VALUE                      : 19303.00 BTU/lb  
 FUEL TEMPERATURE                      : 86.00 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	.596	5.73	9.614	10.09
ART	.394	3.82	9.695	10.18
COM	.227	3.82	16.828	17.67
TOTAL	1.217	13.37	10.986	11.53
Run #2, CW				
CBD	.603	5.73	9.502	9.98
ART	.402	3.82	9.502	9.98
COM	.229	3.82	16.681	17.51
TOTAL	1.234	13.37	10.835	11.37
Run #3, CCW				
CBD	.612	5.73	9.363	9.83
ART	.404	3.82	9.455	9.93
COM	.234	3.82	16.325	17.14
TOTAL	1.250	13.37	10.696	11.23
Run #4, CW				
CBD	.609	5.73	9.409	9.88
ART	.399	3.82	9.574	10.05
COM	.216	3.82	17.685	18.57
TOTAL	1.224	13.37	10.923	11.47

## ----- IDLE CONSUMPTION (MEASURED) -----

First 20 Minutes Data: .11GAL    Last 20 Minutes Data: .11GAL  
 Average Idle Consumption : .32GAL/Hr

RUN CONSISTENCY: % Difference from overall average of total fuel used

-----  
 Run 1: 1.2            Run 2: -.2            Run 3: -1.5            Run 4: .6

## SUMMARY (CORRECTED VALUES) -----

Average Idle Consumption                      : .31 G/Hr  
 Average CBD Phase Consumption                      : 9.94 MPG  
 Average Arterial Phase Consumption: 10.03 MPG  
 Average Commuter Phase Consumption: 17.72 MPG  
 Overall Average Fuel Consumption : 11.40 MPG  
 Overall Average Fuel Consumption : 95.97 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 Test Track Facility.
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 45.9 dB(A); ranging from 46.5 dB(A) at the front passenger seats and middle speaker to 45.1 dB(A) at the rear passenger seats. The interior ambient noise level for this test was < 30.0 dB(A).

The second test measures interior noise during acceleration from 0 to 35 mph. This noise level ranged from 78.6 dB(A) at the rear passenger seats to 84.5 dB(A) at the driver's seat. The overall average was 81.5 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**

Page 1 of 3

Bus Number: 1609	Date: 7-26-16
Personnel: T.S., S.R. & E.D.	
Temperature (°F): 78	Humidity (%): 71
Wind Speed (mph): 4	Wind Direction: SSW
Barometric Pressure (in.Hg): 30.10	
Initial Sound Level Meter Calibration: 93.7 dB(A)	
Interior Ambient Noise Level dB(A): < 30.0	Exterior Ambient Noise Level dB(A): 37.3
Microphone Height During Testing (in): 47.5	
Initial Reading at Bus: 80.7 dB(A)	Final Reading at Bus: 80.6 dB(A)

Reading Location	Measured Sound Level dB(A)
Driver's Seat	46.0
Front Passenger Seats	46.5
In Line with Front Speaker	46.0
In Line with Middle Speaker	46.5
In Line with Rear Speaker	45.5
Rear Passenger Seats	45.1

Final Sound Level Meter Calibration: 93.8 dB(A)
---

<b>Comments:</b> None noted.



**INTERIOR NOISE TEST DATA FORM**  
**Test Condition 2: 0 to 35 mph Acceleration Test**

Page 2 of 3

Bus Number: 1609	Date: 05-17-16
Personnel: T.S., T.G. & C.S.	
Temperature (°F): 66	Humidity (%): 48
Wind Speed (mph): 6	Wind Direction: SSW
Barometric Pressure (in.Hg): 28.89	
Initial Sound Level Meter Calibration: 93.8 dB(A)	
Interior Ambient Noise Level dB(A): < 30	Exterior Ambient Noise Level dB(A): 41.5
Microphone Height During Testing (in): 47	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	84.5
Front Passenger Seats	81.0
Middle Passenger Seats	82.0
Rear Passenger Seats	78.6

Final Sound Level Meter Calibration: 93.7 dB(A)
---

<b>Comments:</b> None noted

**INTERIOR NOISE TEST DATA FORM**  
**Test Condition 3: Audible Vibration Test**

Page 3 of 3

Bus Number: 1609	Date: 05-17-16
Personnel: T.G., T.S. & C.S.	
Temperature (°F): 69	

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	N/A
Windows and Doors	None	N/A
Seats and Wheel Chair lifts	None	N/A
Other	None	N/A

<b>Comment on any other vibration or noise source which may have occurred that is not described above:</b> None
<b>Comments:</b> None

## 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 41.4 dB(A), the average test result obtained while accelerating from a constant speed was 74.8 dB(A) on the right side and 76.0 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 44.1 dB(A), the average of the results obtained were 70.7 dB(A) on the right side and 74.2 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 55.7 dB(A) at low idle and 66.3 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 14.0 dB(A) lower at low idle and 0.9 dB(A) lower at wide open throttle. The exterior ambient noise level measured during this test was 33.7 dB(A). Note: This test bus is not equipped with a high idle mode.

# EXTERIOR NOISE TEST DATA FORM

## Accelerating from Constant Speed

Page 1 of 3

Bus Number: 1609		Date: 05-17-16	
Personnel: T.G., T.S. & C.S.			
Temperature (°F): 69		Humidity (%): 48	
Wind Speed (mph): 2		Wind Direction: Variable	
Barometric Pressure (in.Hg): 28.87			
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: 93.8 dB(A)			
Exterior Ambient Noise Level: 41.4 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	75.1	1	75.3
2	74.5	2	74.3
3	73.5	3	75.5
4	74.0	4	75.2
5	74.2	5	76.4
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 = 74.8 dB(A)		Average of two highest actual noise levels = 76.0 dB(A)	
Final Sound Level Meter Calibration Check: 93.7 dB(A)			
<b>Comments:</b> None noted			

# EXTERIOR NOISE TEST DATA FORM

## Accelerating from Standstill

Page 2 of 3

Bus Number: 1609		Date: 05-17-16	
Personnel: T.G., T.S. & C.S.			
Temperature (°F): 66		Humidity (%): 48	
Wind Speed (mph): 3		Wind Direction: Variable	
Barometric Pressure (in.Hg): 28.87			
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: 93.8 dB(A)			
Exterior Ambient Noise Level: 44.1 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	70.6	1	74.0
2	70.5	2	72.4
3	70.1	3	74.3
4	70.7	4	73.6
5	70.8	5	72.8
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 = 70.7 dB(A)		Average of two highest actual noise levels = 74.2 dB(A)	
Final Sound Level Meter Calibration Check: 93.7 dB(A)			
<b>Comments:</b> None noted			

# EXTERIOR NOISE TEST DATA FORM

## Stationary

Page 3 of 3

Bus Number: 1609		Date: 05-17-16	
Personnel: T.G., T.S. & C.S.			
Temperature (°F): 69		Humidity (%): 48	
Wind Speed (mph): 5		Wind Direction: Variable	
Barometric Pressure (in.Hg): 28.86			
Initial Sound Level Meter Calibration: 93.8 dB(A)			
Exterior Ambient Noise Level: 33.7 dB(A)			
Accessories and Air Conditioning ON			
Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side dB(A)
		Measured	Measured
Low Idle	650	51.8	59.5
High Idle	N/A	N/A	N/A
Wide Open Throttle	4,000	65.4	67.2
Accessories and Air Conditioning OFF			
Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side dB(A)
		Measured	Measured
Low Idle	650	41.4	42.0
High Idle	N/A	N/A	N/A
Wide Open Throttle	4,000	65.2	65.5
Final Sound Level Meter Calibration Check: 93.7 dB(A)			
<b>Comments:</b> None noted			



## 7.2 EXTERIOR NOISE TESTS



**TEST BUS UNDERGOING  
EXTERIOR NOISE TESTS**



## **8. EMISSIONS TEST – DYNAMOMETER-BASED EMISSIONS TEST USING TRANSIT DRIVING CYCLES**

### **8-I. TEST OBJECTIVE**

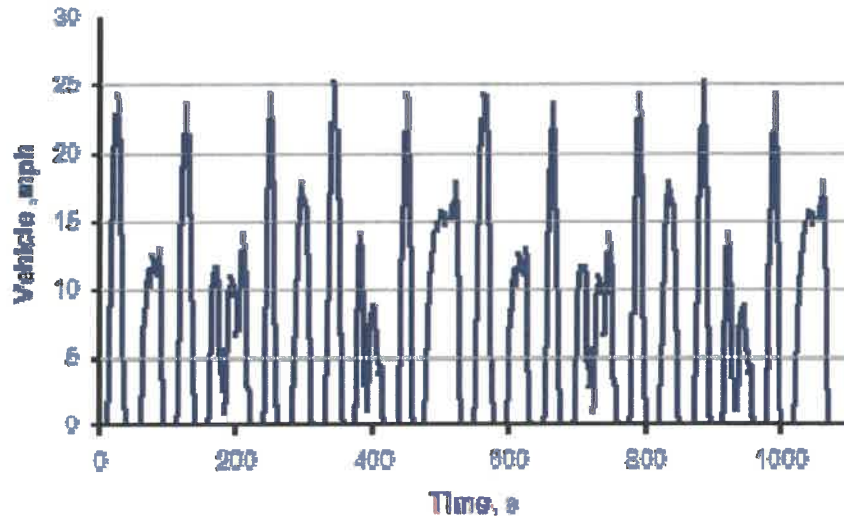
The objective of this test is to provide comparable emissions data on transit buses produced by different manufacturers. This chassis-based emissions test bears no relation to engine certification testing performed for compliance with the Environmental Protection Agency (EPA) regulation. EPA's certification 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, CO<sub>2</sub>, NO<sub>x</sub>, 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**

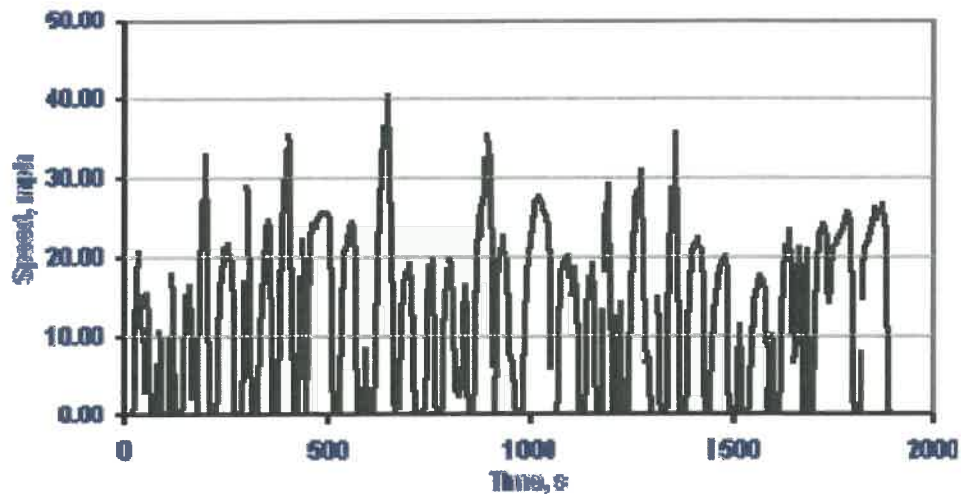
This test is performed in the emissions bay of the LTI Vehicle Testing Laboratory. The Laboratory is equipped with a Schenk Pegasus 300 HP, large-roll (72 inch diameter) chassis dynamometer suitable for heavy-vehicle emissions testing. The dynamometer is located in the end test bay and is adjacent to 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

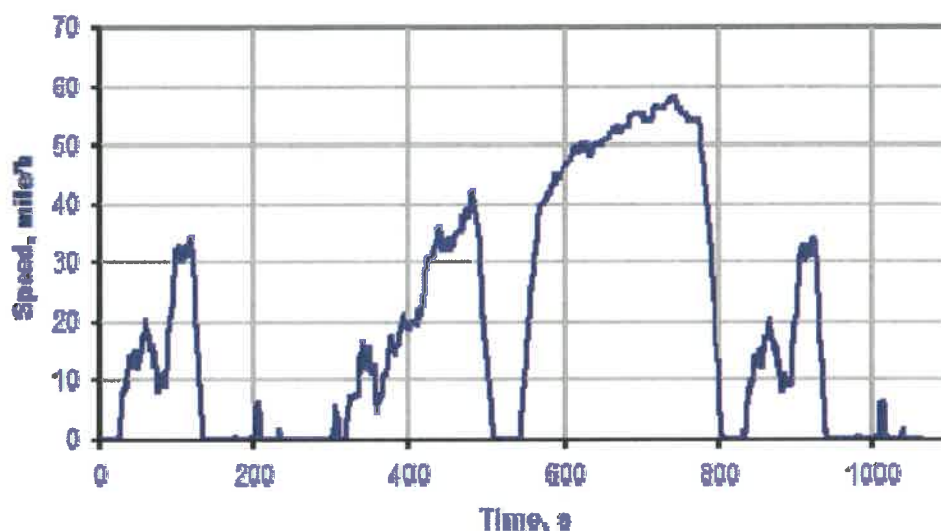
grams per mile value for each of the gaseous emissions for gasoline buses, for all the three driving cycles. In addition, the particulate matter emissions are included for diesel buses, and non-methane hydrocarbon emissions (NMHC) are included for CNG buses. Testing is performed in accordance with EPA 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. TEST ARTICLE

The test article is a Starcraft Bus a Division of Forest River, Inc., model Starlite Transit bus equipped with a gasoline fueled Ford Motor Co. 3.7 L engine. The bus was tested on August 18, 2016.

### 8-IV. TEST EQUIPMENT

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, CO<sub>2</sub> and cold NO<sub>x</sub> 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 CDCTS 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

<b>Test Completed at Half SLW: <u>9,100 LBS.</u></b>			
<b>Driving Cycle</b>	<b>Manhattan</b>	<b>Orange County Bus</b>	<b>UDDS</b>
<b>CO<sub>2</sub>, gm/mi</b>	1,230	875	821
<b>CO, gm/mi</b>	1.2	0.15	0.57
<b>THC, gm/mi</b>	0.18	0.04	0.04
<b>NMHC, gm/mi</b>	0.13	0.02	0.03
<b>NO<sub>x</sub>, gm/mi</b>	0.03	0.01	0.01
<b>Particulates, gm/mi</b>	NA	NA	NA
<b>Fuel consumption mpg</b>	7.00	9.86	10.50

**STURAA TEST**

**5 YEAR**

**150,000 MILE BUS**

**from**

**GLAVAL BUS**

**MODEL SPORT**

**AUGUST 2008**

**PTI-BT-R0805**

**PENNSTATE**



**The Thomas D. Larson  
Pennsylvania Transportation Institute**

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The Pennsylvania State University  
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## **EXECUTIVE SUMMARY**

Glaval Bus submitted a model Sport, diesel-powered 8 seat (including the driver) 22-foot bus, for a 5 yr/150,000 mile STURAA test. The odometer reading at the time of delivery was 590 miles. The bus is built on a 2007 Chevy, Savana chassis. Testing started on March 27, 2008 and was completed on July 25, 2008. 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 April 2, 2008 and was completed on July 16, 2008.

The interior of the bus is configured with seating for 8 passengers including the driver and 2 wheelchair positions. Free floor space will accommodate 8 standing passengers resulting in a potential load of 16 persons and 2 wheelchair positions. At 150 lbs per person, this load results in a measured gross vehicle weight of 12,410 lbs. In order to avoid exceeding the GAWR (8,600 lbs) of the rear axle, 200 lbs of wheelchair position ballast was eliminated. This reduction from full capacity resulted in an adjusted measured gross vehicle weight of 12,200 lbs and was used for all dynamic testing. The middle segment was performed at a SLW of 11,220 lbs and the final segment was performed at a CW of 8,830 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 10 reported failures, 6 were Class 3 and 4 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 13.76 seconds.

The Shakedown Test produced a maximum final loaded deflection of 0.192 inches with a permanent set ranging between -.002 to 0.005 inches under a distributed static load of 7,200 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 test bus was not equipped with any type of tow eyes or tow hooks, therefore, the Static Towing Test was not performed. 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 6.3 inches.

A Fuel Economy Test was run on simulated central business district, arterial, and commuter courses. The results were 9.49 mpg, 9.53 mpg, and 15.56 mpg respectively; with an overall average of 10.69 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 Glaval Bus, model Sport. The bus is built on a 2007 Chevy Savana chassis. The bus has an OEM driver's door rear of the front axle, a passenger door rear of the front axle and a dedicated wheelchair entrance equipped with a Ricon model K2005-F1020100B platform lift rear of the rear axle. Power is provided by a diesel-fueled, General Motors Inc. model 6.6 L V8 engine coupled to a General Motors Co. model Hydra Matic, HD, Tow/Haul transmission.

The measured curb weight is 3,470 lbs for the front axle and 5,360 lbs for the rear axle. These combined weights provide a total measured curb weight of 8,830 lbs. There are 8 seats including the driver, 2 wheelchair positions and room for 8 standing passengers bringing the total passenger capacity to 16 and 2 wheelchair positions. Gross load is  $150 \text{ lb} \times 16 = 2,400 \text{ lbs.} + 1,200 \text{ lbs (2 wheelchair positions)} = 3,600 \text{ lbs.}$  At full capacity, the measured gross vehicle weight is 12,410 lbs. This value was used for all static tests. In order to avoid exceeding the GAWR ( 8,600 lbs) of the rear axle, 200 lbs of wheelchair position ballast was eliminated. This reduction from full capacity resulted in an adjusted measured gross vehicle weight of 12,200 lbs and was used for all dynamic testing.

## VEHICLE DATA FORM

Bus Number: 0805	Arrival Date: 3-27-08
Bus Manufacturer: Glaval Bus	Vehicle Identification Number (VIN): 1GBJG316271202349
Model Number: Sport	Date: 3-27-08
Personnel: S.C. & T.S.	Chassis: 2007 Chevy Savana / G33503

WEIGHT: \*Values in parenthesis indicate the adjusted weights necessary to avoid exceeding the GAWR. These values were used for all dynamic testing.

Individual Wheel Reactions:

Weights (lb)	Front Axle		Middle Axle		Rear Axle	
	Right	Left	Right	Left	Right	Left
CW	1,890	1,580	N/A	N/A	2,700	2,660
SLW	1,630	1,720	N/A	N/A	3,750	4,120
GVW	1,770 (1,820)	1,760 (1,770)	N/A	N/A	4,310 (4,190)	4,570 (4,420)

Total Weight Details:

Weight (lb)	CW	SLW	GVW	GAWR
Front Axle	3,470	3,350	3,530 (3,590)	4,600
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	5,360	7,870	8,880 (8,610)	8,600
Total	8,830	11,220	12,410 (12,200)	GVWR: 12,320

Dimensions:

Length (ft/in)	22 / 0
Width (in)	95.0
Height (in)	105.5
Front Overhang (in)	40.5
Rear Overhang (in)	84.5
Wheel Base (in)	139.0
Wheel Track (in)	Front: 68.0
	Rear: 74.8

Bus Number: 0805	Date: 3-27-08
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**CLEARANCES:**

Lowest Point Outside Front Axle	Location: Frame	Clearance(in): 8.5
Lowest Point Outside Rear Axle	Location: Exhaust pipe	Clearance(in): 15.4
Lowest Point between Axles	Location: Body	Clearance(in): 9.9
Ground Clearance at the center (in)	9.9	
Front Approach Angle (deg)	19.2	
Rear Approach Angle (deg)	13.3	
Ramp Clearance Angle (deg)	8.1	
Aisle Width (in)	21.5	
Inside Standing Height at Center Aisle (in)	71.7	

**BODY DETAILS:**

Body Structural Type	Integral		
Frame Material	Steel		
Body Material	Steel & fiberglass		
Floor Material	Plywood		
Roof Material	Steel & fiberglass		
Windows Type	<input type="checkbox"/> Fixed	<input checked="" type="checkbox"/> Movable	
Window Mfg./Model No.	KTG / ASE M3 Dot 620		
Number of Doors	<u>1</u> Front	<u>1</u> Rear	<u>1</u> W/C door
Mfr. / Model No.	A & M / N/A		
Dimension of Each Door (in)	Front - 31.0 x 76.8	Rear – 34.4 x 57.7	W/C – 44.6 x 64.4
Passenger Seat Type	<input type="checkbox"/> Cantilever	<input checked="" type="checkbox"/> Pedestal	<input type="checkbox"/> Other (explain)
Mfr. / Model No.	Freedman Seating Co. / na		
Driver Seat Type	<input type="checkbox"/> Air	<input type="checkbox"/> Spring	<input checked="" type="checkbox"/> Other (cushion)
Mfr. / Model No.	General Motors Inc. / OEM		
Number of Seats (including Driver)	8 + 2 wheelchair positions		

Bus Number: 0805	Date: 3-27-08
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**BODY DETAILS (Contd..)**

Free Floor Space ( ft <sup>2</sup> )	12.2
Height of Each Step at Normal Position (in)	Front 1. <u>11.5</u> 2. <u>8.2</u> 3. <u>8.4</u> 4. <u>N/A</u>
	Middle 1. <u>N/A</u> 2. <u>N/A</u> 3. <u>N/A</u> 4. <u>N/A</u>
	Rear 1. <u>N/A</u> 2. <u>N/A</u> 3. <u>N/A</u> 4. <u>N/A</u>
Step Elevation Change - Kneeling (in)	N/A

**ENGINE**

Type	<input checked="" type="checkbox"/> C.I.	<input type="checkbox"/> Alternate Fuel	
	<input type="checkbox"/> S.I.	<input type="checkbox"/> Other (explain)	
Mfr. / Model No.	General Motors Inc. / 6.6L V8		
Location	<input checked="" type="checkbox"/> Front	<input type="checkbox"/> Rear	<input type="checkbox"/> Other (explain)
Fuel Type	<input type="checkbox"/> Gasoline	<input type="checkbox"/> CNG	<input type="checkbox"/> Methanol
	<input checked="" type="checkbox"/> Diesel	<input type="checkbox"/> LNG	<input type="checkbox"/> Other (explain)
Fuel Tank Capacity (indicate units)	33 gals		
Fuel Induction Type	<input checked="" type="checkbox"/> Injected	<input type="checkbox"/> Carburetion	
Fuel Injector Mfr. / Model No.	General Motors Inc. / 6.6L V8		
Carburetor Mfr. / Model No.	N/A		
Fuel Pump Mfr. / Model No.	General Motors Inc. / 6.6L V8		
Alternator (Generator) Mfr. / Model No.	American Armature / 66GMCSC6-FS		
Maximum Rated Output (Volts / Amps)	12 / 145		
Air Compressor Mfr. / Model No.	N/A		
Maximum Capacity (ft <sup>3</sup> / min)	N/A		
Starter Type	<input checked="" type="checkbox"/> Electrical	<input type="checkbox"/> Pneumatic	<input type="checkbox"/> Other (explain)
Starter Mfr. / Model No.	Hitachi / S14-101E		

Bus Number: 0805	Date: 3-27-08
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#### TRANSMISSION

Transmission Type	<input type="checkbox"/> Manual	<input checked="" type="checkbox"/> Automatic	
Mfr. / Model No.	General Motors Co. / Hydra Matic, HD, Tow/Haul		
Control Type	<input checked="" type="checkbox"/> Mechanical	<input type="checkbox"/> Electrical	<input type="checkbox"/> Other
Torque Converter Mfr. / Model No.	General Motors Co. / Hydra Matic, HD, Tow/Haul		
Integral Retarder Mfr. / Model No.	N/A		

#### SUSPENSION

Number of Axles	2		
Front Axle Type	<input checked="" type="checkbox"/> Independent	<input type="checkbox"/> Beam Axle	
Mfr. / Model No.	GM / OEM		
Axle Ratio (if driven)	N/A		
Suspension Type	<input type="checkbox"/> Air	<input checked="" type="checkbox"/> Spring	<input type="checkbox"/> Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Tenneco / C 072A12		
Middle Axle Type	<input type="checkbox"/> Independent	<input type="checkbox"/> Beam Axle	
Mfr. / Model No.	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type	<input type="checkbox"/> Air	<input type="checkbox"/> Spring	<input type="checkbox"/> Other (explain)
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	<input type="checkbox"/> Independent	<input checked="" type="checkbox"/> Beam Axle	
Mfr. / Model No.	Dana / 70D		
Axle Ratio (if driven)	3.73 : 1		
Suspension Type	<input type="checkbox"/> Air	<input checked="" type="checkbox"/> Spring (MorRyde)	<input type="checkbox"/> Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Tenneco / C067A1		



Bus Number: 0805	Date: 3-27-08
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#### WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Accuride / 16 x 6
	Tire Mfr./ Model No.	Uniroyal Laredo HD/H / LT 225/75R 16
Rear	Wheel Mfr./ Model No.	Accuride / 16 x 6
	Tire Mfr./ Model No.	Uniroyal Laredo HD/H / LT 225/75R 16

#### BRAKES

Front Axle Brakes Type	<input type="checkbox"/> Cam	<input checked="" type="checkbox"/> Disc	<input type="checkbox"/> Other (explain)
Mfr. / Model No.	GM / OEM		
Middle Axle Brakes Type	<input type="checkbox"/> Cam	<input type="checkbox"/> Disc	<input type="checkbox"/> Other (explain)
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	<input type="checkbox"/> Cam	<input checked="" type="checkbox"/> Disc	<input type="checkbox"/> Other (explain)
Mfr. / Model No.			
Retarder Type	N/A		
Mfr. / Model No.	N/A		

#### HVAC

HVAC			
Heating System Type	<input type="checkbox"/> Air	<input checked="" type="checkbox"/> Water	<input type="checkbox"/> Other
Capacity (Btu/hr)	Not available		
Mfr. / Model No.	General Motors, Inc. & ACC Climate Control		
Air Conditioner	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	
Location	Chassis dash & interior, rear ceiling mount.		
Capacity (Btu/hr)	47,000		
A/C Compressor Mfr. / Model No.	GM / OEM		

#### STEERING

Steering Gear Box Type	Hydraulic gear
Mfr. / Model No.	GM / OEM
Steering Wheel Diameter	15.5
Number of turns (lock to lock)	3.0

Bus Number: 0805	Date: 3-27-08
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#### OTHERS

Wheel Chair Ramps	Location: N/A	Type: N/A
Wheel Chair Lifts	Location: Right rear	Type: Hydraulic platform
Mfr. / Model No.	Ricon / K2005-F 1020100B	
Emergency Exit	Location: Window Door Roof hatch	Number: 2 2 1

#### CAPACITIES

Fuel Tank Capacity (units)	33 gals
Engine Crankcase Capacity (gallons)	3.7
Transmission Capacity (gallons)	Not available.
Differential Capacity (gallons)	1.3
Cooling System Capacity (quarts)	6.8
Power Steering Fluid Capacity (gallons)	Not available.

### VEHICLE DATA FORM

Bus Number: 0805	Date: 3-27-08
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**List all spare parts, tools and manuals delivered with the bus.**

[illegible]

## COMPONENT/SUBSYSTEM INSPECTION FORM

Bus Number: 0805	Date: 3-27-08
------------------	---------------

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	✓	
Interior Fasteners	✓	
Batteries	✓	

## **CHECK - IN**



## **GLAVAL BUS MODEL SPORT**



**CHECK - IN CONT.**



**GLAVAL BUS  
MODEL SPORT EQUIPPED WITH A RICON MODEL  
K2005-F1020100B HANDICAP LIFT**

# **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: 0805	Date: 7-23-08
------------------	---------------

Component	Checked	Comments
<b>ENGINE :</b>		
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	✓	
<b>TRANSMISSION :</b>		
Fluid Dip-Stick	✓	
Filler Hole	✓	
Drain Plug	Na	No drain plug.
<b>SUSPENSION :</b>	✓	
Bushings	✓	
Shock Absorbers	✓	
Air Springs	Na	
Leveling Valves	Na	
Grease Fittings	✓	



## ACCESSIBILITY DATA FORM

Bus Number: 0805	Date: 7-23-08
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Component	Checked	Comments
<b>HVAC :</b>		
A/C Compressor	✓	
Filters	✓	
Fans	✓	
<b>ELECTRICAL SYSTEM :</b>		
Fuses	✓	
Batteries	✓	
Voltage regulator	✓	
Voltage Converters	✓	
Lighting	✓	
<b>MISCELLANEOUS :</b>		
Brakes	✓	
Handicap Lifts/Ramps	✓	
Instruments	✓	
Axles	✓	
Exhaust	✓	
Fuel System	✓	
<b>OTHERS :</b>		

## **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.

(Page 1 of 1)  
**SCHEDULED MAINTENANCE**  
 Glaval #-0805

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
05-05-08	1,269	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
06-11-08	2,952	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
06-17-08	3,460	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
06-26-08	4,929	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
07-11-08	5,000	P.M. / Inspection Fuel Economy Preparation	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:

<u>ITEM</u>	<u>PRODUCT CODE</u>	<u>TEXACO DESCRIPTION</u>
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.

	<u>MAN HOURS</u>
Both rear bump stops.	2.00
Grill.	1.00
Power steering line.	4.00

At the end of the test, the remaining items on the list were removed and replaced. The transmission assembly took 6.0 man-hours (two men 3.0 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	6.0 man hours
Wiper Motor	0.75 man hours
Starter	0.5 man hours
Alternator	1.0 man hours
Batteries	0.75 man hours

### **1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS**



**TRANSMISSION REMOVAL AND REPLACEMENT  
(6.0 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 (0.5 MAN HOURS)**



#### **ALTERNATOR REMOVAL AND REPLACEMENT (1.0 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 6 Class 3 failures, 4 involved the suspension system and 2 occurred with the steering. These, and the remaining 4 Class 4 failures are available for review in the Unscheduled Maintenance List, located in Section 5.7 Structural Durability.

# RELIABILITY DATA FORMS

Bus Number: 0805	Date: 07-16-08
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		615			2.00	8.00
		1,101			2.00	38.00
	1,186				2.00	59.00
		1,381			4.00	16.00
		1,577			2.00	27.00
	2,952				1.00	8.00
Body/Compartments	1,344				1.00	20.00
	3,106				1.00	4.00
Steering		2,590			4.00	2.00
		2,670			4.00	68.00

### **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: 0805	Date: 7-18-08
Personnel: T.S., B.S. & B.J.	

Temperature (°F): 86	Humidity (%): 49
Wind Direction: WSW	Wind Speed (mph): 8
Barometric Pressure (in.Hg): 30.09	

<b>SAFETY TEST: DOUBLE LANE CHANGE</b>	
Maximum safe speed tested for double-lane change to left	45 mph
Maximum safe speed tested for double-lane change to right	45 mph
<b>Comments of the position of the bus during the lane change:</b> A safe profile was maintained through all portions of testing.	
<b>Comments of the tire/ground contact patch:</b> 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 13.76 seconds.



## PERFORMANCE DATA FORM

Bus Number: 0805		Date: 7-18-08	
Personnel: T.S., B.S. & B.J.			
Temperature (°F): 86		Humidity (%): 49	
Wind Direction: WSW		Wind Speed (mph): 8	
Barometric Pressure (in.Hg): 30.09			
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	
<b>ACCELERATION, GRADEABILITY, TOP SPEED</b>			
Counter Clockwise Recorded Interval Times			
Speed	Run 1	Run 2	Run 3
10 mph	2.39	2.63	2.26
20 mph	4.54	4.88	4.14
30 mph	6.84	7.23	6.43
40 mph	10.32	10.70	10.14
Top Test Speed(mph) 50	13.73	14.23	13.73
Clockwise Recorded Interval Times			
Speed	Run 1	Run 2	Run 3
10 mph	2.76	2.39	2.70
20 mph	4.70	4.48	4.76
30 mph	6.85	6.73	7.20
40 mph	9.88	9.82	10.39
Top Test Speed(mph) 50	13.48	13.45	13.92

# PERFORMANCE SUMMARY SHEET

BUS MANUFACTURER :G[ava]  
BUS MODEL :Sport

BUS NUMBER :0805  
TEST DATE :7/18/08

## TEST CONDITIONS :

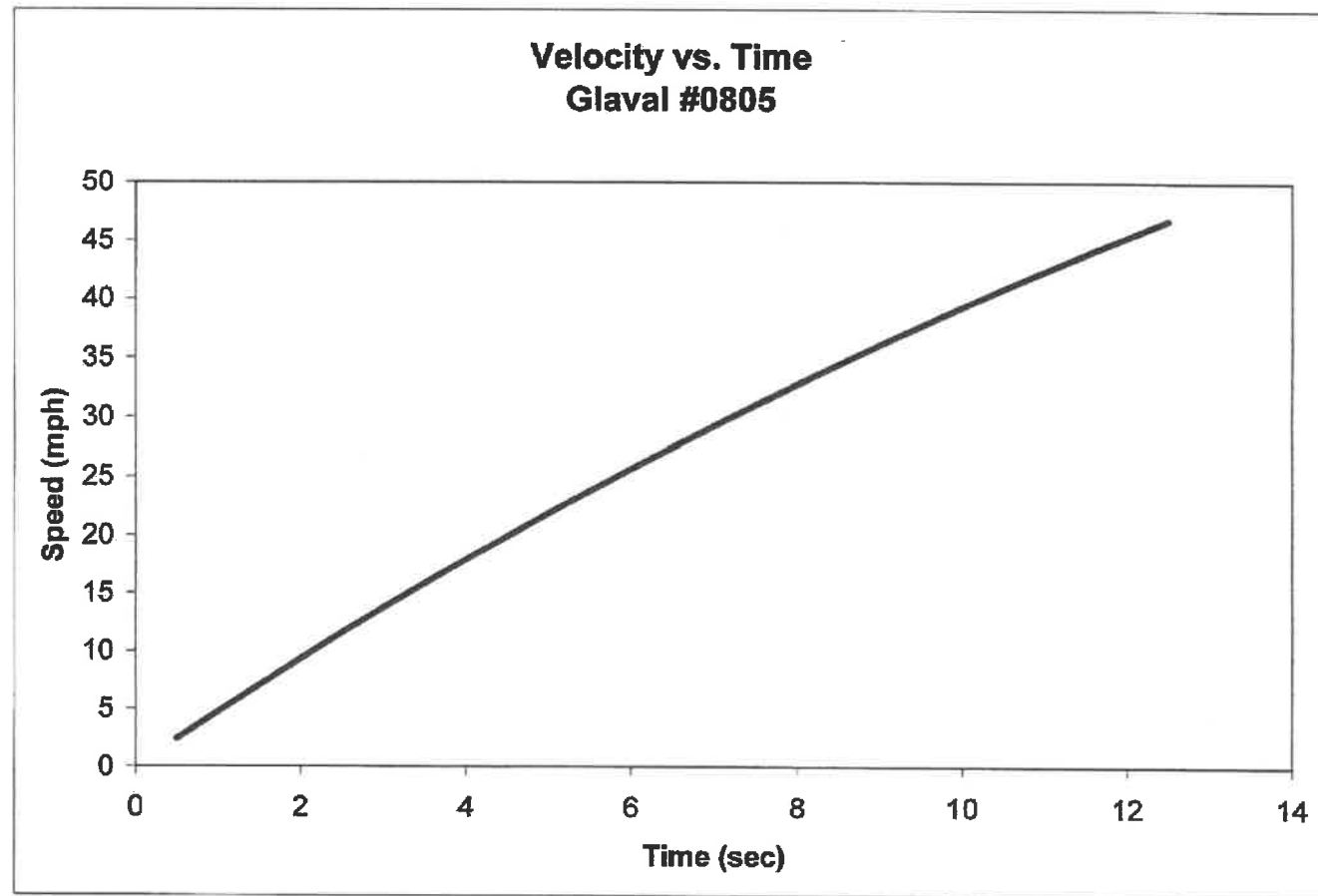
TEMPERATURE (DEG F) : 86.0  
WIND DIRECTION : WSW  
WIND SPEED (MPH) : 8.0  
HUMIDITY (%) : 49  
BAROMETRIC PRESSURE (IN. HG) : 30.1

VEHICLE SPEED (MPH)	AVERAGE TIME (SEC)		
	CCW DIRECTION	CW DIRECTION	TOTAL
10.0	2.43	2.62	2.52
20.0	4.52	4.65	4.58
30.0	6.83	6.93	6.88
40.0	10.39	10.03	10.21
50.0	13.90	13.62	13.76

## TEST SUMMARY :

VEHICLE SPEED (MPH)	TIME (SEC)	ACCELERATION (FT/SEC^2)	MAX. GRADE (%)
1.0	.21	7.1	22.5
5.0	1.05	6.8	21.6
10.0	2.15	6.5	20.6
15.0	3.32	6.2	19.5
20.0	4.54	5.8	18.4
25.0	5.83	5.5	17.3
30.0	7.21	5.2	16.3
35.0	8.67	4.9	15.3
40.0	10.22	4.6	14.3
45.0	11.88	4.3	13.4
50.0	13.66	4.0	12.4

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.



## 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 16 people including the driver and 2 wheelchair positions. The resulting test load is  $(16 \times 375 \text{ lb}) = 6,000 \text{ lbs} + 1,220 \text{ lbs}$  (2 wheelchair positions) = 7,200 lbs. 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 0.192 inches at reference point 6. The maximum permanent deflection after the final loading sequence ranged from -.002 inches at reference points 3, 4, and 5 to .005 inches at reference point 7.

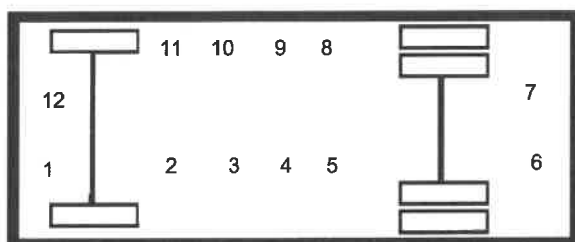
# STRUCTURAL SHAKEDOWN DATA FORM

Bus Number: 0805	Date: 3-31-08
Personnel: T.S., S.C. & E.D.	Temperature (°F): 68
Loading Sequence: <input checked="" type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3   (check one)	
Test Load (lbs): 7,200	

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	-.030	-.030	-.002	-.002
2	0	.009	.009	.005	.005
3	0	.013	.013	.007	.007
4	0	.014	.014	.006	.006
5	0	.015	.015	.006	.006
6	0	.232	.232	.041	.041
7	0	.181	.181	.023	.023
8	0	.021	.021	.007	.007
9	0	.013	.013	.002	.002
10	0	.010	.010	.002	.002
11	0	.008	.008	.002	.002
12	0	-.036	-.036	.000	.000

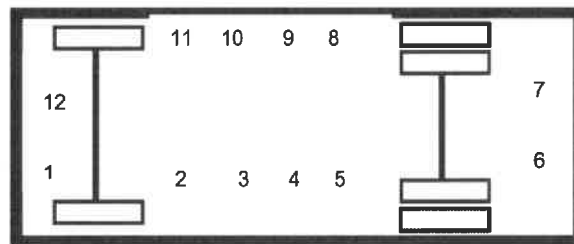
## STRUCTURAL SHAKEDOWN DATA FORM

Bus Number: 0805	Date: 3-31-08
Personnel: T.S., S.C. & E.D.	Temperature (°F): 68
Loading Sequence: <input type="checkbox"/> 1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3   (check one)	
Test Load (lbs): 7,200	

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	-.002	-.030	-.028	-.001	.003
2	.005	.011	.006	.004	-.001
3	.007	.015	.008	.005	-.002
4	.006	.016	.010	.004	-.002
5	.006	.017	.011	.004	-.002
6	.041	.233	.192	.045	.004
7	.023	.186	.163	.028	.005
8	.007	.022	.015	.007	.000
9	.002	.014	.012	.002	.000
10	.002	.010	.008	.001	-.001
11	.002	.009	.007	.002	.001
12	.000	-.034	-.034	.000	.000

## **5.1 STRUCTURAL SHAKEDOWN TEST**



**BUS LOADED TO 2.5 TIMES GVL  
(7,200 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: 0805	Date: 4-1-08
Personnel: T.S., E.D. & S.C.	Temperature(°F): 69

Wheel Position : (check one)		
All wheels level	<input checked="" type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower

	Comments
<input checked="" type="checkbox"/> Windows	No deficiencies.
<input checked="" type="checkbox"/> Front Doors	No deficiencies.
<input checked="" type="checkbox"/> Rear Doors	No deficiencies.
<input checked="" type="checkbox"/> Escape Mechanisms/ Roof Vents	No deficiencies.
<input checked="" type="checkbox"/> Engine	No deficiencies.
<input checked="" type="checkbox"/> Handicapped Device/ Special Seating	No deficiencies.
<input checked="" type="checkbox"/> Undercarriage	No deficiencies.
<input checked="" type="checkbox"/> Service Doors	No deficiencies.
<input checked="" type="checkbox"/> Body	No deficiencies.
<input checked="" type="checkbox"/> Windows/ Body Leakage	No deficiencies.
<input checked="" type="checkbox"/> Steering Mechanism	No deficiencies.

**DISTORTION TEST INSPECTION FORM**  
(Note: Ten copies of this data sheet are required)

Bus Number: 0805	Date: 4-1-08
Personnel: T.S., E.D. & S.C.	Temperature(°F): 69

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input checked="" type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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: 0805	Date: 4-1-08
Personnel: T.S., E.D. & S.C.	Temperature(°F): 69

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input checked="" type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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: 0805	Date: 4-1-08
Personnel: T.S., E.D. & S.C.	Temperature(°F): 69

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input checked="" type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower

	Comments
<input checked="" type="checkbox"/> Windows	No deficiencies.
<input checked="" type="checkbox"/> Front Doors	No deficiencies.
<input checked="" type="checkbox"/> Rear Doors	No deficiencies.
<input checked="" type="checkbox"/> Escape Mechanisms/ Roof Vents	No deficiencies.
<input checked="" type="checkbox"/> Engine	No deficiencies.
<input checked="" type="checkbox"/> Handicapped Device/ Special Seating	No deficiencies.
<input checked="" type="checkbox"/> Undercarriage	No deficiencies.
<input checked="" type="checkbox"/> Service Doors	No deficiencies.
<input checked="" type="checkbox"/> Body	No deficiencies.
<input checked="" type="checkbox"/> Windows/ Body Leakage	No deficiencies.
<input checked="" type="checkbox"/> Steering Mechanism	No deficiencies.

**DISTORTION TEST INSPECTION FORM**  
(Note: Ten copies of this data sheet are required)

Bus Number: 0805	Date: 4-1-08
Personnel: T.S., E.D. & S.C.	Temperature(°F): 69

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input checked="" type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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: 0805	Date: 4-1-08
Personnel: T.S., E.D. & S.C.	Temperature(°F): 69

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input checked="" type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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: 0805	Date: 4-1-08
Personnel: T.S., E.D. & S.C.	Temperature(°F): 69

<b>Wheel Position : (check one)</b>		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input checked="" type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 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: 0805	Date: 4-1-08
Personnel: T.S., E.D. & S.C.	Temperature(°F): 69

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input checked="" type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower

	Comments
<input checked="" type="checkbox"/> Windows	No deficiencies.
<input checked="" type="checkbox"/> Front Doors	No deficiencies.
<input checked="" type="checkbox"/> Rear Doors	No deficiencies.
<input checked="" type="checkbox"/> Escape Mechanisms/ Roof Vents	No deficiencies.
<input checked="" type="checkbox"/> Engine	No deficiencies.
<input checked="" type="checkbox"/> Handicapped Device/ Special Seating	No deficiencies.
<input checked="" type="checkbox"/> Undercarriage	No deficiencies.
<input checked="" type="checkbox"/> Service Doors	No deficiencies.
<input checked="" type="checkbox"/> Body	No deficiencies.
<input checked="" type="checkbox"/> Windows/ Body Leakage	No deficiencies.
<input checked="" type="checkbox"/> Steering Mechanism	No deficiencies.



**DISTORTION TEST INSPECTION FORM**  
(Note: Ten copies of this data sheet are required)

Bus Number: 0805	Date: 4-1-08
Personnel: T.S., E.D. & S.C.	Temperature(°F): 69

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input checked="" type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower

	Comments
<input checked="" type="checkbox"/> Windows	No deficiencies.
<input checked="" type="checkbox"/> Front Doors	No deficiencies.
<input checked="" type="checkbox"/> Rear Doors	No deficiencies.
<input checked="" type="checkbox"/> Escape Mechanisms/ Roof Vents	No deficiencies.
<input checked="" type="checkbox"/> Engine	No deficiencies.
<input checked="" type="checkbox"/> Handicapped Device/ Special Seating	No deficiencies.
<input checked="" type="checkbox"/> Undercarriage	No deficiencies.
<input checked="" type="checkbox"/> Service Doors	No deficiencies.
<input checked="" type="checkbox"/> Body	No deficiencies.
<input checked="" type="checkbox"/> Windows/ Body Leakage	No deficiencies.
<input checked="" type="checkbox"/> Steering Mechanism	No deficiencies.

**DISTORTION TEST INSPECTION FORM**  
(Note: Ten copies of this data sheet are required)

Bus Number: 0805	Date: 4-1-08
Personnel: T.S., E.D. & S.C.	Temperature(°F): 69

Wheel Position : (check one)		
All wheels level	<input type="checkbox"/> before	<input type="checkbox"/> after
Left front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right front	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left rear	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Right center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower
Left center	<input type="checkbox"/> 6 in higher	<input type="checkbox"/> 6 in lower

	Comments
<input type="checkbox"/> Windows	No deficiencies.
<input type="checkbox"/> Front Doors	No deficiencies.
<input type="checkbox"/> Rear Doors	No deficiencies.
<input type="checkbox"/> Escape Mechanisms/ Roof Vents	No deficiencies.
<input type="checkbox"/> Engine	No deficiencies.
<input type="checkbox"/> Handicapped Device/ Special Seating	No deficiencies.
<input type="checkbox"/> Undercarriage	No deficiencies.
<input type="checkbox"/> Service Doors	No deficiencies.
<input type="checkbox"/> Body	No deficiencies.
<input type="checkbox"/> Windows/ Body Leakage	No deficiencies.
<input type="checkbox"/> Steering Mechanism	No deficiencies.

## **5.2 STRUCTURAL DISTORTION TEST**



**RIGHT FRONT WHEEL SIX INCHES HIGHER**



**LEFT FRONT WHEEL SIX INCHES HIGHER  
AND HANDICAP LIFT FUNCTIONING**

## **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 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.

## **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: 0805	Date: 7-21-08
Personnel: T.S. & P.S.	

Temperature (°F): 84	Humidity (%): 49
Wind Direction: WSW	Wind Speed (mph): 12
Barometric Pressure (in.Hg): 29.90	

<b>Inspect tow equipment-bus interface.</b>
<b>Comments:</b> A safe and adequate connection was made between the tow equipment and the bus.
<b>Inspect tow equipment-wrecker interface.</b>
<b>Comments:</b> A safe and adequate connection was made between the tow equipment and the wrecker.
<b>Towing Comments:</b> A front lift tow was performed incorporating a hydraulic under lift wrecker.
<b>Description and location of any structural damage:</b> No damage observed.
<b>General Comments:</b> No problems with the tow or towing interface were encountered during the test.

## 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 6.3 inches to 20.3 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	13.0"
Rear axle – one tire flat	20.3"
Rear axle – two tires flat	18.0"



## JACKING TEST DATA FORM

Bus Number: 0805	Date: 3-28-08
Personnel: T.S. & 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	15.3 " I 13.0 " D	9.2 " I 6.3 " D	None noted.
Left front	15.4 " I 13.1 " D	9.3 " I 6.4 " D	"
Right rear—outside	20.6 " I 20.2 " D	11.7 " I 11.3 " D	"
Right rear—both	20.6 " I 18.0 " D	11.7 " I 9.0 " D	"
Left rear—outside	20.7 " I 20.3 " D	11.8 " I 11.4 " D	"
Left rear—both	20.7 " I 18.1 " D	11.8 " I 9.1 " 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	
<b>Additional comments of any deformation or difficulty during jacking:</b>			
None noted.			

## **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: 0805	Date: 3-28-08
Personnel: T.S. & S.C.	Temperature (°F): 69

<b>Comments of any structural damage to the jacking pads or axles while both the front wheels are supported by the jack stands:</b>
None noted.
<b>Comments of any structural damage to the jacking pads or axles while both the rear wheels are supported by the jack stands:</b>
None noted.
<b>Comments of any structural damage to the jacking pads or axles while both the front and rear wheels are supported by the jack stands:</b>
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 5,050 miles; approximately 3,750 miles on the PSBRTF Durability Test Track and approximately 1,300 miscellaneous other miles. The test will be conducted with the bus operated under three different loading conditions. The first segment will consist of approximately 2,125 miles with the bus operated at GVW. The second segment will consist of approximately 800 miles with the bus operated at SLW. The remainder of the test, approximately 2,125 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 April 2, 2008 and was conducted until July 16, 2008. The first 2,125 miles were performed at a GVW of 12,200 lbs. 200 lbs of ballast was eliminated from one of the wheelchair positions. This reduction in weight was necessary to avoid exceeding the GARW (8,600 lbs) of the rear axle. The GVW segment as completed on May 21, 2008. The next 800 mile SLW segment was performed at 11,220 lbs and completed on June 6, 2008, and the final 2,125 mile segment was performed at a CW of 8,830 lbs and completed on July 16, 2008.

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.

**Glaval - TEST BUS #0805**

**MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS**

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
03/31/08 TO 04/06/08	139.00	107.00	246.00
04/07/08 TO 04/13/08	0.00	0.00	0.00
04/14/08 TO 04/20/08	0.00	0.00	0.00
04/21/08 TO 04/27/08	774.00	81.00	855.00
04/28/08 TO 05/04/08	161.00	7.00	168.00
05/05/08 TO 05/11/08	107.00	5.00	112.00
05/12/08 TO 05/18/08	188.00	8.00	196.00
05/19/08 TO 05/25/08	388.00	368.00	756.00
05/26/08 TO 05/31/08	246.00	11.00	257.00
06/02/08 TO 06/08/08	76.00	4.00	80.00
06/09/08 TO 06/15/08	231.00	205.00	436.00
06/16/08 TO 06/22/08	845.00	37.00	882.00
06/23/08 TO 06/29/08	595.00	369.00	964.00

**Glaval - TEST BUS #0805**

**MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS**

06/30/08 TO 07/06/08	0.00	48.00	48.00
07/07/08 TO 7/13/2008	0.00	0.00	0.00
07/14/08 TO 7/20/2008	0.00	52.00	52.00
TOTAL	3750.00	1302.00	5052.00

M

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

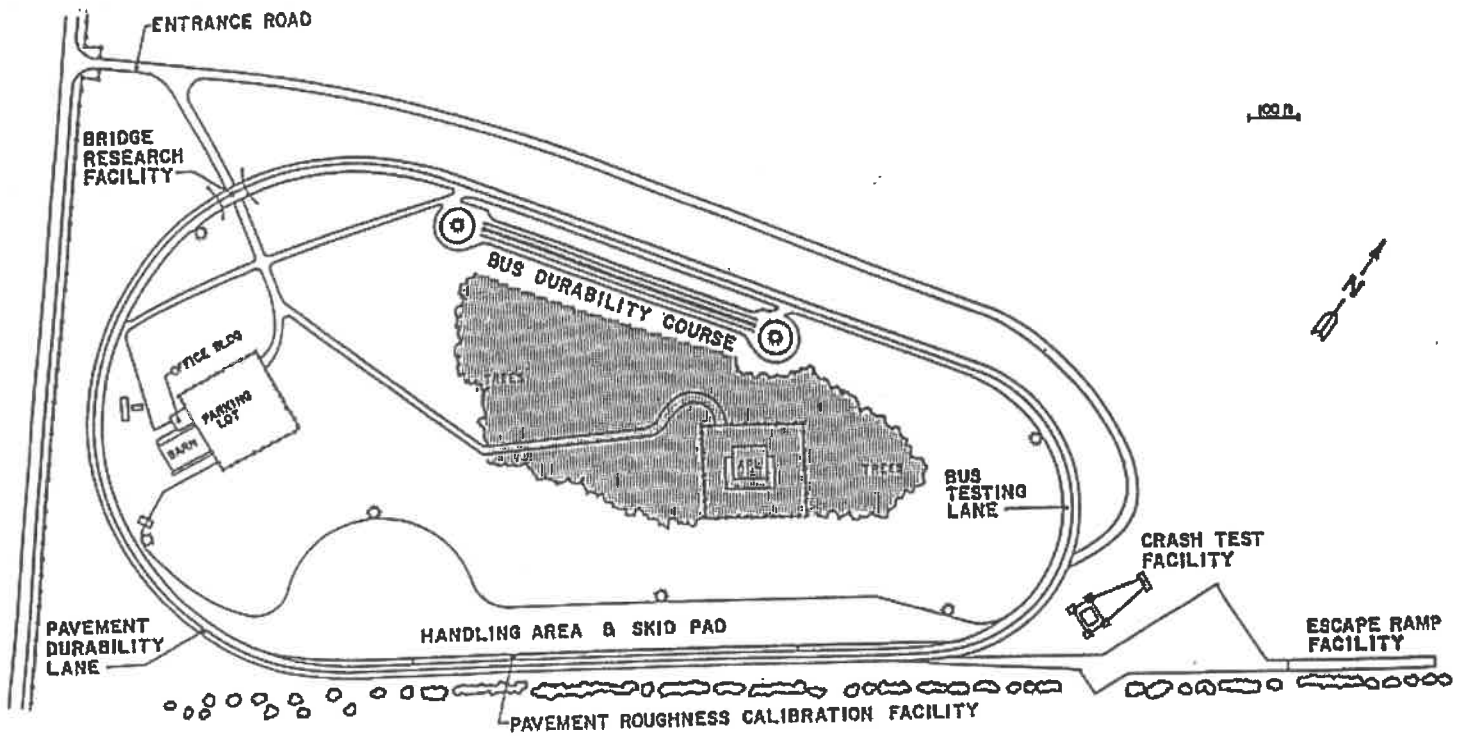
B—Break

C—Cycle all systems five times, visual inspection, driver's log entries

D—Drive bus as specified by procedure

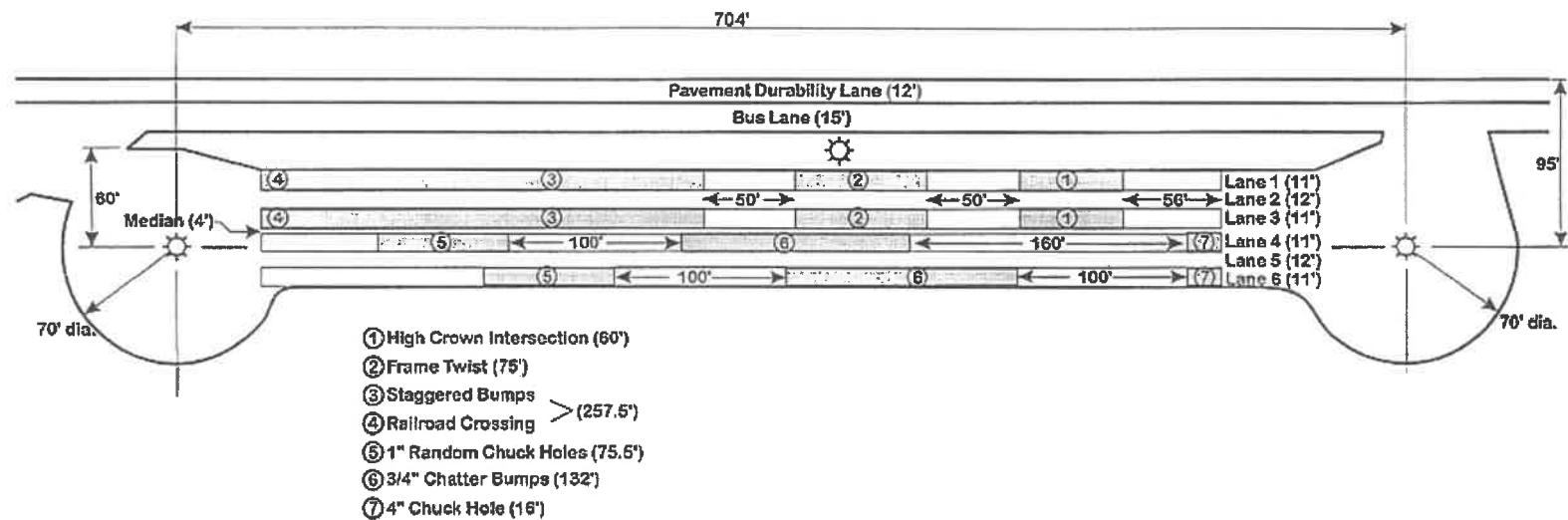
F—Fuel bus, complete driver's log shift entries

**“PLAN VIEW OF PENN STATE BUS TESTING AND  
RESEARCH FACILITY”**



**BUS TESTING AND RESEARCH TEST TRACK  
UNIVERSITY PARK, PA**



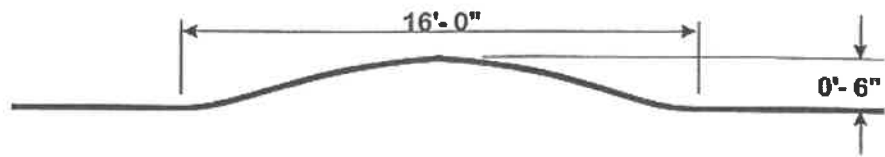


Plan View

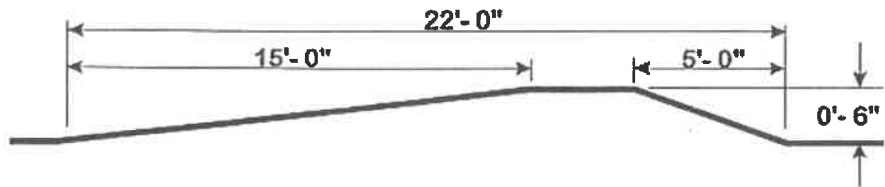
## Vehicle Durability Test Track

The Pennsylvania Transportation Institute  
Penn State

**Staggered  
Bumps  
(10 mph)**



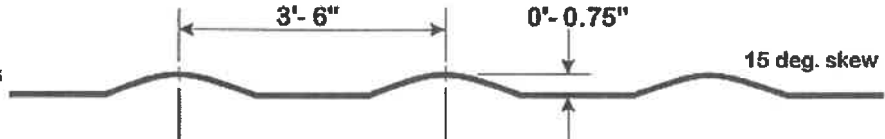
**Railroad  
Crossing  
(8 mph)**



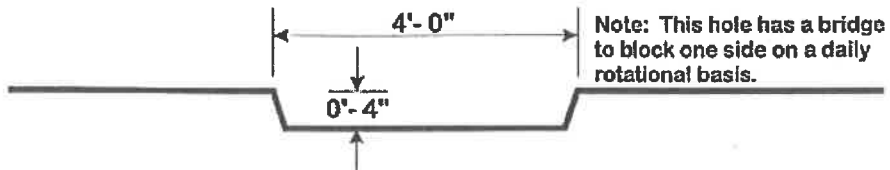
**1" Random  
Chuck Holes  
(20 mph)**



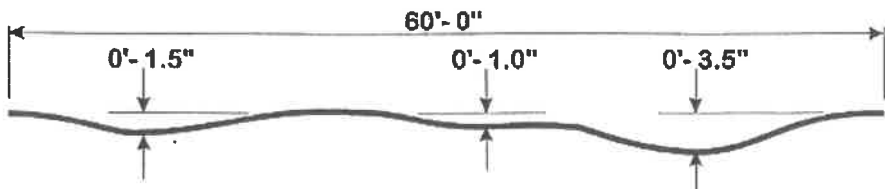
**Chatter Bumps  
(20 mph)**



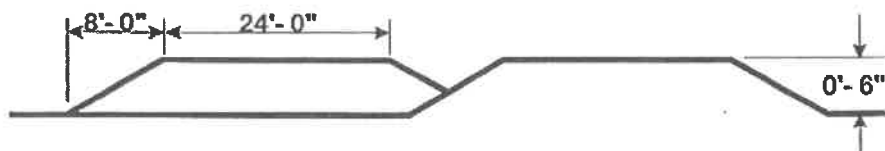
**4" Chuck Hole  
(5 mph)**



**High Crown  
Intersection  
(20 mph)**



**Frame Twist  
(10 mph)**



## Durability Element Profiles

The Pennsylvania Transportation Institute  
Penn State

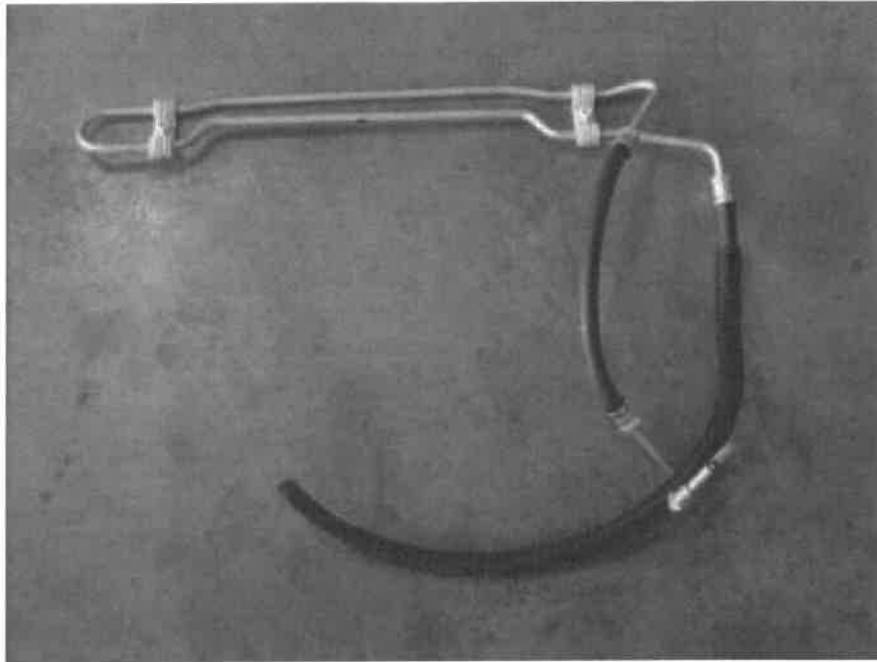
(Page 1 of 2)  
**UNSCHEDULED MAINTENANCE**  
 Bus Name: Glaval #0805

DATE	TEST MILES	SERVICE	ACTIVITY	MAN HOURS	DOWN TIME
04-23-08	615	The rear spring eyes are hitting the suspension tower.	Replaced bump stops.	2.00	8.00
04-28-08	1,101	The bump stops on the Mor/Ryde suspension are smashed.	Temporarily replaced with a 4"x4" piece of rubber belting on each side. Ordered bump stops.	2.00	38.00
05-01-08	1,186	New Mor/Ryde bump stops arrived.	Replaced both bump stops.	2.00	59.00
05-07-08	1,344	The mounting bolts are missing from the grill.	Used new bolts to reinstall grill and parking light.	1.00	20.00
05-08-08	1,381	The right side rear suspension Mor-Ryde rubber bump stop failed.	Replaced bump stop.	4.00	16.00
05-19-08	1,577	The left rear Mor/Ryde bump stop is pounded out.	Replaced left rear Mor/Ryde bump stop.	2.00	27.00
06-02-08	2,590	The power steering line from the steering box to the steering pump is leaking fluid.	Replaced power steering line and o-ring. Topped off power steering fluid.	2.00	4.00
06-09-08	2,670	The power steering cooler line is leaking hydraulic fluid.	Replaced power steering cooler line.	4.00	68.00

(Page 2 of 2)  
**UNSCHEDULED MAINTENANCE**  
 Bus Name: Glaval #0805

DATE	TEST MILES	SERVICE	ACTIVITY	MAN HOURS	DOWN TIME
06-11-08	2,952	The bump stop for the right rear spring is worn.	Replaced right rear spring bump stop.	1.00	8.00
06-16-08	3,106	The battery tray is coming apart.	Reassembled battery tray with 1/4" bolts.	1.00	4.00

## **UNSCHEDULED MAINTENANCE**



**LEAKING HYDRAULIC LINE  
(2,670 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, 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

<u>phase</u>	<u>miles per phase</u>	<u>total miles per run</u>
CBD	1.9097	5.7291
ART	1.9097	3.8193
COM	3.8193	3.8193

$$FE_{o_{mi/lb}} = \text{Observed fuel economy} = \frac{\text{miles}}{\text{lb of fuel}}$$



- 2.) Convert the observed fuel economy to miles per gallon [mpg] by multiplying by the specific gravity of the test fuel  $G_s$  (referred to water) at 60°F and multiply by the density of water at 60°F

$$FE_{o_{mpg}} = FE_{c_{mi/lb}} \times G_s \times G_w$$

where  $G_s$  = Specific gravity of test fuel at 60°F (referred to water)  
 $G_w$  = 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.

$$FE_c = FE_{o_{mpg}} \times \frac{Q}{H}$$

where

$H$  = Volumetric heating value of test fuel [BTU/gal]  
 $Q$  = Volumetric heating value of standard reference fuel

Combining steps 1-3 yields

$$\Rightarrow FE_c = \frac{\text{miles}}{\text{lbs}} \times (G_s \times G_w) \times \frac{Q}{H}$$

- 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/BTU $\times 10^6$ .

$Eq$  = Energy equivalent of converting mpg to mile/BTU $\times 10^6$ .

$$Eq = ((mpg)/(H)) \times 10^6$$

## 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  $T=60^\circ\text{F}$ ). These combine to give a fuel economy in miles per lb. The energy equivalent

(mile/BTUx10<sup>6</sup>) 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.

<u>phase</u>	<u>miles per phase</u>	<u>total miles per run</u>
CBD	1.9097	5.7291
ART	1.9097	3.8193
COM	3.8193	3.8193

$$FEO_{mi/scf} = \text{Observed fuel economy} = \frac{\text{miles}}{\text{scf of fuel}}$$

- 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<sup>3</sup>).

**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.**

$$FEO_{mi/lb} = FEO / Gm$$

where  $Gm$  = Density of test fuel at standard conditions

- 3.) Convert the observed fuel economy (FEOmi/lb) to an energy equivalent of (miles/BTUx10<sup>6</sup>) by dividing the observed fuel economy (FEOmi/lb) by the heating value of the test fuel at standard conditions.

$$Eq = (FEO_{mi/lb})/H \times 10^6$$

where

$Eq$  = Energy equivalent of miles/lb to mile/BTUx10<sup>6</sup>

$H$  = 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 19,631.0 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 – 9.49 mpg, ART – 9.53 mpg, and COM – 15.56 mpg. Average fuel consumption at idle was 0.34 gph.

## FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 0805	Date: 77-11-08	SLW (lbs): 11,220
Personnel: T.S. & S.C.		

FUEL SYSTEM	OK	Date	Initials
Install fuel measurement system	✓	7/11/08	S.C.
Replace fuel filter	✓	7/11/08	S.C.
Check for fuel leaks	✓	7/11/08	S.C.
Specify fuel type (refer to fuel analysis)	Diesel		
Remarks: None noted.			
BRAKES/TIRES	OK	Date	Initials
Inspect hoses	✓	7/11/08	T.S.
Inspect brakes	✓	7/11/08	T.S.
Relube wheel bearings	✓	7/11/08	T.S.
Check tire inflation pressures (mfg. specs.)	✓	7/11/08	T.S.
Remarks: None noted.			
COOLING SYSTEM	OK	Date	Initials
Check hoses and connections	✓	7/11/08	S.C.
Check system for coolant leaks	✓	7/11/08	S.C.
Remarks: None noted.			

## FUEL ECONOMY PRE-TEST MAINTENANCE FORM (page 2)

Bus Number: 0805	Date: 7-11-08		
Personnel: T.S. & S.C.			
<b>ELECTRICAL SYSTEMS</b>	OK	Date	Initials
Check battery	✓	7-11-08	S.C.
Inspect wiring	✓	7-11-08	S.C.
Inspect terminals	✓	7-11-08	S.C.
Check lighting	✓	7-11-08	S.C.
Remarks: None noted.			
<b>DRIVE SYSTEM</b>	OK	Date	Initials
Drain transmission fluid	✓	7-11-08	T.S.
Replace filter/gasket	✓	7-11-08	T.S.
Check hoses and connections	✓	7-11-08	T.S.
Replace transmission fluid	✓	7-11-08	T.S.
Check for fluid leaks	✓	7-11-08	T.S.
Remarks: None noted.			
<b>LUBRICATION</b>	OK	Date	Initials
Drain crankcase oil	✓	7-11-08	T.S.
Replace filters	✓	7-11-08	T.S.
Replace crankcase oil	✓	7-11-08	T.S.
Check for oil leaks	✓	7-11-08	T.S.
Check oil level	✓	7-11-08	T.S.
Lube all chassis grease fittings	✓	7-11-08	T.S.
Lube universal joints	✓	7-11-08	T.S.
Replace differential lube including axles	✓	7-11-08	T.S.
Remarks: None noted.			

## FUEL ECONOMY PRE-TEST MAINTENANCE FORM (page 3)

Bus Number: 0805	Date: 7-11-08		
Personnel: T.S. & S.C.			
EXHAUST/EMISSION SYSTEM	OK	Date	Initials
Check for exhaust leaks	✓	7-11-08	S.C.
Remarks: None noted.			
ENGINE	OK	Date	Initials
Replace air filter	✓	7-11-08	S.C.
Inspect air compressor and air system	✓	7-11-08	S.C.
Inspect vacuum system, if applicable	✓	7-11-08	S.C.
Check and adjust all drive belts	✓	7-11-08	S.C.
Check cold start assist, if applicable	✓	7-11-08	S.C.
Remarks: None noted.			
STEERING SYSTEM	OK	Date	Initials
Check power steering hoses and connectors	✓	7-11-08	S.C.
Service fluid level	✓	7-11-08	S.C.
Check power steering operation	✓	7-11-08	S.C.
Remarks: None noted.			
	OK	Date	Initials
Ballast bus to seated load weight	✓	7-11-08	S.C.
TEST DRIVE	OK	Date	Initials
Check brake operation	✓	7-11-08	S.C.
Check transmission operation	✓	7-11-08	S.C.
Remarks: None noted.			

## FUEL ECONOMY PRE-TEST INSPECTION FORM

Bus Number: 0805	Date: 7-17-08
Personnel: S.C.	
PRE WARM-UP	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	S.C.
Cold tire pressure (psi): Front <u>65</u> Middle <u>N/A</u> Rear <u>65</u>	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 <u>69</u> Middle <u>N/A</u> Rear <u>73</u>	S.C.
Environmental conditions Average wind speed <12 mph and maximum gusts <15 mph Ambient temperature between 30°F(-1°C) 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: 0805		Manufacturer: Glaval		Date: 7-17-08	
Run Number: 1		Personnel: B.S., T.S. & S.C.			
Test Direction: <input type="checkbox"/> CW or <input checked="" type="checkbox"/> CCW		Temperature (°F): 78		Humidity (%): 60	
SLW (lbs): 11,220		Wind Speed (mph) & Direction: 5 / SW		Barometric Pressure (in.Hg): 30.15	

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	8:29	8:29	35.5	0	.189	.189
ART #1	0	3:47	3:47	37.0	0	.196	.196
CBD #2	0	7:57	7:57	39.0	0	.198	.198
ART #2	0	3:50	3:50	40.0	0	.199	.199
CBD #3	0	8:18	8:18	40.5	0	.196	.196
COMMUTER	0	5:59	5:59	40.5	0	.243	.243
Total Fuel = 1.221 lbs							
20 minute idle : Total Fuel Used = .110 lbs							
Heating Value = 19,631 BTU/LB							
Comments: None noted.							



### FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0805		Manufacturer: Glaval		Date: 7-17-08	
Run Number: 2		Personnel: B.S., T.S. & S.C.			
Test Direction: <input type="checkbox"/> CW or <input type="checkbox"/> CCW		Temperature (°F): 80		Humidity (%): 58	
SLW (lbs): 11,220		Wind Speed (mph) & Direction: 5 / SW		Barometric Pressure (in.Hg): 30.15	

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	8:13	8:13	40.5	0	.185	.185
ART #1	0	3:53	3:53	40.5	0	.183	.183
CBD #2	0	7:58	7:58	41.0	0	.191	.191
ART #2	0	3:51	3:51	41.5	0	.197	.197
CBD #3	0	8:03	8:03	41.5	0	.191	.194
COMMUTER	0	6:00	6:00	41.5	0	.223	.223
Total Fuel = 1.178 lbs							
20 minute idle : Total Fuel Used = N/A lbs							
Heating Value = 19,631 BTU/LB							
Comments: None noted.							

1.173

### FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0805		Manufacturer: Glaval		Date: 7-17-08	
Run Number: 3		Personnel: B.S., T.S. & S.C.			
Test Direction: ◐CW or ◑CCW		Temperature (°F): 82		Humidity (%): 52	
SLW (lbs): 11,220		Wind Speed (mph) & Direction: 6 / SW		Barometric Pressure (in.Hg): 30.15	

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	8:15	8:15	37.5	0	.190	.190
ART #1	0	3:51	3:51	37.5	0	.191	.191
CBD #2	0	8:05	8:05	38.0	0	.197	.197
ART #2	0	3:48	3:48	38.5	0	.188	.188
CBD #3	0	8:19	8:19	39.5	0	.195	.195
COMMUTER	0	5:57	5:57	40.0	0	.235	.235
Total Fuel = 1.196 lbs							
20 minute idle : Total Fuel Used = N/A lbs							
Heating Value = 19,631 BTU/LB							
Comments: None noted.							

### FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0805		Manufacturer: Glaval		Date: 7-17-08	
Run Number: 4		Personnel: B.S., T.S. & S.C.			
Test Direction: <input checked="" type="checkbox"/> CW or <input type="checkbox"/> CCW		Temperature (°F): 84		Humidity (%): 52	
SLW (lbs):		Wind Speed (mph) & Direction: 6 / SW		Barometric Pressure (in.Hg): 30.15	

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	8:20	8:20	40.0	0	.187	.187
ART #1	0	3:50	3:50	40.5	0	.191	.191
CBD #2	0	8:11	8:11	41.0	0	.193	.193
ART #2	0	3:47	3:47	41.0	0	.189	.189
CBD #3	0	8:18	8:18	42.0	0	.194	.194
COMMUTER	0	6:03	6:03	42.5	0	.239	.239
Total Fuel = 1.193 lbs							
20 minute idle : Total Fuel Used = .107 lbs							
Heating Value = 19,631 BTU/LB							
Comments: None noted.							

0805 .fu]  
FUEL ECONOMY SUMMARY SHEET

BUS MANUFACTURER :Glaval  
BUS MODEL :Sport  
BUS NUMBER :0805  
TEST DATE :07/17/08

FUEL TYPE : DIESEL  
SP. GRAVITY : .8095  
HEATING VALUE : 19631.00 BTU/Lb  
FUEL TEMPERATURE : 60.00 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	.583	5.73	9.828	9.40
ART	.395	3.82	9.671	9.25
COM	.243	3.82	15.720	15.03
TOTAL	1.221	13.37	10.950	10.47
Run # :2, CW				
CBD	.570	5.73	10.053	9.61
ART	.380	3.82	10.053	9.61
COM	.223	3.82	17.130	16.38
TOTAL	1.173	13.37	11.398	10.90
Run # :3, CCW				
CBD	.582	5.73	9.845	9.42
ART	.379	3.82	10.079	9.64
COM	.235	3.82	16.255	15.54
TOTAL	1.196	13.37	11.179	10.69
Run # :4, CW				
CBD	.574	5.73	9.983	9.55
ART	.380	3.82	10.053	9.61
COM	.239	3.82	15.983	15.28
TOTAL	1.193	13.37	11.207	10.72

-----  
IDLE CONSUMPTION (MEASURED)

First 20 Minutes Data : .11GAL Last 20 Minutes Data : .11GAL  
Average Idle Consumption : .33GAL/Hr

RUN CONSISTENCY: % Difference from overall average of total fuel used

Run 1 : -2.1 Run 2 : 1.9 Run 3 : .0 Run 4 : .2

-----  
SUMMARY (CORRECTED VALUES)

Average Idle Consumption : .34 G/Hr  
Average CBD Phase Consumption : 9.49 MPG  
Average Arterial Phase Consumption : 9.53 MPG  
Average Commuter Phase Consumption : 15.56 MPG  
Overall Average Fuel Consumption : 10.69 MPG  
Overall Average Fuel Consumption : 80.72 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 47.4 dB(A); ranging from 47.0 dB(A) in line with the rear speaker to 48.2 dB(A) in line with the front speaker. The interior ambient noise level for this test was < 34.0 dB(A).

The second test measures interior noise during acceleration from 0 to 35 mph. This noise level ranged from 75.0 dB(A) at the driver's and front passenger seats to 80.4 dB(A) at the middle passenger seats. The overall average was 76.6 dB(A). The interior ambient noise level for this test was < 34.0 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: 0805	Date: 3-26-08
Personnel: S.C., T.S. & P.D.	
Temperature (°F): 46	Humidity (%): 63
Wind Speed (mph): 10	Wind Direction: W
Barometric Pressure (in.Hg): 30.02	
Initial Sound Level Meter Calibration: ■ checked by: S.C.	
Interior Ambient Noise Level dB(A): < 34.0	Exterior Ambient Noise Level dB(A): 39.6
Microphone Height During Testing (in): 48.0	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	47.6
Front Passenger Seats	47.4
In Line with Front Speaker	48.2
In Line with Middle Speaker	47.2
In Line with Rear Speaker	47.0
Rear Passenger Seats	47.2

Final Sound Level Meter Calibration: ■ checked by: S.C.
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<b>Comments:</b> All readings taken in the center aisle.

**INTERIOR NOISE TEST DATA FORM**  
**Test Condition 2: 0 to 35 mph Acceleration Test**

Bus Number: 0805	Date: 7-18-08
Personnel: T.S., B.S. & B.J.	
Temperature (°F): 86	Humidity (%): 49
Wind Speed (mph): 8	Wind Direction: WSW
Barometric Pressure (in.Hg): 30.09	
Initial Sound Level Meter Calibration: ■ checked by: S.C.	
Interior Ambient Noise Level dB(A): < 34.0	Exterior Ambient Noise Level dB(A):
Microphone Height During Testing (in): 48.0	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	75.0
Front Passenger Seats	75.0
Middle Passenger Seats	80.4
Rear Passenger Seats	75.8

Final Sound Level Meter Calibration: ■ checked by: S.C.
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<b>Comments:</b> All readings taken in the center aisle.     
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**INTERIOR NOISE TEST DATA FORM**  
**Test Condition 3: Audible Vibration Test**

Bus Number: 0805	Date: 7-18-08
Personnel: T.S., B.S. & B.J.	
Temperature (°F): 86	Humidity (%): 49
Wind Speed (mph): 8	Wind Direction: WSW
Barometric Pressure (in.Hg): 30.09	

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.

<b>Comment on any other vibration or noise source which may have occurred that is not described above:</b> 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 40.1 dB(A), the average test result obtained while accelerating from a constant speed was 81.0 dB(A) on the right side and 80.4 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 40.1 dB(A), the average of the results obtained were 80.4 dB(A) on the right side and 80.8 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 51.9 dB(A) at low idle, 63.0 dB(A) at high idle, and 73.0 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 0.8 dB(A) lower at low idle, the same 63.0 dB(A) at high idle, and 0.3 dB(A) higher at wide open throttle. The exterior ambient noise level measured during this test was 40.1 dB(A).

# **EXTERIOR NOISE TEST DATA FORM** **Accelerating from Constant Speed**

Bus Number: 0805	Date: 7-18-08
Personnel: T.S., B.S. & B.J.	
Temperature (°F): 86	Humidity (%): 49
Wind Speed (mph): 8	Wind Direction: WSW
Barometric Pressure (in.Hg): 30.09	
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): 40.1	

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	75.2	1	76.2
2	75.3	2	76.3
3	78.3	3	76.1
4	80.4	4	80.5
5	81.5	5	80.3
Average of two highest actual noise levels = 81.0 dB(A)		Average of two highest actual noise levels = 80.4 dB(A)	
Final Sound Level Meter Calibration Check: ■ checked by: S.C.			
Comments: None noted.			

# **EXTERIOR NOISE TEST DATA FORM** **Accelerating from Standstill**

Bus Number: 0805	Date: 7-18-08
Personnel: T.S., B.S. & B.J.	
Temperature (°F): 86	Humidity (%): 49
Wind Speed (mph): 8	Wind Direction: WSW
Barometric Pressure (in.Hg): 30.09	
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): 40.1	

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	80.5	1	80.7
2	80.1	2	80.6
3	80.2	3	80.8
4	79.4	4	80.7
5	79.7	5	80.7
Average of two highest actual noise levels = 80.4 dB(A)		Average of two highest actual noise levels = 80.8 dB(A)	
Final Sound Level Meter Calibration Check: ■ checked by: S.C.			
Comments: None noted.			

## EXTERIOR NOISE TEST DATA FORM

### Stationary

Bus Number: 0805		Date: 7-18-08	
Personnel: T.S., B.S. & B.J.			
Temperature (°F): 86		Humidity (%): 49	
Wind Speed (mph): 8		Wind Direction: WSW	
Barometric Pressure (in.Hg): 30.09			
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): 40.1			
Accessories and Air Conditioning ON			
Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	680	50.8	52.9
High Idle	1,201	62.5	63.4
Wide Open Throttle	3,437	72.2	73.7
Accessories and Air Conditioning OFF			
Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	685	50.8	51.3
High Idle	1,205	62.1	63.9
Wide Open Throttle	3,438	72.7	73.8
Final Sound Level Meter Calibration Check: ■ checked by: T.S.			
Comments: None noted.			

## 7.2 EXTERIOR NOISE TESTS



**TEST BUS UNDERGOING  
EXTERIOR NOISE TESTING**



**ADDENDUM ACKNOWLEDGEMENT FORM**  
**SOLICITATION NO.:**

**Instructions:** Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

**Acknowledgment:** I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

**Addendum Numbers Received:**

*(Check the box next to each addendum received)*

- ☒ Addendum No. 1
- ☐ Addendum No. 2
- ☐ Addendum No. 3
- ☐ Addendum No. 4
- ☐ Addendum No. 5

- ☐ Addendum No. 6
- ☐ Addendum No. 7
- ☐ Addendum No. 8
- ☐ Addendum No. 9
- ☐ Addendum No. 10

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

Creative Bus Sales, Inc.

Company



Authorized Signature

11/3/2020

Date

**NOTE:** This addendum acknowledgement should be submitted with the bid to expedite document processing.





**DOCUMENTATION TO BE SUBMITTED WITH THE BID**

Listed as Ford chassis related items first, then body items

**CHASSIS RELATED ITEM DETAILS:**

\*Please note, as is industry standard Ford does not supply chassis literature that can be provide with the bid. For all items below the warranty period is 3 years and 36,000 miles except for the Powertrain which is 5 years and 60,000miles, Corrosion warranty which is 5 years with unlimited miles, and the Roadside Assistance warranty period is 5 years and 60,000 miles. Please see details page provided.

**3.2** The Chassis used will be a Ford Transit T350 cutaway chassis. Please see detail page provided.

**3.3** The Engine will be Ford's 3.5L Ecoboost V-6 gasoline engine. The engine produces 400 ft/lb of torque and 310 Horsepower at 5,000 RPM's. The compression ratio is 10.0:1. Fuel delivery will be direct gasoline injection with dual turbochargers. Please see details page provided.

**3.17.1** The Radio provided will be the OEM Am/FM/BT/SYNC radio with 4" display, to meet the bid specifications. Please see details page provided.

**3.8** The Transmission provided will be Ford OEM 10-speed automatic Selectshift with overdrive. Please see details page provided.

**3.5** Radiator and Cooling system will be Ford OEM as required to maintain applicable warranties. Please see details page provided.

**3.13** The Brakes will be Ford OEM 4-wheel Antilock disc brakes. Please see details page provided.

**3.11.4** Ford OEM tilt wheel is standard and will be provided. Cruise control will be OEM as well. OEM power steering is an Electric EPS system. Please see details pages provided.

**3.14** The wheels provided will be OEM 16" Heavy Duty Steel Wheels. Please see details page provided.

**3.15** The tires provided will be 235/65R16 All Season tires-Michelin or similar subject to Ford's supply chain moving forward. Please see details page provided.

**3.16** The battery system will consist of dual AGM Batteries-70 amp/hr each. Please see details page provided.

3.16.5 The OEM alternator system will consist of dual alternators providing 250 amps total. Please see details page provided.

**BODY RELATED ITEM DETAILS:**

\* For all items below the warranty period is 1 years and 12,000 miles unless otherwise noted

**3.6** The High Idle system that will be provide is a Intermotive Gateway High Idle and Shift Interlock system. Please find the provide product literature.

**3.21** Wheelbase: Creative Bus Sales will build our buses in response to this RFP on a 156" wheel base. Please see the below **floorplan drawings provided**, which show the wheelbase measurements.

**3.9.4** Rear View Back Up Camera-we will provide the Rosco STSK4750 back up camera system with 7" monitor. Please see the literature included within our offering.

**3.26 FRONT AND REAR HEAT AND AIR CONDITIONING**

Creative Bus Sales will provide OEM, chassis included, front heat and air conditioning. The Ford warranty applies, which is 3 Year 36,000 mile.

For the Rear Air Conditioning Creative will include an ACC R226216 60,000 BTU system. The system will include model 23022 skirt evaporator and TM16 10 CID compressor. Please find the included product literature for these items.

For the Rear Heat, Creative will include a 35,000 BTU low profile floor heater, by PROAIR LLC. This 3-speed motor auxiliary heater produces the maximum of 35,000 BTU with outstanding 313CFM's. The unit size is 7" X 10" X 9" and it weighs 5.2 lbs. Please see the included product literature for this component. The warranty period on the heater is 1 year 12,000 miles.

**3.19** Body Specifications-The construction will use the body on chassis method. The Ford chassis will be prepped at Mor-Ryde and pre-wired as required. The construction steps can be summarized by adding subflooring, walls/ceiling, non-chassis entry doors, commercial flooring, electronic equipment, seats, and wheelchair lift if ordered. The internal height of the vehicle upon completion will be 76" and the overall vehicle length is 282 3/4". Please see the document with construction details submitted with our offering.

**3.21** Sealant Rustproofing and Undercoating-Please see the information document provided with our submittal

**3.19** Passenger Doors and Stepwells-Please see the documents provided within our submittal

**3.29** Flooring We will provide Gerflor Sirius NT #6801 Graphite (Black) transit flooring. Please find the datasheet outlining the flooring specs for this product, making sure to focus on the NT product column. Due to the submission being electronic, we will provided samples if needed

**3.22 Seats, Grab Handles, Passenger restraints-** We will provide seats, grab handles, and seat belts provided by Freedman Seating. Seat material will be level 4 to meet bid specifications, color to be provided prior to order placement. Please see the included documents within our submittal.

**3.34 Mobility Aid/Occupant Restraint System-**We will provide Q-Straint Deluxe retractable wheelchair restraints and L Tracking in the floor. Please see the brochure provided with our submission

**3.44 Training-**please find the letter we provided within our offering pertaining to this section

**3.35.4** We will provide Angel Trax Vulcan V12 MDVR camera system with 6 dome cameras and a 1 TB harddrive. Please see information document we provided within our submission.

**4.12.2** The warranty on the completed vehicle from Glaval will be 12 months 12,000 miles bumper to bumper. Please see details page provided.

**4.12.3** The Glaval structural warranty is 5 years and 100,000 miles. Please see details page provided.

**4.12.5** The vehicle subsystems and components will be 12 months and 12,000 miles. Please see details page provided.

**7.3** Complete two (2) bids in binder form-one marked for DPT-Due to this being an electronic submittal, hard copies can be provided if needed.

**9.2A Vehicle Description-**we are offering a Glaval Commute narrow body bus built on a Ford Transit T350 chassis (10,360 GVWR). Please see our construction method document provided within our offering.

**9.2.B Proposed Interior Floor Plans-**Please see the floor plan documents provided within our offering

**9.2C Curb Weight-**Please find the weigh calculations provided within our offering. The GVWR for all Class floor plan offerings is 10,360 pounds

**9.2D Graphics-**We will provide 3M vinyl material for graphics based on the Class selected. Due to it being a electronic submittal, color samples can be supplied if needed.

**9.2H** The vehicles will be constructed at 2367 Century Drive Goshen Indiana.  
Activities to take place at this location are:

- Chassis receipt and prep
- Body construction and component installation
- Receive customer factory tour if requested by customer
- Body Paint if necessary
- Water test
- Test Drive
- Component functionality review
- Factory PDI for quality control

**9.2I** 5 customer referrals

**Addendum Acknowledgement-use form in the bid docs**

# 2020 TRANSIT OPTIONAL EQUIPMENT

BODY CODES	Body Type Order Code	CARGO VAN 101A	CREW VAN 201A	PASSENGER VAN XL 301A	PASSENGER VAN XL T 302A	CUTAWAY 501A	CHASSIS CAB 701A
NOTE: Body Codes have changed, double-check before inputting orders. Also, you must input Wheelbase into CONCEPS now							
<b>LOW ROOF (83.6")</b>							
<b>Transit-150 (GVWR: Cargo Van 8,670#   Crew Van 8,670#   Passenger Van 8,550#)</b>							
Regular (130")	RWD	E1Y	E1Z	K1Y	K1Y	—	—
Regular (130")	AWD	E2Y	E2Z	K2Y	K2Y	—	—
Long (148")	RWD	E1Y	E1Z	—	—	—	—
Long (148")	AWD	E2Y	E2Z	—	—	—	—
<b>Transit-250 (GVWR: Cargo Van 9,070#   Crew Van 9,070#   Cutaway 9,070#   Chassis Cab 9,070#)</b>							
Regular (130")	RWD	R1Y	R1Z	—	—	—	—
Regular (130")	AWD	R2Y	R2Z	—	—	—	—
Regular (138")	RWD	—	—	—	—	R5P	R5Z
Regular (138")	AWD	—	—	—	—	R7P	R7Z
Long (148")	RWD	R1Y	R1Z	—	—	—	—
Long (148")	AWD	R2Y	R2Z	—	—	—	—
Long (156")	RWD	—	—	—	—	R5P	R5Z
Long (156")	AWD	—	—	—	—	R7P	R7Z
<b>Transit-350 (GVWR: Cargo Van 9,500#   Crew Van 9,250#, except with Long (148") is 9,500#   Passenger Van 9,250#, except with 14 or 15-Passenger Seating and RWD is 9,400#   Passenger Van with 14 or 15-Passenger Seating and AWD is 9,550#   Cutaway 9,500#   Chassis Cab 9,500#)</b>							
Regular (130")	RWD	W1Y	W1Z	—	—	—	—
Regular (130")	AWD	W2Y	W2Z	—	—	—	—
Regular (138")	RWD	—	—	—	—	W5P	W5Z
Regular (138")	AWD	—	—	—	—	W7P	W7Z
Long (148")	RWD	W1Y	W1Z	X2Y	X2Y	—	—
Long (148")	AWD	W2Y	W2Z	X9Y	X9Y	—	—
Long (156")	RWD	—	—	—	—	W5P	W5Z
Long (156")	AWD	—	—	—	—	W7P	W7Z
<b>Transit-350 HD DRW (GVWR: Cutaway 9,950#   Chassis Cab 9,950#)</b>							
Regular (138")	RWD	—	—	—	—	F6P	F6Z
Regular (138")	AWD	—	—	—	—	F8P	F8Z
Long (156")	RWD	—	—	—	—	F6P	F6Z
Long (156")	AWD	—	—	—	—	F8P	F8Z
Extended (178")	RWD	—	—	—	—	F6P	F6Z
Extended (178")	AWD	—	—	—	—	F8P	F8Z
<b>Transit-350 HD DRW (GVWR: Cutaway 10,360#   Chassis Cab 10,360#)</b>							
Regular (138")	RWD	—	—	—	—	S6P	S6Z
Regular (138")	AWD	—	—	—	—	S8P	S8Z
Long (156")	RWD	—	—	—	—	S6P	S6Z
Long (156")	AWD	—	—	—	—	S8P	S8Z
Extended (178")	RWD	—	—	—	—	S6P	S6Z
Extended (178")	AWD	—	—	—	—	S8P	S8Z
<b>Transit-350 HD DRW (GVWR: Cutaway 11,000#   Chassis Cab 11,000#)</b>							
Regular (138")	RWD	—	—	—	—	U6P	U6Z
Regular (138")	AWD	—	—	—	—	U8P	U8Z
Long (156")	RWD	—	—	—	—	U6P	U6Z
Long (156")	AWD	—	—	—	—	U8P	U8Z
Extended (178")	RWD	—	—	—	—	U6P	U6Z
Extended (178")	AWD	—	—	—	—	U8P	U8Z
<b>MEDIUM ROOF (100.8")</b>							
<b>Transit-150 (GVWR: Cargo Van 8,670#   Crew Van 8,670#   Passenger Van 8,550#)</b>							
Regular (130")	RWD	E1C	E1D	K1C	K1C	—	—
Regular (130")	AWD	E2C	E2D	K2C	K2C	—	—
Long (148")	RWD	E1C	E1D	—	—	—	—
Long (148")	AWD	E2C	E2D	—	—	—	—
<b>Transit-250 (GVWR: Cargo Van 9,070#   Crew Van 9,070#)</b>							
Regular (130")	RWD	R1C	R1D	—	—	—	—
Regular (130")	AWD	R2C	R2D	—	—	—	—
Long (148")	RWD	R1C	R1D	—	—	—	—
Long (148")	AWD	R2C	R2D	—	—	—	—
<b>Transit-350 (GVWR: Cargo Van 9,500#   Crew Van 9,250#, except with Long (148") is 9,500#   Passenger Van 9,250#, except with 14 or 15-Passenger Seating and RWD is 9,400#   Passenger Van with 14 or 15-Passenger Seating and AWD is 9,550#)</b>							
Regular (130")	RWD	W9C	W1D	—	—	—	—
Regular (130")	AWD	W2C	W2D	—	—	—	—
Long (148")	RWD	W9C	W1D	X2C	X2C	—	—
Long (148")	AWD	W2C	W2D	X9C	X9C	—	—
<b>HIGH ROOF (110.1")</b>							
<b>Transit-250 (GVWR: Cargo Van 9,070#   Crew Van 9,070#)</b>							
Long (148")	RWD	R1X	R1V	—	—	—	—
Long (148")	AWD	R2X	R2V	—	—	—	—
Extended (148")	RWD	R3X	—	—	—	—	—
Extended (148")	AWD	R3U	—	—	—	—	—
<b>Transit-350 (GVWR: Cargo Van 9,500#   Crew Van 9,500#   Passenger Van 9,250#, except with 14 or 15-Passenger Seating and RWD is 9,400#   Passenger Van with 14 or 15-Passenger Seating and AWD is 9,550#)</b>							
Long (148")	RWD	W1X	W1V	X2X	X2X	—	—
Long (148")	AWD	W2X	W2V	X9X	X9X	—	—
Extended (148")	RWD	W3X	—	—	—	—	—
Extended (148")	AWD	W3U	—	—	—	—	—
<b>Transit-350 HD DRW (GVWR: Cargo Van 9,950#   Crew Van 9,950#)</b>							
Extended (148")	RWD	F4X	F4V	—	—	—	—
Extended (148")	AWD	F4U	F4W	—	—	—	—

★ = New for this model year

S = Standard / O = Optional / P = Packaged Option  
F = Fleet Option with valid FIN code / I = Included

# 2020 Transit

2020 Transit > **Performance and Capability** > Gasoline Engines

## 3.5L EcoBoost V6 with Ti-VCT

### CYLINDER BLOCK

- Die-cast aluminum engine block is strong, yet lightweight
- Forged-steel, fully counterweighted crankshaft with 6-bolt press-fit main bearing caps for strength and durability
- Piston-cooling engine oil jets help improve oil warm-up and maintain cooler piston temperatures for improved durability

### ENGINE POWER

#### 3.5L EcoBoost V6 with Ti-VCT (RWD/AWD)

**310/295**  
horsepower  
@ 5,000/5,500 rpm

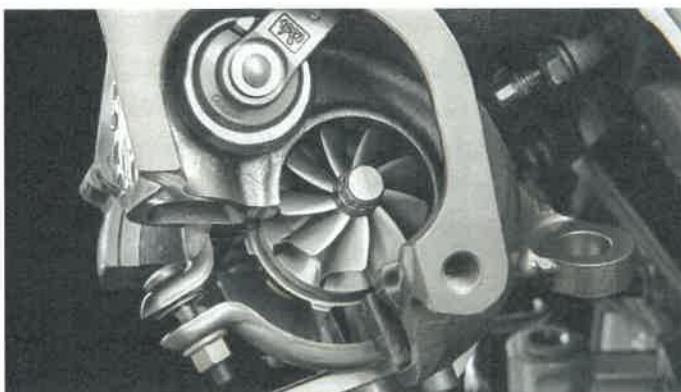
**400/375**  
lb.-ft. of torque  
@ 2,500 rpm

### VALVETRAIN

- Dual overhead camshaft (DOHC), lightweight aluminum cylinder heads with 4 valves per cylinder
  - Roller-finger follower valvetrain
  - Hollow camshafts reduce the weight of the valvetrain
- Twin independent variable camshaft timing (Ti-VCT)
- Uses a timing chain

### DEEP-SUMP OIL PAN

- Die-cast aluminum deep-sump oil pan
  - Optimized oil pan capacity to provide up to 1-year/10,000-mile oil change intervals



### TWIN TURBOCHARGERS

- Parallel dual/twin turbochargers
  - Work seamlessly with Ford-first electrically activated wastegates, enhancing operating efficiency
  - Utilize lightweight turbine wheels to help improve responsiveness
  - Made out of high-temperature super alloy Mar-M-247 developed by the aerospace industry

### INTAKE AND EXHAUST

- Cast exhaust manifolds for heavy-duty operation and durability
- Intake and exhaust camshafts enhanced for improved operating efficiency and performance
- Intercooler reduces incoming air temperature

### TRUCK-SPECIFIC FEATURES

- Twin independent variable camshaft timing (Ti-VCT) for operating efficiency and performance improvement
- Intake and exhaust camshafts enhanced for improved operating efficiency and performance
- Cast exhaust manifolds for heavy-duty operation and durability
- Improved torque capability and durability
- Cooling system enhanced for improved engine coolant flow

### ECOBOOST DURABILITY TESTING

- Extensive durability tests ensure the 3.5L EcoBoost V6 engine can excel in all conditions
- Start-up tests, with a wide variety of fuels, were made in conditions ranging from -40° F to 110° F
- Peak power testing for hundreds of hours to ensure durability and reliability goals

### ENGINE TECHNOLOGIES

- Aggressive deceleration fuel shutoff (ADFSS)
- Auto Start-Stop
- Fail-Safe Engine Cooling System
- Intelligent Oil-Life Monitor
- Smart charging alternator

NOTE: For availability of product features, please see Availability by Model and/or the Dealer Ordering Guide.

# 2020 Transit

2020 Transit > **Performance and Capability** > Gasoline Engine Technologies

## Fail-Safe Engine Cooling System

The Fail-Safe Engine Cooling System is designed to help protect the engine from potential damage due to loss of coolant, allowing the driver to travel a short distance to obtain service or reach a service facility.

### MORE DETAILS

- If the engine overheats, it will switch from normal all-cylinder operation to alternating-cylinder operation
  - The non-powered cylinders act as air pumps to help cool the powered cylinders
- The vehicle will continue to operate, but with limited engine power, and the air conditioning system will be disabled
- Driving distance is limited by a number of factors, including vehicle load, outside temperature and road conditions



**NOTE:** For availability of product features, please see Availability by Model and/or the [Dealer Ordering Guide](#).





**Gateway**



**INTERMOTIVE**  
**VEHICLE**  
**CONTROLS**

An ISO 9001:2015 Registered Company

# Gateway

## High Idle and Shift Interlock System

### Overview

- All-in-one wheelchair interlock and high idle system to ensure full functionality of the vehicle's systems while using the lift
- Provides battery charge protection and improves air conditioning performance
- System is fully compliant with FMVSS 403/404 and the Americans with Disabilities Act (ADA) for wheelchair lift interlocks
- Simple plug and play connections to the OEM chassis

### Features

- Prevents vehicle movement while the lift is in use by locking the shifter in Park
- Monitors OEM sensor inputs from the transmission, engine, charging system and ambient air temperature
- Programmable RPM for high idle
- Prevents driving with the park brake set
- Can provide real-time chassis data
- Diagnostic trouble codes available
- Uses Intermittent Fault Filter™ (IFF) technology to eliminate erroneous lift door signals



*Product features may vary by make, model or year. See instructions for complete details.*

Proudly distributed by

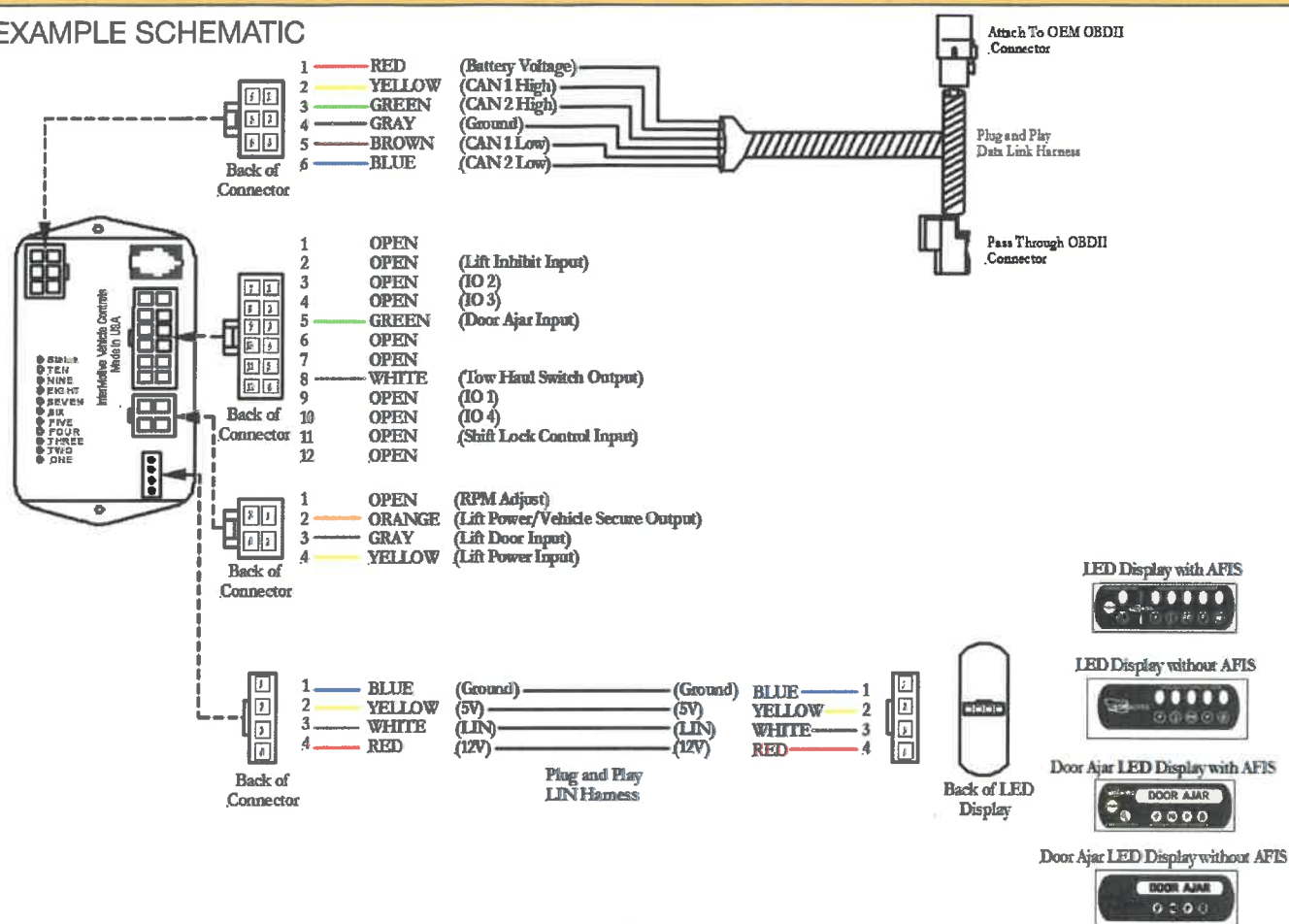
**LGS GROUP**  
AUTOMOTIVE TECHNOLOGIES

**(775) 831-2002**



# Details

## EXAMPLE SCHEMATIC



## SPECIFICATIONS

Number of Inputs

Five inputs (lift inhibit, door ajar, shift lock, lift door and RPM adjust)

Number of Outputs

Four configurable outputs, plus one lift power/vehicle secure output and one tow haul switch output

Current Draw

~120 mA

Quiescent Draw

~2 mA (sleep current)

CAN Speed

High and medium speed

Temperature Range

-40°C to 80°C

Dimensions

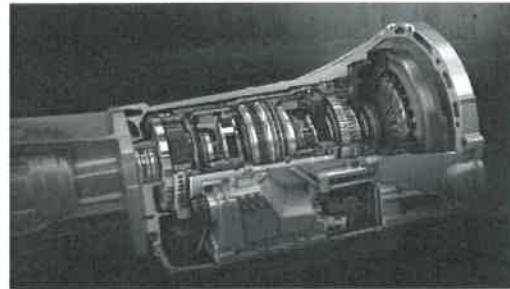
4" L x 2" W x 1" H

# 2020 Transit

## 2020 Transit > Performance and Capability

### 10-Speed Automatic with Selectable Drive Modes

- This transmission is paired with all Transit engines
- Three overdrive gears and a wide 7.4:1 gear ratio span
- Integrated torque converter/turbine clutch helps reduce weight, while also reducing the packaging size of the transmission
- High-speed, one-way clutch helps deliver smooth and responsive shifting
- Engine rpm matching on coast-down shifts provides a seamless transition to lower gears — effective when cornering
- Integrated electric pump works with Auto Start-Stop Technology for seamless restarts
- Ultra-low viscosity transmission fluid and off-axis variable-displacement pump maximize transmission performance
- Utilizes real-time adaptive shift schedule algorithms which monitor more than a dozen powertrain- and driver-control signals to help ensure the transmission is in the right gear at the right time
- Progressive Range Select



#### DRIVE MODES

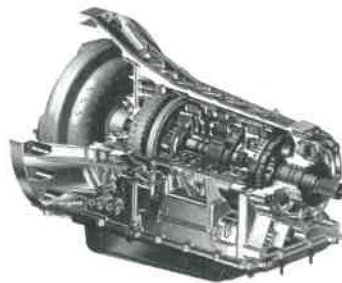
Drive modes change the performance of electronic stability control, traction control, engine throttle response, transmission shifting and steering feel. Select the desired mode using the button on the instrument panel.

- Normal — Balanced combination of comfort and handling for everyday driving
- ECO — Helps deliver enhanced fuel efficiency with trade-offs in performance and comfort
- Slippery — Designed for driving in slippery conditions
- Tow/Haul — Improves transmission operation with trailers and heavy loads, especially over steep grades
- Mud/Ruts — Ideal for muddy or rutted surfaces, such as a rain-soaked job site (All-Wheel Drive only)



#### MAKE THE POINT: SMART SHIFT LOGIC

Customers may notice that an Transit with the 10-speed transmission does not always shift sequentially. For example, the indicator gauge may change from displaying 1st to displaying 3rd. This is because of the smart shift logic with real-time-adaptive shift-scheduling algorithms which monitor more than a dozen powertrain-control and driver-control signals to ensure the right gear at the right time.



**NOTE:** For availability of product features, please see Availability by Model and/or the [Dealer Ordering Guide](#).

#### Feature Resources



VIDEO  
10-speed automatic with SelectShift® capability

# LEADING THE INDUSTRY IN REAR VISION SAFETY



## STSK4750B KIT COMPONENTS:

MONITOR: STSM244

CAMERA: STSC130B

HARNESSES: STSH349 (49FT BLACK), STSH130 (ADAPTER HARNESSES)

Forest River, Inc. bus manufacturing companies will be the industry's first to offer a rear backup safety camera as standard equipment on every bus in 2019... Setting the safety tone and trend in the commercial and school bus market.

Forest River's hard stance on safety with the new 2019 rear backup safety program has selected Rosco Vision Systems in NY as the manufacturers of the STSK4750B backup camera system.



STSM244 MONITOR SPECS		STSC130B CAMERA SPECS	
SCREEN SIZE	7"	TV LINES	420 TVL
RESOLUTION	800*480 pixels	FIELD OF VIEW (DIAGONAL)	150°
MONITOR BRIGHTNESS	700cd/m2	MINIMUM ILLUMINATION	0.2 LUX
NUMBER OF CAMERA INPUTS	1	DUST/WATER RATING	IP69K
INPUT FORMAT	13-pin	POWER SUPPLY	12 Vdc
VIEWING ANGLES	L/75°, R/75°, UP/60°, DOWN/60°	OPERATING TEMPERATURE	-22°F to 140°F -30°C TO 65°C
SHOCK RATING	2G		
VIBRATION RATING	6G		
POWER SUPPLY	12 ~ 32 VDC		
OPERATING TEMPERATURE RANGE	-4°F to 158°F -20°C to 70°C		

**1-800-227-2095**





## **RAIN BOOTH INFORMATION**

Constructed as part of a corporatewide pre-delivery inspection facility, the first over 2000 sqm motorized needle rain booth utilized by Glaval Bus offers exceptional performance in the area of water leak detection.



The motorized needle rain booth adds front end needles to the design of the trailer rain booth simulation. The belt in the booth can rain at 100 mph speeds. The booth includes two 1200 gallon recycling tanks and utilizes a 12" orsepower pump to the multistage filters cascade delivering 40 to 60 gpm of water that equates to 100 gallons per minute. Used throughout the spray leads to the equivalent of a 24 inch per hour downpour.

The needles directed at the roof, side, front and undercarriage of the bus are untouched in our quest for leak elimination. As the velocity and volume in our test procedure ensures our valuable customers that we are doing the utmost to deliver a leak-free product to them.



Customers are always welcome to witness the test process whenever they are in operation.

# 2020 TRANSIT OPTIONAL EQUIPMENT

BODY CODES	Body Type Order Code	CARGO VAN	CREW VAN	PASSENGER VAN XL	PASSENGER VAN XLT	CUTAWAY	CHASSIS CAB
		101A	201A	301A	302A	501A	701A
<b>EXTERIOR (continued)</b>							
★16" Heavy-Duty Forged Aluminum Wheel (Heavy-Duty Front Axle configurations only). Available with Exterior Upgrade Package – DRW (Heavy-Duty Front Axle configurations only) (18L).	76G	P/O	P/O	O	O	P/O	P/O
<b>Wheels – Spare Tire</b>							
Spare Tire and Wheel. Included in the Ambulance Prep Package – Cutaway (47F). <b>Note:</b> Includes 4 ton jack, tool kit and full-size matching tire.	51D	S	S	S	S	O/I	O
Spare Tire and Wheel Delete. Optional on Extended Length only.	51A	O	O	O	O	S	S
<b>Windows (Refer to the Windows Offering Chart on page 21 for complete window details)</b>							
Fixed Rear Cargo Door Glass	17A	O	—	—	—	—	S
Fixed Rear Cargo Door Glass and Fixed Passenger-side Glass.	17B	O	—	—	—	—	—
Fixed Rear Cargo Door Glass and Fixed Driver and Passenger-side Glass. Requires Dual Sliding Side Doors (59B) on Cargo Van.	17D	O	S	—	—	—	—
Windows-All-Around, Fixed. Not available with Dual Sliding Side Doors (59B).	17F	O	—	S	S	—	—
★Egress Window. Only available with Windows-All-Around, Fixed (17F). Requires Privacy Glass (92E). Not available on Low Roof Passenger Vans. <b>Note:</b> Replaces 2 <sup>nd</sup> row Driver-side window.	17L	—	—	O	O	—	—
<b>Glass</b>							
★Safety Glass. Included with Multi-Function School Activity Bus (MFSAB) Prep (47Q) and School Bus Prep (47C) packages. <b>Note:</b> Applies to the front and side windows. Provides additional safety that makes the glass less likely to break, or less likely to pose a threat when broken.	65B	—	—	—	—	O/I	—
High Strength Laminated Glass. Available with Windows-All-Around, Fixed (17F) only. Optional on Medium/High Roof Long Length Cargo Van. Not available on Low Roof or with Dual Sliding Side Doors (59B). <b>Note:</b> High strength laminated glass applies to 2 <sup>nd</sup> -4 <sup>th</sup> row windows	92A	O	—	—	—	—	—
Privacy Glass. Includes Rear-window Defroster (57N). <b>Note:</b> Provides protection of vehicle occupant(s) and occupant personal belongings. The glass also provides occupant comfort by helping to reduce vehicle cool-down time.	92E	O	O	O	O	—	—
Rear-Window Defroster. Requires any window package that includes fixed rear cargo door glass (17A-K).	57N	O	O	O	O	—	—
<b>INTERIOR</b>							
Cruise Control. Includes Adjustable Speed Limiting Device (ASLD). <b>Note:</b> The ASLD feature is great for city driving; it allows the driver to set an upper speed limit for the vehicle. If the vehicle begins to approach the upper speed limit then audible and visual warning are given.	60C	O	O	O	S	O	O
D-Pillar Assist Handles <b>Note:</b> Located on the Driver and Passenger-side. Due to space requirements, the Driver-side handle is deleted if Front/Rear Aux A/C and Heater (Driver controlled) (57G) is also ordered.	66C	O	O	—	—	—	—
Illuminated Sun Visors. Included with Interior Upgrade Package – Cargo Van (96C) and Interior Upgrade Package – Cutaway/Chassis Cab (47A).	85C	O/I	O	O	S	O/I	O/I
Rearview Mirror. Included with rear glass window configurations (17A, 17B, 17D and 17F). Not available with Radio Prep Package (58T) or Rear View Display in Rearview Mirror (61B).	90B	I	S	S	S	O	S
<b>Bulkheads</b>							
★Bulkhead – Lockable Door with Window. Optional only on Medium Roof and High Roof. <b>Note:</b> The bulkhead is located behind the driver and passenger seats in the Cargo Van, and separates them from the cargo area.	47T	O	—	—	—	—	—
★Bulkhead – Window Only. Optional only on Low Roof and Medium Roof.	47U	O	—	—	—	—	—

★ = New for this model year

S = Standard / O = Optional / P = Packaged Option  
F = Fleet Option with valid FIN code / I = Included

# 2020 TRANSIT STANDARD EQUIPMENT

FUNCTIONAL (continued)	CARGO VAN	CREW VAN	PASSENGER VAN XL	PASSENGER VAN XLT	CUTAWAY	CHASSIS CAB
<b>Base Frontal Area Limitation</b> <b>Note:</b> Provides a Vehicle Emission Control Information label with a frontal area restriction up to 72 ft <sup>2</sup> . Frontal area limitation requires second unit body to meet profile restrictions. For additional information please reference the Incomplete Vehicle Manual and SVE Bulletins.	—	—	—	—	•	•
<b>Instrumentation</b>						
Tachometer, Fuel Level and Coolant Temperature	•	•	•	•	•	•
<b>Interior Power</b>						
<b>★PowerPoint – 12V</b> <b>Note:</b> One is located in the instrument panel and one in center console.	•	•	•	•	•	•
<b>★USB Ports – 5 amps</b> <b>Note:</b> Depending on seating configuration, one is located in each of the 2 <sup>nd</sup> row, 3 <sup>rd</sup> row, 4 <sup>th</sup> row and 5 <sup>th</sup> row.	—	—	•	•	—	—
<b>Steering</b>						
<b>★Electric Power Assisted Steering (EPAS)</b>	•	•	•	•	•	•
Steering Wheel – Power Rack and Pinion	•	•	•	•	•	•
Steering Wheel – Tilt and Telescoping	•	•	•	•	•	•
<b>Suspension</b>						
Front – Independent MacPherson-strut, Stabilizer Bar	•	•	•	•	•	•
Rear – Leaf Springs, Heavy-duty Gas Shock Absorbers	•	•	•	•	•	•
<b>SAFETY/SECURITY</b>						
Autolocking Drive Away with Crash Unlocking	•	•	•	•	•	•
AdvanceTrac® w/Roll Stability Control™ (RSC®)	•	•	•	•	•	•
Safety Belts – 3-point, All Positions <b>Note:</b> Belt minder is included on the driver and front passenger seat(s).	•	•	•	•	•	•
SecuriLock® Passive Anti-Theft System (PATS) with engine immobilizer	•	•	•	•	•	•
SOS Post-Crash Alert System™. Not available with Radio Prep Package (58T) and Audio Pack #18 (58U). <b>Note:</b> Automatically flashes the hazard lights and intermittently sounds the horn when the airbag deploys.	•	•	•	•	•	•
Tire Pressure Monitoring System (TPMS). Standard on SRW and DRW configurations.	•	•	•	•	•	•
<b>Airbags</b>						
Driver and Passenger Airbags	•	•	•	•	•	•

## 2020 Transit > Specs > Chassis

### Front/Rear Disc

Type	Series/ Model	Axle Usage (lbs.)	Rotor Dia. (in.)		Brake Lining Segment	Area (sq. in.)/ Width (in.)/ Thickness (in.)	Caliper Piston No. Dia. (in.)	Gross Lining Area Per Axle (sq. in.)	Total Swept Area Per Axle (sq. in.)
			OD	ID					
Front Disc	Cargo Van/Crew Van	All	12.1	6.5	Outboard	8.4/2.3/0.33	2 x 1.89	16.8	163.0
					Inboard	8.4/2.3/0.33	2 x 1.89	16.8	163.0
	Passenger Van	All	12.1	6.5	Outboard	8.4/2.3/0.33	2 x 1.89	16.8	163.0
					Inboard	8.4/2.3/0.33	2 x 1.89	16.8	163.0
	Cutaway/Chassis Cab	All	12.1	6.5	Outboard	8.4/2.3/0.33	2 x 1.89	16.8	163.0
					Inboard	8.4/2.3/0.33	2 x 1.89	16.8	163.0
Rear Disc	Cargo Van/Crew Van	All	12.1	7.9	Outboard	6.0/1.9/0.41	1 x 2.13	12.0	133.0
					Inboard	6.0/1.9/0.41	1 x 2.13	12.0	133.0
	Passenger Van	All	12.1	7.9	Outboard	6.0/1.9/0.41	1 x 2.13	12.0	133.0
					Inboard	6.0/1.9/0.41	1 x 2.13	12.0	133.0
	Cutaway/Chassis Cab	All	12.1	7.9	Outboard	6.0/1.9/0.41	1 x 2.13	12.0	133.0
					Inboard	6.0/1.9/0.41	1 x 2.13	12.0	133.0

## 2020 Transit > Specs > Chassis

### Brake Master Cylinder Specifications

Type	Series/Model	Bore Dia. (in.)	Booster Type
Dual System, Dash-mounted	N/A	1.125	10+10 Tandem

# 2020 TRANSIT STANDARD EQUIPMENT

EXTERIOR (continued)	CARGO VAN	CREW VAN	PASSENGER VAN XL	PASSENGER VAN XLT	CUTAWAY	CHASSIS CAB
205/75R16C 113/111 BSW all-season (AWD, 11,000lb GVWR or RWD with Heavy-Duty Front Axle configurations only)	•	•	•	•	•	•
<b>Towing</b>						
Rear Tow Hook	•	•	•	•	—	—
<b>Wheels – SRW</b>						
16" Silver Steel Wheel with Black Hubcap (Standard Front Axle configurations only)	•	•	•	—	•	•
16" Steel Wheel with Full Silver Wheel Cover (Standard Front Axle configurations only)	—	—	—	•	—	—
16" Silver Steel Wheel with Exposed Lug Nuts (Heavy-Duty Front Axle configurations only)	•	•	•	•	•	•
<b>Wheels – DRW</b>						
16" Heavy-Duty Silver Steel Wheel with Exposed Lug Nuts <b>Note:</b> The center ornament only comes on the front wheels, and not on the rear wheels.	•	•	•	•	•	•
<b>Wheels – Spare Tire</b>						
Full-size Spare Tire and Wheel	•	•	•	•	—	—
<b>Windows/Glass</b>						
Windows All-around	—	—	•	•	—	—
Rear window	—	•	•	•	—	•
No Cargo Area Windows	•	—	—	—	—	—
High-Strength Laminated Glass (Sliding Doors only)	•	•	—	—	—	—
Tinted Glass	•	•	•	•	•	•
<b>INTERIOR</b>						
Cargo Tie-Down Hooks (Regular and Long Length configurations: 8 tie-down hooks; Extended Length: 10 tie-down hooks)	•	•	—	—	—	—
Step Well Pads – Black	•	•	•	•	—	—
<b>Center Console</b>						
★ Medium Center Console <b>Note:</b> Includes an integrated shifter and a dual cup holder	•	•	•	—	•	•
★ Large Center Console <b>Note:</b> Includes an integrated shifter, a dual cup holder and an additional storage area	—	—	—	•	—	—
<b>Door-Locks and Windows</b>						
Glove Box – Locking	•	•	•	•	•	•
Rear Cargo Door – Interior Exit Handle	•	•	—	—	—	—
Rear Cargo Door – Locking	•	•	•	•	—	—
Power Equipment Group (Power Locks and Windows) with Remote Keyless-Entry	•	•	•	•	•	•
<b>Floor Covering</b>						
Vinyl, Front only	•	—	—	—	•	•
Vinyl, Front and Rear	—	•	•	—	—	—
Carpet, Front and Rear	—	—	—	•	—	—
Carpet Floor Mats, Front only	—	—	—	•	—	—
<b>Rearview Mirror</b>						
Rearview Mirror (When Equipped with Rear Glass)	—	•	•	•	—	•
Rearview Mirror Delete (When Equipped Without Rear Glass)	•	—	—	—	•	—
<b>Interior Lighting</b>						



## 2020 Transit

2020 Transit > [Specs](#)

### Standard Equipment

<b>DRIVE:</b>		<b>RWD</b>
<b>Powertrain</b>		Refer to the Ordering Guide for 50 States Usage
Engine	Type	3.5L PFDI V6
Transmission	Type	10-speed automatic overdrive with Selectable Drive Modes
	Speeds	10
<b>Axles</b>		
Rear Axle	Type — Full-floating	Sterling Circular Flange
	Capacity (Rating @ Ground)	Max. — 6,000 lbs. (SRW)/7,275 lbs. (DRW)
<b>Brakes</b>		
Front/Rear Disc	Type	Power disc
	Rotor Diameter — Front/Rear (in.)	12.1/12.1
Power Assist Unit	Type	Vacuum, RSC
	Effective Diameter (in.)	TBD
Anti-Lock Braking System		4-wheel (4-channel); AdvanceTrac with RSC (Roll Stability Control)
Parking Brake (Rear Brakes) (in.)		Rear brake integrated caliper, hand-operated
<b>Electrical</b>		
Alternator	Rating	250-amp, 3,375-watt (V6 engines)
Battery	Type	Maintenance-free
	Rating	70-AH, 610 CCA (3.5L PFDI V6)
Harnesses	Type	TBD
Fuel Tank	Capacity (gal.)	25
Jack	Capacity	TBD
Steering	Type	Electric power-assisted steering
	Ratio	Overall on-center ratio is 19:1 (steering wheel angle to road wheel angle)
<b>Suspension</b>		
Frame	Type	TBD
	Section Modulus (cu. in.)	TBD
Springs, Front	Type	Independent MacPherson-Strut
	Rating @ Ground (min.)	Refer to Weight Ratings for usage and ratings
Springs, Rear	Type	Leaf single stage constant rate
	Rating @ Ground (min.)	Refer to Weight Ratings for usage and ratings
Shock Absorbers	Gas-type (in.)	Heavy-duty (rear)
Stabilizer Bar	Front/Rear (mm)	21/25/25 (solid)/32 (hollow)
Tires	Type/Size	235/65R16C 121/119R BSW (SRW) 195/75R16C 107/105R BSW (DRW) ETRO
	Spare Tire Carrier	Full-size spare tire and wheel
Wheels	Type and Size	16" steel

NOTE: Refer to Weight Ratings for Standard and Available Weight Rating Specifications (GVWR/Payload/Spring and GAWR/Base Curb Weight).



**INTERMOTIVE**  
**VEHICLE**  
**CONTROLS**

An ISO 9001:2015 Registered Company

# FlexTech™

## Programmable Electrical System

### Overview

- Foundation of the system is a Programmable Relay Power Center
- Can add optional modules to create an entire custom control system
- Connects electronic modules through the overall vehicle network, reducing the need for wiring
- Uses real-time chassis data to control loads
- Simple plug and play connections to the OEM chassis

### Features

- Centralizes and improves diagnostic capabilities; eliminates the need for timers, flashers, latching relays and multi-relay logic
- Access to InterMotive's graphical interface allows for customization of the entire system
- Communicates with Ford and Chevy CAN as well as J1939
- Warning LEDs for easy troubleshooting



Watch  
FlexTech  
in action

*Product features may vary by make,  
model or year. See instructions  
for complete details.*



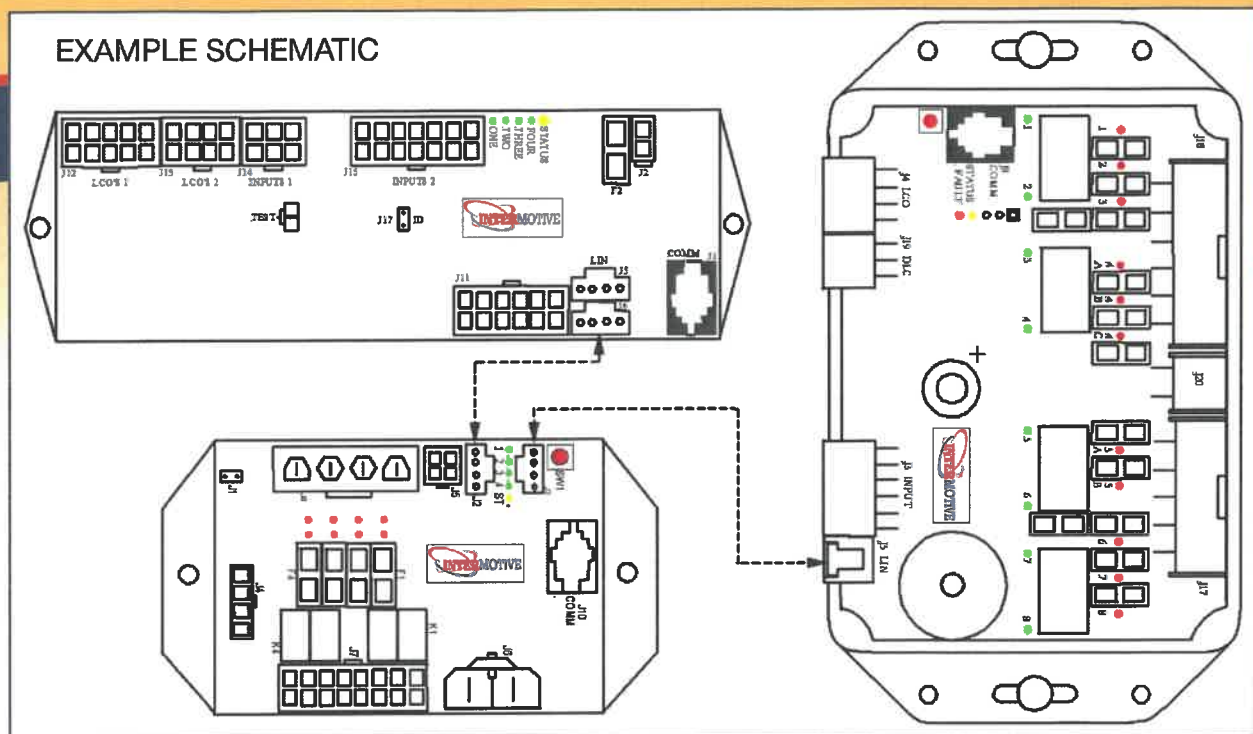
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# Details

## EXAMPLE SCHEMATIC



## COMPONENTS

### Programmable Relay Power Board (PRPC)

- Eight programmable relay power outputs
- Ten separate digital inputs
- Eight programmable low-current outputs: Seven sourcing (0.5 A), one sinking (0.5 A)
- Outputs can be configured as momentary, latching, flashing or timed
- Easy diagnostics with LED indicators
- Programmable audible patterns for multiple uses

### Expansion Board (Optional)

- Four 10 A relay fused outputs
- Four 1 A low-current outputs
- Four active low outputs
- Loads controlled by the PRPC

### Switch Backer Board (Optional)

- Controls system inputs and outputs
- Eight switches and eight light outputs
- Two switch backer boards can be used together
- Six outputs: Two 1 A and four 0.5 A
- Compatible with any brand of switches

### Other Module Options

- Gateway: Compliant FMVVS 403/404 wheelchair interlock and high idle system
- Advanced Fast Idle System (AFIS): Adjustable system with battery charge protection and optional air conditioning auto trigger
- BrakeMax: Tow haul mode for reduced brake wear

# 2020 Transit

[2020 Transit > Specs](#)

## Standard Equipment

<b>Powertrain</b>		Refer to the Ordering Guide for 50 States Usage
Engine	Type	3.5L PFDI V6
Transmission	Type	10-speed automatic overdrive with Selectable Drive Modes
	Speeds	10
<b>Axles</b>		
Rear Axle	Type — Full-floating	Sterling Circular Flange
	Capacity (Rating @ Ground)	Max. — 6,000 lbs. (SRW)/7,275 lbs. (DRW)
<b>Brakes</b>		
Front/Rear Disc	Type	Power disc
	Rotor Diameter — Front/Rear (in.)	12.1/12.1
Power Assist Unit	Type	Vacuum, RSC
	Effective Diameter (in.)	TBD
Anti-Lock Braking System		4-wheel (4-channel); AdvanceTrac with RSC (Roll Stability Control)
Parking Brake (Rear Brakes) (in.)		Rear brake integrated caliper, hand-operated
<b>Electrical</b>		
Alternator	Rating	250-amp, 3,375-watt (V6 engines)
Battery	Type	Maintenance-free
	Rating	70-AH, 610 CCA (3.5L PFDI V6)
Harnesses	Type	TBD
Fuel Tank	Capacity (gal.)	25
Jack	Capacity	TBD
Steering	Type	Electric power-assisted steering
	Ratio	Overall on-center ratio is 19:1 (steering wheel angle to road wheel angle)
<b>Supporting</b>		
<b>DRIVE: RWD</b>		
Frame	Type	TBD
	Section Modulus (cu. in.)	TBD
Springs, Front	Type	Independent MacPherson-Strut
	Rating @ Ground (min.)	Refer to Weight Ratings for usage and ratings
Springs, Rear	Type	Leaf single stage constant rate
	Rating @ Ground (min.)	Refer to Weight Ratings for usage and ratings
Shock Absorbers	Gas-type (in.)	Heavy-duty (rear)
Stabilizer Bar	Front/Rear (mm)	21/25/25 (solid)/32 (hollow)
Tires	Type/Size	235/65R16C 121/119R BSW (SRW) 195/75R16C 107/105R BSW (DRW) ETRO
	Spare Tire Carrier	Full-size spare tire and wheel
Wheels	Type and Size	16" steel

NOTE: Refer to Weight Ratings for Standard and Available Weight Rating Specifications (GVWR/Payload/Spring and GAWR/Base Curb Weight).

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## Battery Applications

Ampere-Hour (AH) Rating	70	70
Cold-Cranking Amps (CCA) at 0°F	610	760
<b>Transit</b>		
3.5L EcoBoost V6	Std.	Opt. <sup>(1)(2)</sup>
3.5L PFDI V6	Std. <sup>(2)</sup>	Opt. <sup>(1)(2)</sup>

(1) Dual batteries — 1520 CCA.

(2) Absorbent Glass Mat (AGM) battery.

## Cold Weather Recommendations

Minimum Temperature	Equipment	
	HD Battery	Engine Block Heater
0° F	Suggested	Not Needed
-10° F	Recommended	Suggested
-20° F	Recommended	Recommended
Below -20° F	Strongly Recommended	Strongly Recommended

### DEFINITIONS

**Suggested:** Helpful, but not needed.

**Recommended:** Could improve reliability in less-than-ideal conditions.

**Strongly Recommended:** Will give definite improvement over the standard components.

**HD Battery:** Higher-capacity battery available. (Usage varies by model.)

**Engine Block Heater:** Available equipment for all engines. (Usage and heater capacity vary with engine requirements.)

07/01/20

# 2020 TRANSIT OPTIONAL EQUIPMENT

PROPRIETARY

BODY CODES	Body Type Order Code	CARGO VAN 101A	CREW VAN 201A	PASSENGER VAN XL 301A	PASSENGER VAN XLT 302A	CUTAWAY 501A	CHASSIS CAB 701A
<b>FUNCTIONAL (continued)</b>							
Audio Pack #19 – AM/FM stereo, Bluetooth, Dual USB ports, SYNC 3 and a 4.0" multi-function display. Audio Pack #19 is optional on Cargo Van, Crew Van and Passenger Van XL when Rear View Camera with Trailer Hitch Assist is selected. And is optional on Cutaway and Chassis Cab when No Rear View Camera or Rear View Camera and Prep Kit (61A) is selected. – 4 speakers (4 front) – Cargo Van, Crew Van, Cutaway and Chassis Cab – 8 speakers (4 front/4 rear) – Passenger Van XL and Passenger Van XLT	58V	O	O	O	S	O	O
Audio Pack #20 – AM/FM stereo with HD/SiriusXM® capability, Bluetooth, Dual USB ports, SYNC 3 and a 4.0" multi-function display. Audio Pack #20 is optional on Cargo Van, Crew Van, Passenger Van XL and Passenger Van XLT when Rear View Camera with Trailer Hitch Assist is selected. And is optional on Cutaway and Chassis Cab when No Rear View Camera or Rear View Camera and Prep Kit (61A) is selected. – 4 speakers (4 front) – Cargo Van, Crew Van, Cutaway and Chassis Cab – 8 speakers (4 front/4 rear) – Passenger Van XL and Passenger Van XLT	58W	O	O	O	O	O	O
Audio Pack #21 – AM/FM stereo, Bluetooth, audio input jack, Dual USB ports, SYNC 3 and a 8.0" colored multi-function touch screen. Audio Pack #21 is optional on Cargo Van, Crew Van, Passenger Van XL and Passenger Van XLT when Rear View Camera with Trailer Hitch Assist is selected. And is optional on Cutaway and Chassis Cab when No Rear View Camera or Rear View Camera and Prep Kit (61A) is selected. Audio Pack #21 is included with Front and Rear Split-View Camera (61D). – 4 speakers (4 front) – Cargo Van, Crew Van, Cutaway and Chassis Cab – 8 speakers (4 front/4 rear) – Passenger Van XL and Passenger Van XLT	58X	I/O	I/O	I/O	I/O	I/O	I/O
Audio Pack #22 – AM/FM stereo with HD/SiriusXM® capability, Bluetooth, audio input jack, Dual USB ports, SYNC 3 and a 8.0" colored multi-function touch screen. Audio Pack #22 is optional on Cargo Van, Crew Van, Passenger Van XL and Passenger Van XLT when Rear View Camera with Trailer Hitch Assist is selected. And is optional on Cutaway and Chassis Cab when No Rear View Camera or Rear View Camera and Prep Kit (61A) is selected. Audio Pack #22 is available with Front and Rear Split-View Camera (61D). – 4 speakers (4 front) – Cargo Van, Crew Van, Cutaway and Chassis Cab – 8 speakers (4 front/4 rear) – Passenger Van XL and Passenger Van XLT	58Y	P/O	P/O	P/O	P/O	P/O	P/O
Audio Pack #28 – AM/FM stereo with HD/SiriusXM® capability, Bluetooth, audio input jack, Dual USB ports, SYNC 3 and a 8.0" colored multi-function touch screen with Navigation. Audio Pack #28 is optional on Cargo Van, Crew Van, Passenger Van XL and Passenger Van XLT when Rear View Camera with Trailer Hitch Assist is selected. And is optional on Cutaway and Chassis Cab when No Rear View Camera or Rear View Camera and Prep Kit (61A) is selected. Audio Pack #28 is available with Front and Rear Split-View Camera (61D). – 4 speakers (4 front) – Cargo Van, Crew Van, Cutaway and Chassis Cab – 8 speakers (4 front/4 rear) – Passenger Van XL and Passenger Van XLT	584	P/O	P/O	P/O	P/O	P/O	P/O

★ = New for this model year

S = Standard / O = Optional / P = Packaged Option  
F = Fleet Option with valid FIN code / I = Included





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January 9, 2012

## Door Actuator Specifications

- Actuator built on rugged 11 gauge steel case plate and powder coated for superior corrosion protection.
- Precision machined gear set for smooth operation.
- Proprietary 12 VDC drive motor.
- All bearing surfaces fitted with thermally-treated bronze bushings.
- The interconnect bushing rods are turn-buckle style for ease of adjustment. Adjustment almost never needed after proper installation.
- The motor control PCB is made using solid state microcontroller technology for long service potential.
- Motor control PCB uses current sensing to turn motor when the door reaches the closed position. The use of a closed limit switch is not used. Additionally, the system will also shut down in the event of an object blocking the doors from opening to eliminate undue motor wear.
- The motor control PCB has an adjustment for changing the set point limit to accommodate different load requirements depending on installation requirements.
- The autoreverse model feels an object in the doorway while the door is closing and will automatically reopen the doors preventing damage and injury.
- System is low maintenance once installed and properly adjusted with hundreds of thousands of cycle potential.
- Key components are easily accessible for ease of maintenance.
- AM Systems Inc offers web-based service aids and information for access to the latest service information and parts available.



The following information is submitted for all Glaval Bus products proposed on MID OHIO VALLEY TRANSIT AUTHORITY RFP20-366 as supporting documentation of the structural soundness and impact resistance of the bodies manufactured. All vehicles are built using virtually the same materials with some minor differences in the height and width of cross members due to entry floor heights and/or body width variations.

A representative set of construction prints provided by engineering supplements this verbal accounting of our materials and assembly specifications.

If, in the reviewing of these written technical specifications and engineering frame prints submitted any questions arise, please contact us immediately for any clarification or help in interpretation and understanding.

### **3.0 Body Construction – General Frame Construction**

Manufactured from all galvanized steel products, the floor, roof, side walls, rear wall, driver halo assembly and entry door assembly are all wire welded (MIG) together to form an integral galvanized steel frame that is mounted with specified hardware to the rubber body mount points (pucks) supplied by the chassis manufacturer. Once joined to the chassis, the bus finishing process begins.

#### **3.0.1 Floor frame construction and assembly –**

- 3.0.1.1 Cross Members -- The floor cross members form the base structural support for the rest of the frame components. Our cross members are constructed of 14 gauge galvanized steel, formed to a capital “C” shape. Cross members over the fuel tank are made to provide the clearance needed to conform with FMVSS301, and include formed internal reinforcements welded in place for additional strength. All additional longitudinal and latitudinal structure is flush welded in place to form a one piece floor upon completion.
- 3.0.1.2 Galvanized steel “Hat Posts” – 1”x1”x4” run the length of the floor between cross members and are welded into place. This extremely strong form is used to weld our HSLA steel seat track in place.
- 3.0.1.3 Galvanized steel C Channel – 1”x1.5” C channel is welded in between cross members the full length of the floor in 5 places. Coupled with the Hat Posts this provides a one-piece strong “ladder” type frame for the flooring.
- 3.0.1.4 Seat Track – 12 gauge roll formed high strength/low alloy steel is wire welded in place for seat mounting down each side of the bus, with lengths predicated on the floor plan chosen. This is yet another stiffener in our extensive construction process.





- 3.0.1.5 Wheel Wells -- Constructed of 14 gauge galvanized steel, wheel wells are also welded in during the floor construction process. All seams in the wheel well are welded to create a one piece water resistant wheel housing structure. The wheel wells also provide additional strength to the body assembly, when welded in place.
- 3.0.1.6 Structural Galvanized steel Angle – 1/8" thick 1.5" x 2.5" structural galvanized steel angle is used the full perimeter length of each floor assembly, welded to the ends of all floor cross members. This provides not only a flat plane for joining the sidewall assembly, but also ties all cross members together and provides additional side impact resistance.
- 3.0.1.7 Additional structure – When adding vertical stanchions, wheel chair lifts and/or tie down options, additional structure is welded into the floor at locations specified by our engineering department on CAD drawings.

### **3.0.2 Sidewall Construction –**

- 3.0.2.1 Sidewall vertical member – The heart of our sidewall is the vertical structure, a roll formed 18 gauge galvanized steel 1.5" x 2" tube that provides strength and rigidity. The vertical member is installed in full lengths and in shorter sections below window frames. Additional vertical structure is used at both ends of the sidewall enabling the structure to withstand the forces applied by the vehicle when in motion.
- 3.0.2.2 Galvanized steel Tubing – 1.5"x1" lower and 1.5"x3" upper 16 gauge galvanized steel tubing is welded in horizontally between vertical members to frame in window openings. This adds front to rear reinforcement as well.
- 3.0.2.3 Seat Track – 12 gauge high strength/low alloy roll formed galvanized steel track is welded down each sidewall below the window frame. While serving as a seat attaching device, it adds excellent structure to the sidewall and also adds excellent side impact resistance.
- 3.0.2.4 Wheelchair Options – Add another layer of metal. Depending on track locations, another structure of 11 gauge thick galvanized steel is welded in place between each vertical member for attaching a shoulder belt mount. Also, additional structure is added to accommodate wheelchair door frames – either 1.5"x1" or 1.5"x2" 16 gauge wall galvanized steel tubing..
- 3.0.2.5 Full length galvanized steel tubing – 1.5"x1" 16 gauge galvanized steel tubing is stitch welded to the sidewall bottom and top at each vertical member for attaching to the floor and roof sections, respectively.

### **3.0.3 Rear Wall Construction –**

- 3.0.3.1 Rear wall vertical member – The vertical sidewall 1.5"x 2" galvanized steel tube is also used in the rear wall assembly. Full length structure is used at varying places,



depending on choice of rear window, or rear door. Shorter cut pieces are used above windows and doors. Additional side windows used with the rear door also change the configuration.

3.0.3.2 Galvanized steel Tubing – 1.5"x1" 16 gauge aluminized steel tubing is welded horizontally between vertical members to provide a window frame in the standard product, and used as an upper door frame in the optional rear assembly.

3.0.3.3 Full length galvanized steel tubing – 1.5"x1" 16 gauge galvanized steel tubing is stitch welded to the rear wall top and bottom as in the sidewall

#### assembly. **3.0.4 Roof Construction –**

3.0.4.1 Roof Bows – Radius formed one-piece 16 gauge galvanized steel roof bows formed as a modified hat post design with eight bends for exceptional strength and located on 16" centers (the closest in the industry), including 4 bends in the web that allows for the roof structure to be capable of taking severe loads. They are then capped with top flat pieces from flange to flange to provide abundant surface area for securing the exterior roof material.

3.0.4.2 Galvanized steel Tubing – 1.5"x1" 16 gauge aluminized steel tubing is welded in horizontally to frame all lower window openings and 1.5" x 3" 16 gauge galvanized steel tubing to all upper window openings as required. A full perimeter is also welded on to mate the roof to the sidewall and rear wall, with short vertical pieces providing support on the front and rear ends. The 3" wide galvanized steel tube supplies a structural mounting surface for shoulder belt attachment and has been pull tested to federal standards.

#### **3.0.5 Driver Compartment Overhead Halo –**

3.0.5.1 Galvanized steel Tubing – 1"x1" 16 gauge galvanized steel tubing is cut and jig welded into an integrated one piece structure spanning from the front roof bow of the body to the newly cut roof line of the cab. Also created during the structure manufacture is the housing for mounting the electronic circuit board.

3.0.5.2 11 Gauge Galvanized steel – formed to make brackets used to mount to the chassis roof.

#### **3.0.6 False Floor (Cab to body transition) –**

3.0.6.1 Galvanized steel Tubing – 2" x 2" 16 gauge galvanized steel tubing is welded together forming a flat body floor transition from the step area back to the actual body area. An overhang on the curbside provides a secure attach point frontally for the entry door frame added later.

3.0.6.2 Structural galvanized steel angle – 11 gauge 1.5"x1.5" structural angle is added in short lengths five places to provide attachment points to the chassis floor.



### **3.0.7 Interior Vertical Transition Frames –**

3.0.7.1 Galvanized steel Tubing – 1"x1" 16 gauge galvanized steel tubing is used vertically and a ladder type assembly is made welding the 1x 1 tube to .75"x.75" 11 gauge galvanized steel tube that is used horizontally in the assemblies. These pieces transition from the body fronts on each side to the driver halo side assembly and the entry door frame assembly on the curbside.

### **3.0.8 Entry Door & Step Assembly Frame –**

3.0.8.1 Galvanized steel Tubing – 1"x1" 16 gauge and .75"x.75" 11 gauge galvanized steel tube is cut to length and welded together in a ladder type construction forming a rigid frame for attaching the entry door/step assembly.

### **3.0.9 Entry Door/Step Assembly –**

3.0.9.1 11 Gauge Galvanized steel – The step riser/tread piece is manufactured from one-piece 11 gauge galvanized steel and uses 90° bends at all risers and treads. The bottom tread also adds an additional 90° bend for additional strength and safety. Upper and lower side pieces are then attached and an 11 gauge flat plate with holes is used to bridge the lower and upper side pieces, then is stitch welded and plug welded to form a strong one piece assembly prior to inserting and welding to the entry step framing.

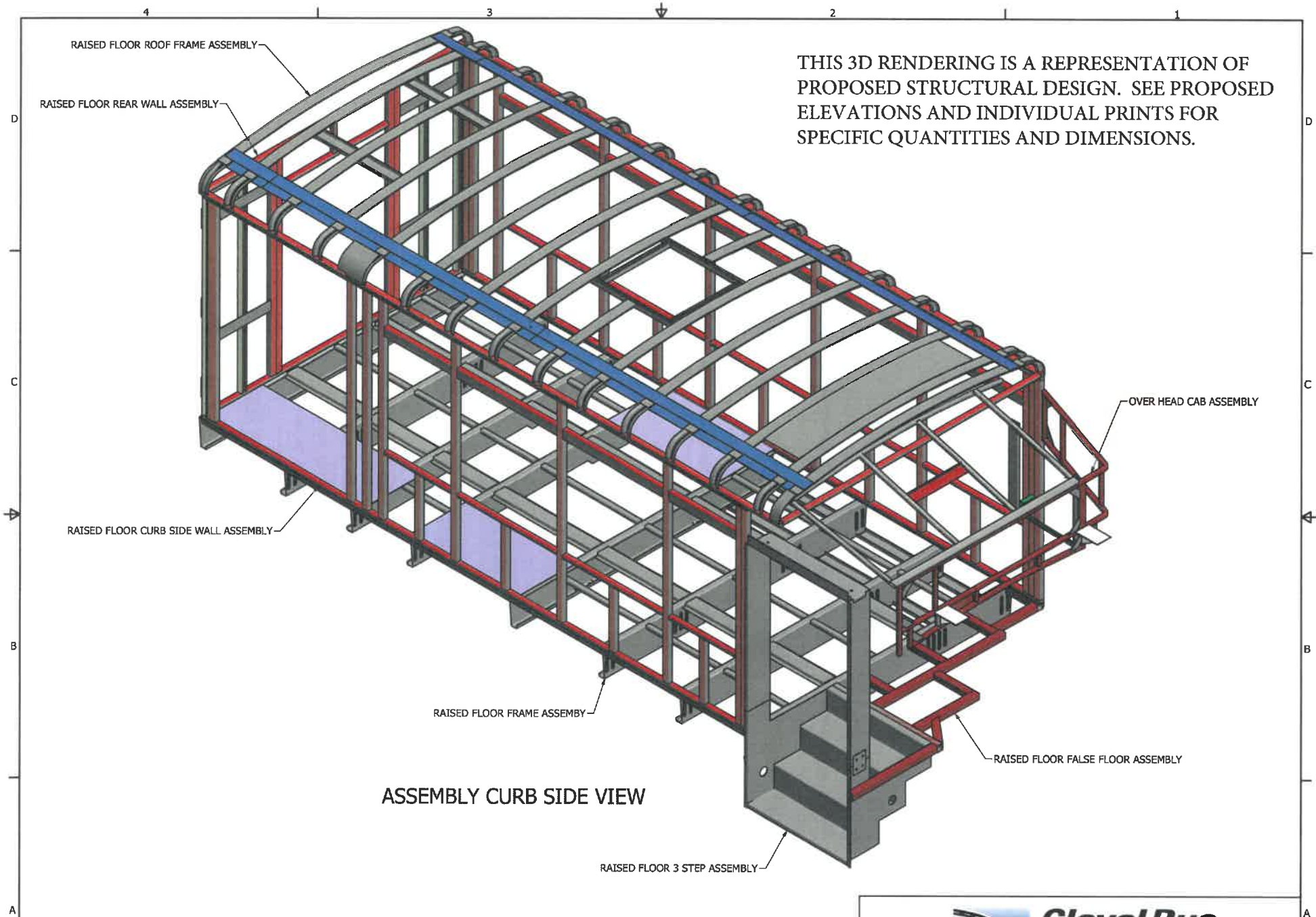
## **APPLICATION OF EXTERIOR SIDEWALL MATERIAL**

### **GALVANIZED STEEL SIDEWALLS OR OPTIONAL FIBERGLASS/FRP/COMPOSITE SIDEWALLS**

The exterior is .024" galvanized steel pre-painted white with an underlayment of 5/32" luan. The interior is 5/32" luan covered with a light gray FRP or padded vinyl. The foam filled galvanized steel cage is placed in the center and all layers are adhered using a cross linked polyurethane hot melt adhesive. The entire assembly is then laminated to assure adhesion.

Composite FRP exterior sidewall panels are installed using the same method.

Should any further questions arise, please contact your Glaval Bus representative.



THIS 3D RENDERING IS A REPRESENTATION OF PROPOSED STRUCTURAL DESIGN. SEE PROPOSED ELEVATIONS AND INDIVIDUAL PRINTS FOR SPECIFIC QUANTITIES AND DIMENSIONS.

ASSEMBLY CURB SIDE VIEW

\*\*\*ALL MATERIALS GALVANIZED\*\*\*

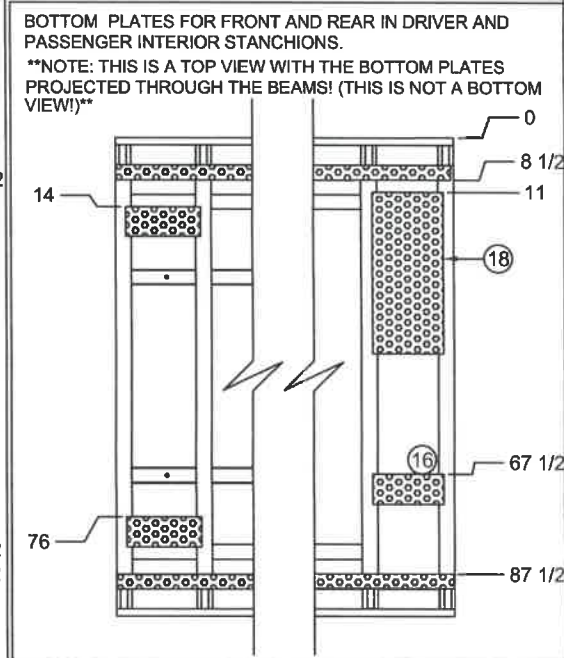
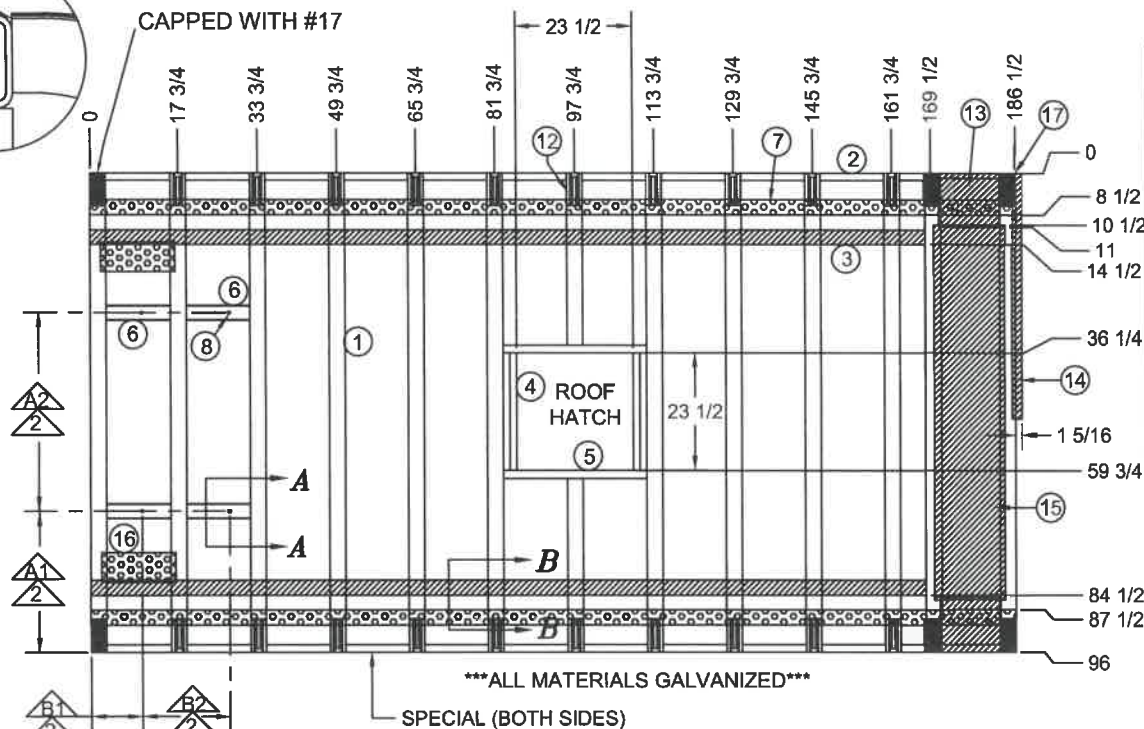
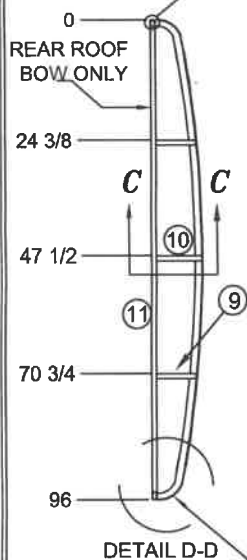
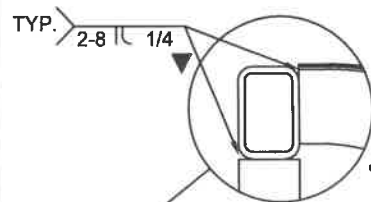
REVISION HISTORY				
ZONE	REV	DESCRIPTION	DATE	APPROVED
BUS	A	REPLACED WALL BOWS WITH TUBE	6/13/2018	TAS

DFTSN: <b>TAS</b>		TITLE: Ford Step Entry Raised Floor Assembly	
DATE: <b>08/27/13</b>	DWG NO: <b>84156B-2</b>	SHEET <b>1</b> OF <b>1</b>	



**USAGE: 2011 ALLSTAR, FORD MODEL 24**

**FRONT**



**NOTES:**

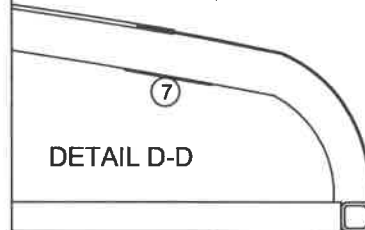
- 1- DRAWING VIEWED FROM EXTERIOR SIDE OF UNIT.
- 2- A/C BOLT PATTREN MAY VERY SEE SALES ORDER.
- 3- BEFORE CUT ROOF HATCH SEE SALES ORDER.
- 4- SCREW LOCATION AT SEAMS AND EDGES 8" ON CENTER  
ALL OTHER LOCATION 16" ON CENTER.
- 5- SEALANT USAGE: 1/4" MINIMUM 3/8" MAXIMUM BEAD ON ALL  
ROOF FRAME TO LUAN SURFACES.

16GA. PLATE WRAPPED AROUND RADIUS OF THE ROOF FOR ADDED SUPPORT REQUESTED BY CALTRANS FOR FUTURE UNITS.

\*\*\*ALL MATERIALS GALVANIZED\*\*\*

- SPECIAL (BOTH SIDES)

SHADED AREA SHOWS 16GA. PLATE FORMED AROUND THE RADIUS OF THE ROOF. (APPLIES TO 13, 14, AND 17)\*\*



5	2	70009047	"C" CHANNEL: 16ga. x 1-3/8" x 1-3/8" x 30-1/2" Lg.	10	1		TUBE: 16ga. x 1" x 1" x 8-1/2" Lg. A-513
4	2	70009047	"C" CHANNEL: 16ga. x 1-3/8" x 1-3/8" x 24-1/4" Lg.	9	2		TUBE: 16ga. x 1" x 1" x 8-1/2" Lg. A-513
3	2		SHEET STEEL: 16ga. x 3" x 168-1/2" Lg.	8	4		BOLT: 3/8-16 x 3" Lg. HEX HEAD
2	2		TUBE: 16ga. x 1" x 1.5" x 186-1/2" Lg. A-513	7	2		SHEET STEEL: 16ga. x 3" x 186-1/2" Lg.
1	12	02062357	ROOF BOW W/CAP 16ga. x 3-3/16 x 96" Lg.	6	4	70009046	"C" CHANNEL: 16ga. x 1" x 3-1/2" x 14-1/2" Lg.
REF. No.	QTY.	PART No.	MATERIAL DESCRIPTION	REF. No.	QTY.	PART No.	MATERIAL DESCRIPTION

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REV  
LET

DESCRIPTION OF CHANGE

BY

CHK

DATE \_\_\_\_\_

ECN No.

TOLERANCE UNLESS  
OTHERWISE SPECIFIED

WOOD

1185
1185

± 1/8"	
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 $\pm 1^\circ$ 
**Glaval Bus**

*a division of Forest River, Inc.*

DATE: 06/11/18

3 TITLE: 158" WHEEL BASE MODEL 24

NAME- MKLINE

ROOF FRAME, STD. ROOF, SINGLE HATCH

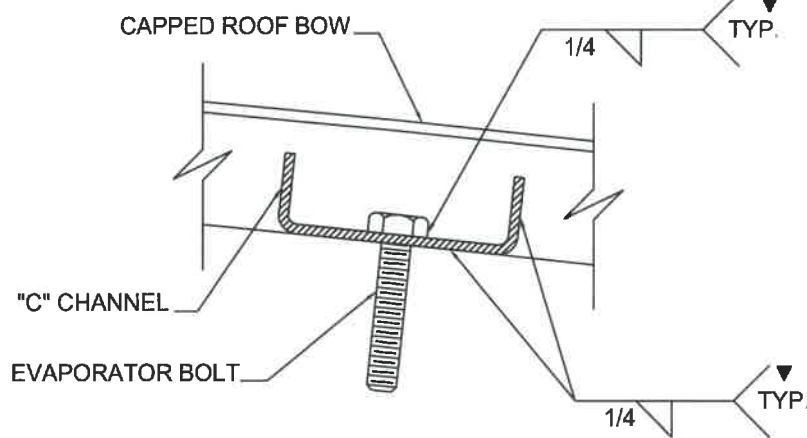
NAME: WIRELINE

2015-10-20

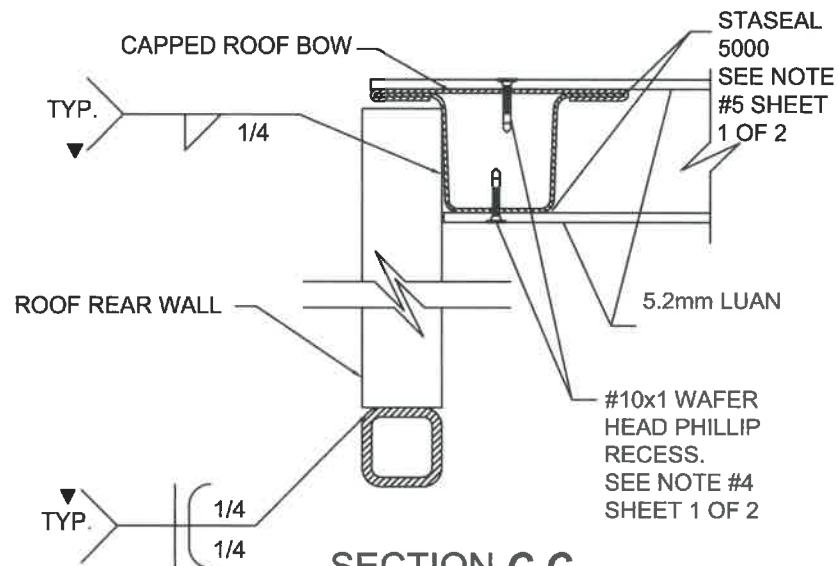
DWG. No.

32-13-0017-18

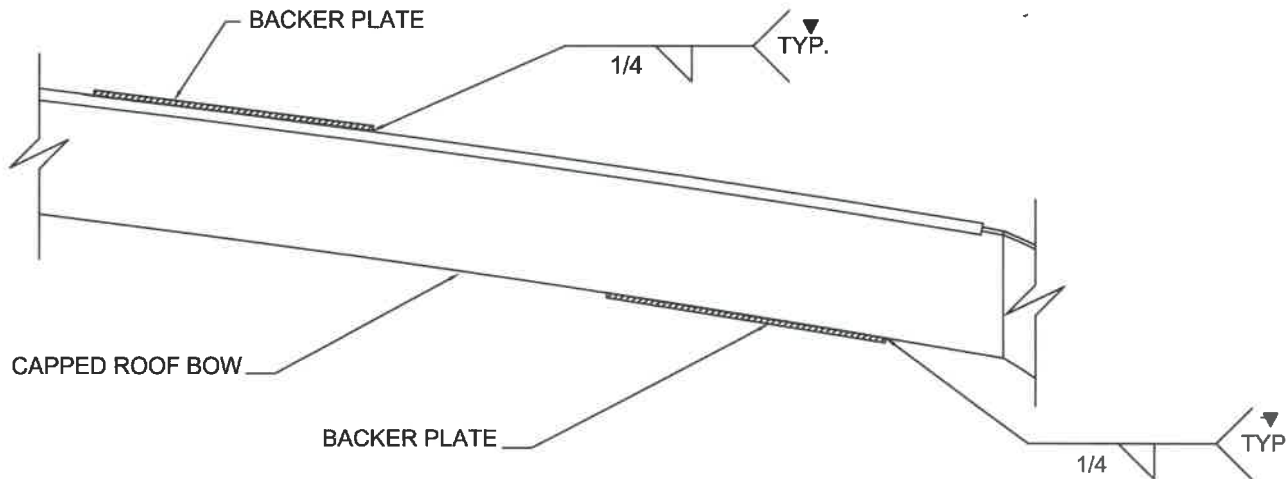
▼ CRITICAL CONTROL ITEM



SECTION A-A



SECTION C-C



SECTION B-B

T/A-71 NEW STYLE	33-5/8	30	10	12-1/4
ACC 23022 SERIES	38	20	10	14-3/4
ACC 23023 SERIES	33-5/8	28-3/4	10	14-3/4
T/A-77	18-1/4	59-1/2	10	10-3/8
T/A-73	28-1/4	39-1/2	10	9-1/2
T/A-71 OLD STYLE	33-5/8	28-3/4	10	12-1/4
T/A-70	36-3/4	22-1/2	10	11-5/8
T/A-30	31	34	10	9-1/2
EM-14 & RE-29	30-3/4	34-1/2	10	9-1/2
EM-6 & RE-10	36	24	10	9-1/2
EM-3 & RE-30	28-1/4	39-1/2	10	16
RE-15 & RE-20	28-1/4	39-1/2	10	9-1/2
EM-1 & EM-2	28-1/4	39-1/2	10	9-1/2
EM-7 GEN 5	36-1/8	23-3/4	10	9-1/2
EM-2 GEN 5	32-3/8	31-1/16	10	9-1/2
EM-1 GEN 5	28-3/16	39-5/8	10	9-1/2
EVAPORATOR MODEL	A-1	A-2	B-1	B-2

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REV	DESCRIPTION OF CHANGE	BY	CHK	DATE	ECN No.
LET.					

TOLERANCE UNLESS OTHERWISE SPECIFIED	WOOD	OTHER	DATE: 06/11/18	TITLE: 158" WHEEL BASE MODEL 24
	± 1/8"	± 1/16"	NAME: MKLINE	ROOF FRAME, DETAILS SINGLE HATCH
	± 1"	± 1/2"	DWG. No.	32-13-0017-18

**Glaval Bus** a division of Forest River, Inc.

**USAGE: 2011, FORD 158" WHEEL BASE, MODEL 24, 42" ENTRYWAY**



- 1- DRAWING VIEWED FROM INTERIOR SIDE OF UNIT.
-  2- LOCATION OF A/C BRACKETS: ONE MOUNT FLUSH WITH OUTSIDE EDGE OF CROSSMEMBER. THE OTHER MOUNTS 14-3/4" FROM OUTSIDE EDGE OF CROSSMEMBER.
- 3- SEE SHEET 2 OF 2 FOR DETAILS, TORQUE SPECIFICATIONS, SECTION VIEWS AND CUT LIST.

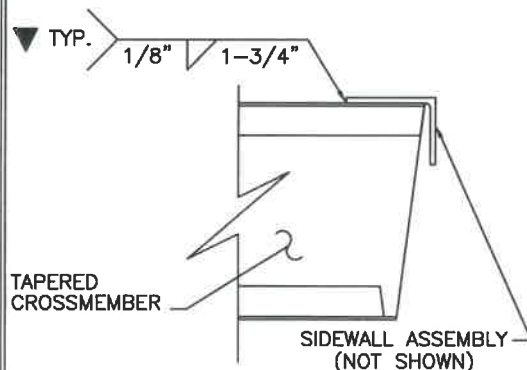
7	2	71002066	SHEET STEEL: 11ga. x 24" x 39-1/4" Lg. HRS
6	1		"U" CHANNEL: 16ga. 1" x 2" x 1" x 35-5/8" Lg.
5	2	70009046	"C" CHANNEL: 12ga. x 1" x 3-1/2" x 30" Lg.
4	2		"C" CHANNEL: 16ga. 1" x 1-1/2" x 1" x 30" Lg.
3	2	32-32-0060-11	HAT CHANNEL: 16ga. x 1" x 6-5/16" x 30" Lg. A-513
2	2		"C" CHANNEL: 12ga. x 1" x 3-1/2" x 26-1/2" Lg.
1	5	71009018	14ga. x 2 x 9-11/16 x 95-1/2 CROSSMEMBER A-365
REF. No.	QTY.	PART No.	MATERIAL DESCRIPTION

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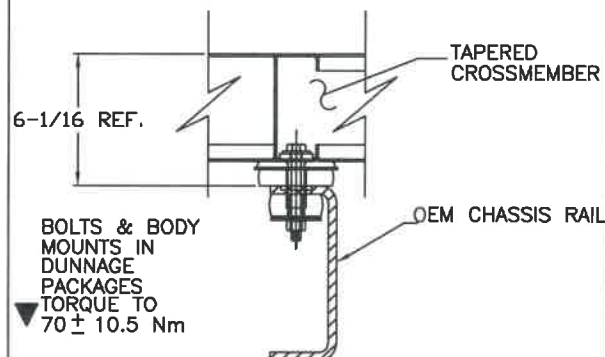
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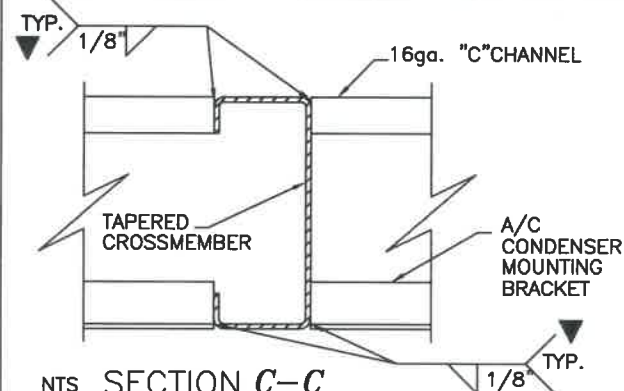
▼ CRITICAL CONTROL ITEM



NTS SECTION A-A



NTS SECTION B-B

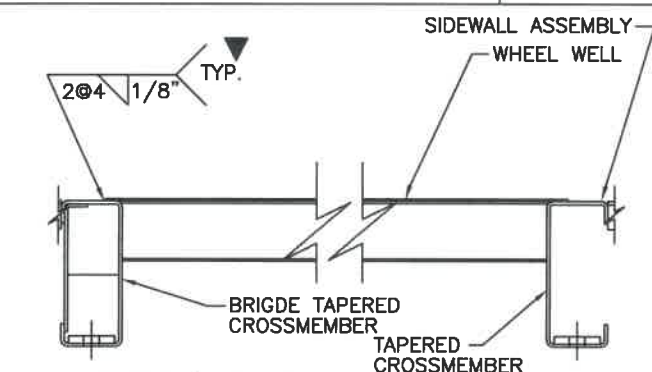


NTS SECTION C-C

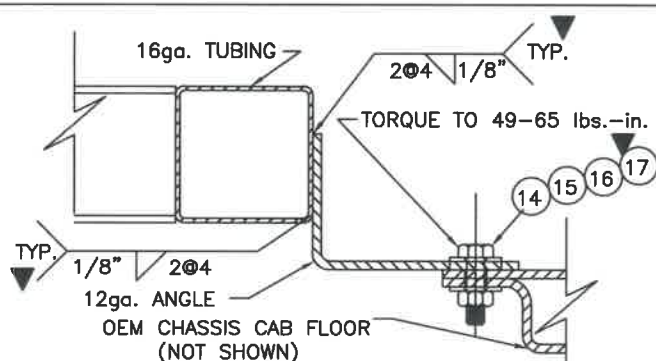
\*\*\*ALL GALVANIZED\*\*\*

29	1		14ga. x 2 x 9-11/16 x 68-1/2 CROSSMEMBER A-365
28	2		PLATE: 11ga. 20" x 64" Lg.
27	2	71002028	TUBE: 16ga. x 1-1/2" x 1-1/2" x 35-5/8" Lg. A-513
26	1		"U" CHANNEL: 16ga. 1" x 2" x 1" x 26-1/2" Lg.
25	1		"U" CHANNEL: 16ga. 1" x 2" x 1" x 30" Lg.
24	1		"U" CHANNEL: 16ga. 1" x 2" x 1" x 22-3/8" Lg.
23	1		"U" CHANNEL: 16ga. 1" x 2" x 1" x 20-7/8" Lg.
22	2	32-32-0060-11	HAT CHANNEL: 16ga. x 1" x 6-5/16" x 20-7/8" Lg. A-513
21	2	32-32-0060-11	HAT CHANNEL: 16ga. x 1" x 6-5/16" x 35-5/8" Lg. A-513
20	2	32-32-0060-11	HAT CHANNEL: 16ga. x 1" x 6-5/16" x 26-1/2" Lg. A-513
19	2		"C" CHANNEL: 16ga. 1" x 1-1/2" x 1" x 26-1/2" Lg.
18	1		"U" CHANNEL: 16ga. 1" x 2" x 1" x 19-3/4" Lg.
17	7	80052007	NUT, HEX HEAD 3/8-16 UNC GRADE 5 ZINC
16	7	80042015	WASHER MED LOCK 3/8 ZINC
15	14	80042007	WASHER 3/8 USS ZINC
14	7	80112051	BOLT, HEX HEAD 3/8-16 X 1 UNC GRADE 5 ZINC
13	2	32-32-0060-11	HAT CHANNEL: 16ga. x 1" x 6-5/16" x 22-3/8" Lg. A-513
12	2	32-32-0060-11	HAT CHANNEL: 16ga. x 1" x 6-5/16" x 19-3/4" Lg. A-513
11	2		"C" CHANNEL: 16ga. 1" x 1-1/2" x 1" x 20-7/8" Lg.
10	2		"C" CHANNEL: 16ga. 1" x 1-1/2" x 1" x 22-3/8" Lg.
9	2		"C" CHANNEL: 16ga. 1" x 1-1/2" x 1" x 19-3/4" Lg.
8	2	70009055	14ga. x 2 x 4-13/16 x 95-1/2 bridge crossmember

REF. No. QTY. PART No. MATERIAL DESCRIPTION



NTS SECTION D-D



NTS DETAILS

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REV. LET.	DESCRIPTION OF CHANGE	BY	CHK	DATE	ECN No.	TOLERANCE UNLESS OTHERWISE SPECIFIED	WOOD	OTHER	DATE 6/14/18	TITLE: 158" WB MODEL 24 FLOOR FRAME, RAISED FLOOR
						± 1/8"	± 1/16"		NAME: MKLINE	
						± 1"	± 1/2"		DWG. No.	32-13-0031-18 SPECIAL

**Glaval Bus**

a division of Forest River, Inc.

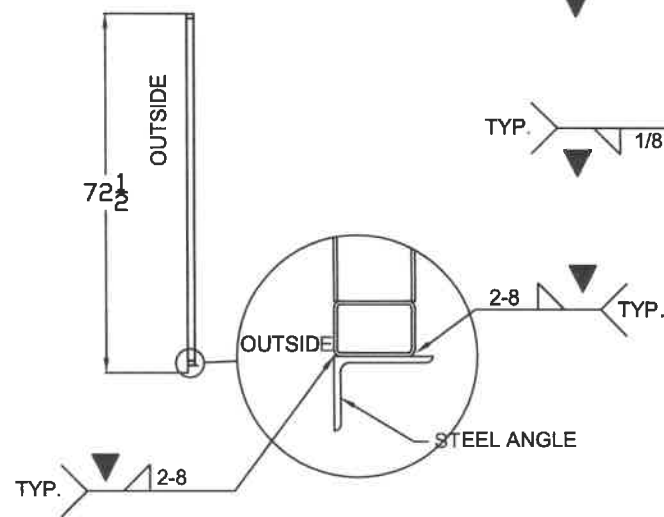
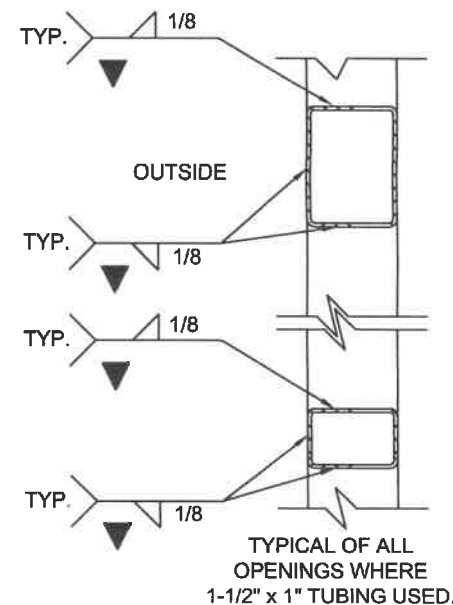
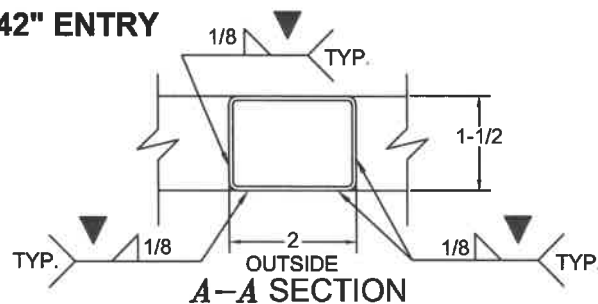
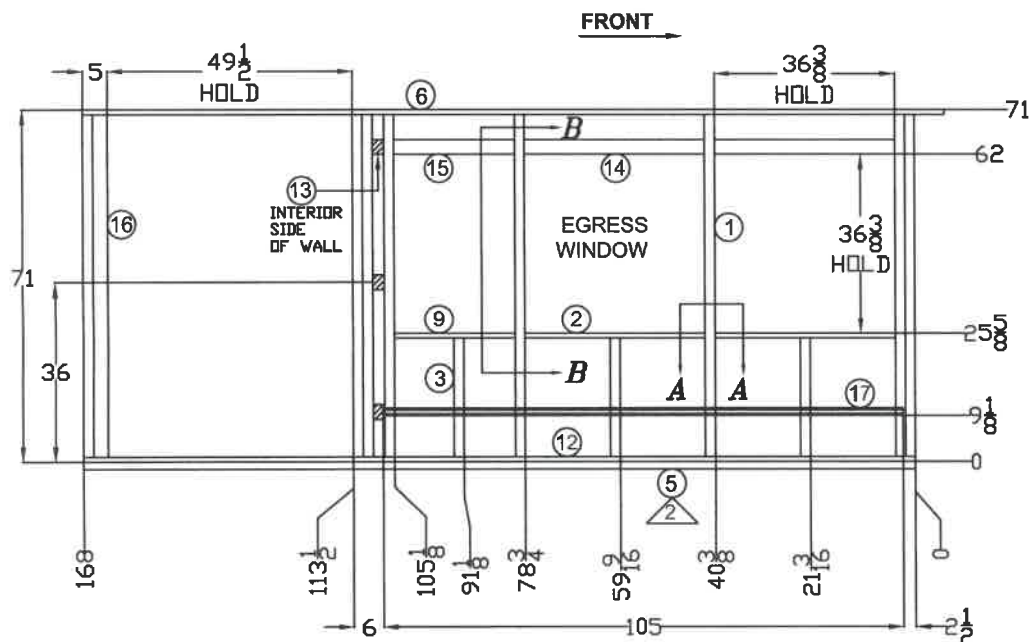


▼ CRITICAL CONTROL ITEM

# USAGE: FORD 158"WB/MODEL 24, 42" ENTRY

## NOTES:

- 1- DRAWING VIEWED FROM EXTERIOR SIDE OF UNIT.
- 2- ANGLE TO BE WELDED FLUSH WITH OUTSIDE EDGE OF WALL.



\*\*\*ALL MATERIALS GALVANIZED\*\*\*

8	0		FRAME, SIDEWALL WHEEL WELL FORD	17	1		SEAT TRACK: 105-1/2"Lg.
7	0		TUBE: 18ga. x 1-1/2" x 2" x 66-13/16"Lg. A-513	16	1		TUBE: 18ga. x 1-1/2" x 3" x 69"Lg. A-513
6	1		TUBE: 16ga. x 1-1/2" x 1" x 174"Lg. A-513	15	1		TUBE: 16ga. x 1-1/2" x 3" x 24-3/8"Lg. A-513
5	1		ANGLE: 11ga. x 1-1/2" x 2" x 168"Lg. A-513	14	2		TUBE: 16ga. x 1-1/2" x 3" x 36-3/8"Lg. A-513
4	0		TUBE: 16ga. x 1-1/2" x 1" x 46-3/4"Lg. A-513	13	3		STRAP: 11ga. x 3" x 2-3/8"Lg. A-513
3	4		TUBE: 18ga. x 1-1/2" x 2" x 23-5/8"Lg. A-513	12	1		TUBE: 16ga. x 1-1/2" x 1" x 168"Lg. A-513
2	2		TUBE: 16ga. x 1-1/2" x 1" x 36-3/8"Lg. A-513	11	0		ANGLE: 11ga. x 1-1/2" x 2" x 65-3/4"Lg. A-513
1	8		TUBE: 18ga. x 1-1/2" x 2" x 69"Lg. A-513	10	0		TUBE: 16ga. x 1-1/2" x 1" x 64-3/4"Lg. A-513
				9	1		TUBE: 16ga. x 1-1/2" x 1" x 24-3/8"Lg. A-513
REF. No.	QTY.	PART No.	MATERIAL DESCRIPTION	REF. No.	QTY.	PART No.	MATERIAL DESCRIPTION

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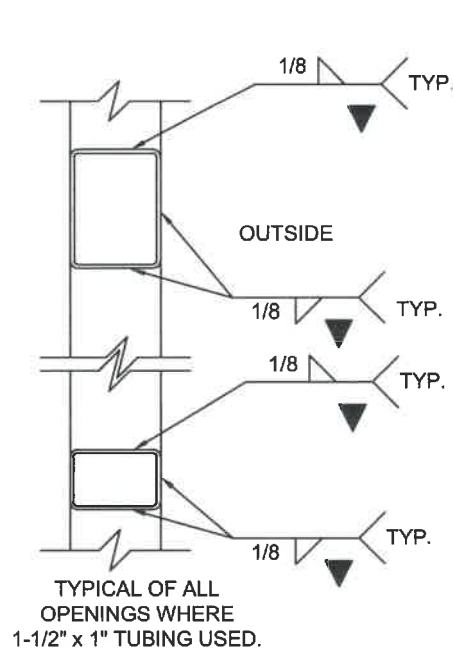
REV. LET.	DESCRIPTION OF CHANGE	BY	CHK	DATE	ECN No.	TOLERANCE UNLESS OTHERWISE SPECIFIED	WOOD	OTHER	DATE	TITLE
						± 1/8"	± 1/16"	NAME, MKLINE	6/14/18	158" WB MODEL 24, 42" ENTRY SIDEWALL, R. LIFT, RAISED FLOOR
						± 1°	± 1/2°	DWG. No.	32-13-0030-18	SPECIAL 42 ENTRY

**Glaval Bus**

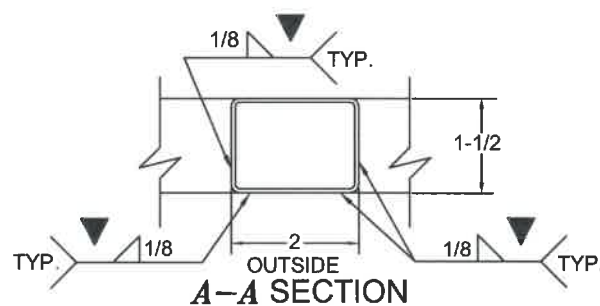
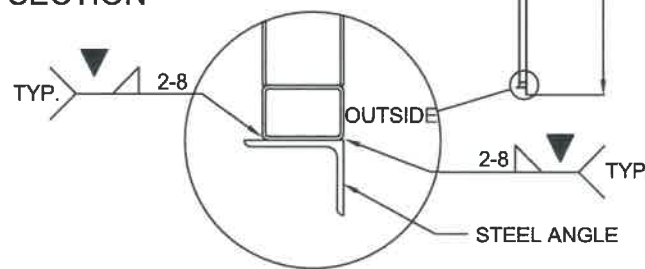
a division of Forest River, Inc.

▼ CRITICAL CONTROL ITEM

## USAGE: FORD 158"WB/MODEL 24



**B-B SECTION**

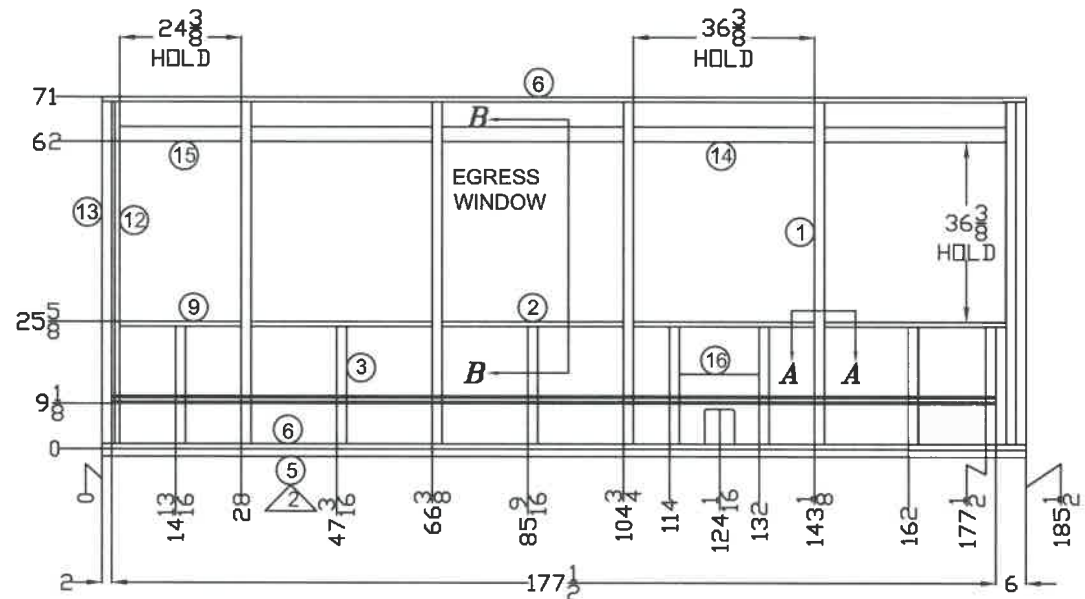


### NOTES:

1- DRAWING VIEWED FROM EXTERIOR SIDE OF UNIT.

2- ANGLE TO BE WELDED FLUSH WITH OUTSIDE EDGE OF WALL.

← FRONT



\*\*\*ALL MATERIALS GALVANIZED\*\*\*

8	0		FRAME, SIDEWALL WHEEL WELL FORD	17	1		SEAT TRACK: 177-1/2"Lg.
7	0		TUBE: 18ga. x 1-1/2" x 2" x 70-7/8"Lg. A-513	16	1		FUEL FILL BACKER BOARD
6	2		TUBE: 16ga. x 1-1/2" x 1" x 185-1/2"Lg. A-513	15	1		TUBE: 16ga. x 1-1/2" x 3" x 24-3/8"Lg. A-513
5	1		ANGLE: 11ga. x 1-1/2" x 2" x 185-1/2"Lg. A-513	14	4		TUBE: 16ga. x 1-1/2" x 3" x 36-3/8"Lg. A-513
4	0		TUBE: 16ga. x 1-1/2" x 1" x 79-9/16"Lg. A-513	13	2		TUBE: 16ga. x 1-1/2" x 2" x 69"Lg. A-513
3	7		TUBE: 18ga. x 1-1/2" x 2" x 23-5/8"Lg. A-513	12	1		TUBE: 16ga. x 1-1/2" x 1" x 69"Lg. A-513
2	4		TUBE: 16ga. x 1-1/2" x 1" x 36-3/8"Lg. A-513	11	0		ANGLE: 11ga. x 1-1/2" x 2" x 70-3/16"Lg. A-513
1	5		TUBE: 18ga. x 1-1/2" x 2" x 69"Lg. A-513	10	0		TUBE: 16ga. x 1-1/2" x 1" x 70-3/16"Lg. A-513
				9	1		TUBE: 16ga. x 1-1/2" x 1" x 24-3/8"Lg. A-513
REF. No.	QTY.	PART No.	MATERIAL DESCRIPTION	REF. No.	QTY.	PART No.	MATERIAL DESCRIPTION

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REV.	DESCRIPTION OF CHANGE	BY	CHK	DATE	ECN No.

TOLERANCE UNLESS OTHERWISE SPECIFIED

WOOD	OTHER
± 1/8"	± 1/16"
± 1"	± 1/2"

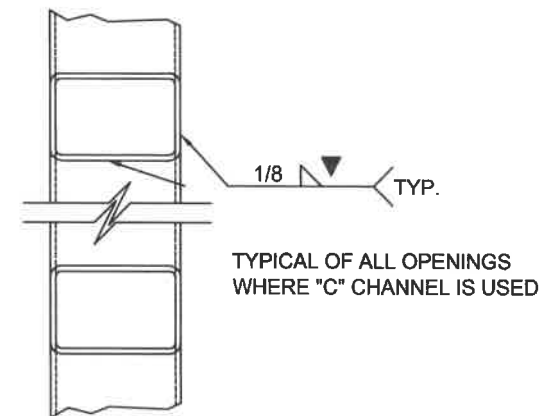
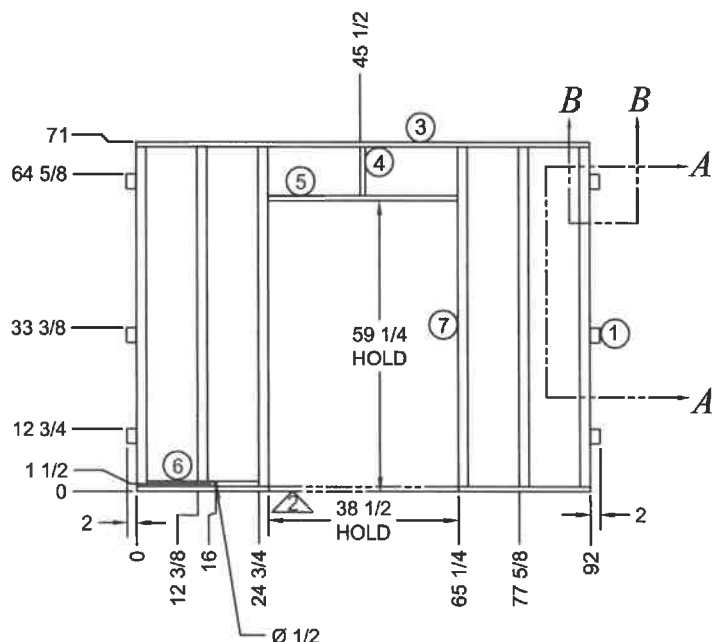
**Glaval Bus**

a division of Forest River, Inc.

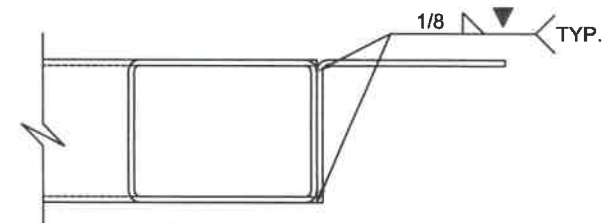
DATE: 6/13/18	TITLE: 158" WB MODEL 24, DR. SIDEWALL ALL PASS, RAISED FLOOR
NAME: MKLINE	DWG. No. 32-13-0002-10

▼ CRITICAL CONTROL ITEM

# USAGE: Raised Floor w/ Rear Door, SPECIAL 1-1/2" THICK WALL



SECTION A-A



SECTION B-B

\*\*\*ALL MATERIALS GALVANIZED\*\*\*

## NOTES:

- 1- DRAWING VIEWED FROM EXTERIOR SIDE OF UNIT.
- 2- REMOVE STEEL TUBE IN DOOR AREA AFTER WALL MOUNT TO FLOOR BUT BEFORE INSTALLING DOOR JAM ASSEMBLY.

7	6		TUBE: 16ga. x 1-1/2" x 2" x 69"Lg. A-513
6	1	02071055	TUBE: 16ga. x 1-1/2" x 1" x 10-3/8"Lg. A-513
5	1	02071055	TUBE: 16ga. x 1-1/2" x 1" x 38-1/2"Lg. A-513
4	1	02071055	TUBE: 16ga. x 1-1/2" x 1" x 9-3/4"Lg. A-513
3	2	02071055	TUBE: 16ga. x 1-1/2" x 1" x 92"Lg. A-513
2	0		
1	6		ANGLE: 16ga. x 1" x 2" x 6"Lg. A-513
REF. No.	QTY.	PART No.	MATERIAL DESCRIPTION



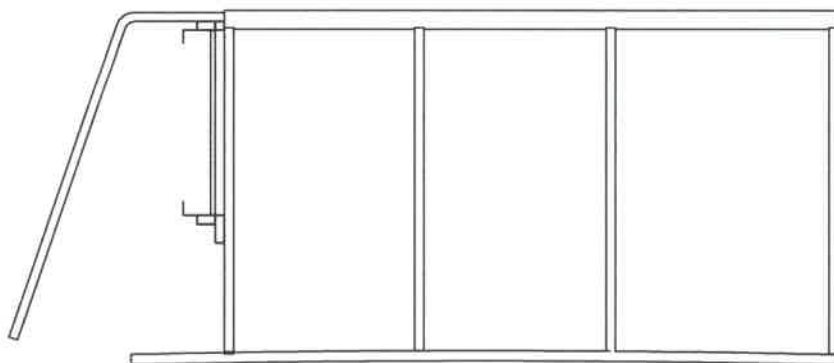
a division of Forest River, Inc.

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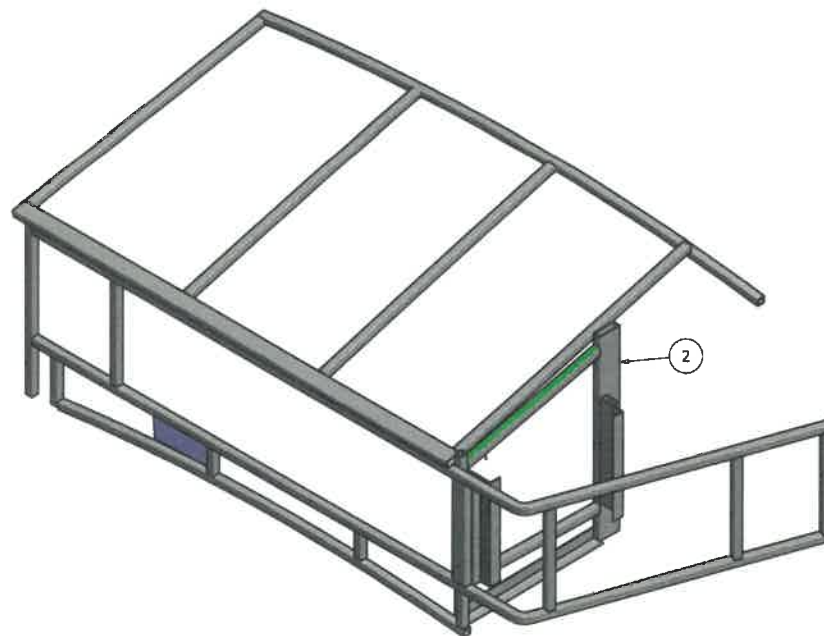
REV. LET.	DESCRIPTION OF CHANGE	BY	CHK	DATE	ECN No.

DATE: 06/14/18	TITLE: Frame, Rear Wall Raised Floor With Door
DFTSN: MKLINE	
CHKR:	DWG. No.
APRVD:	31-28-0010-18 SPECIAL
SCALE:	
DISK No.	SHEET 1 of 1

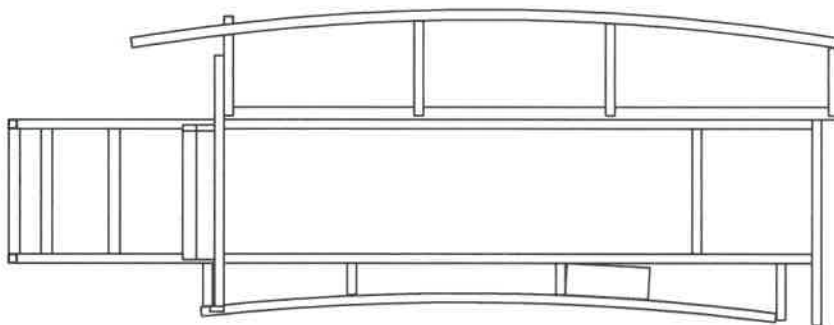
TOLERANCE UNLESS OTHERWISE SPECIFIED  
± .00 ± .030  
± .000 ± .015  
± .0000 ± .005



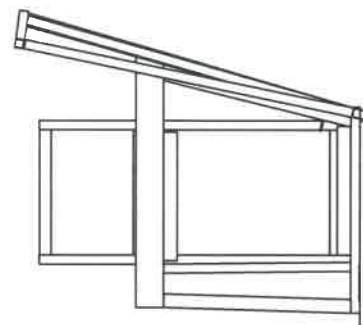
TOP VIEW



ISOMETRIC VIEW



BACK VIEW



SIDE VIEW

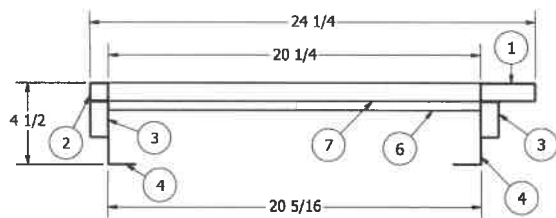
\*\*\*ALL MATERIALS GALVANIZED\*\*\*

Note:

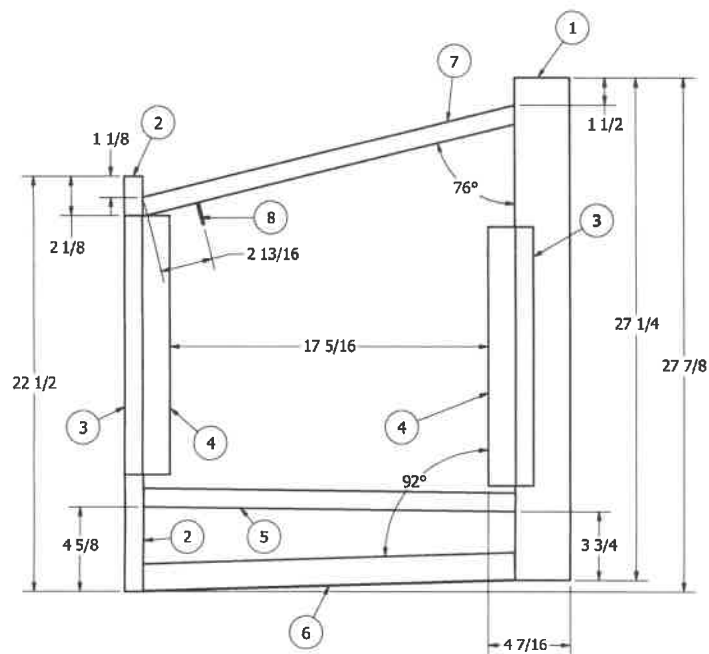
1). Viewed from Interior.

Parts List				
ITEM	QTY	PART NUMBER	DESCRIPTION	
1	1	31-28-0307-11	FORD Front Cab Wrap Around	
2	1	31-28-0299-11	Ford Electrical Panel Frame	
3	1	31-28-0745-11	FORD Cab Overhead	

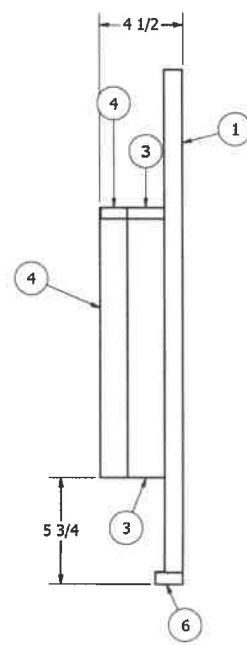
 <b>Glaval Bus</b> A DIVISION OF Forest River, Inc.		DFTSN: <b>TAS</b>		TITLE: Ford Front Cab, Over Head Cab, Electrical Panel Assembly	
		DATE: <b>02/04/15</b>	DWG NO: <b>31-28-0993-15</b>	SHEET <b>1</b> OF <b>1</b>	



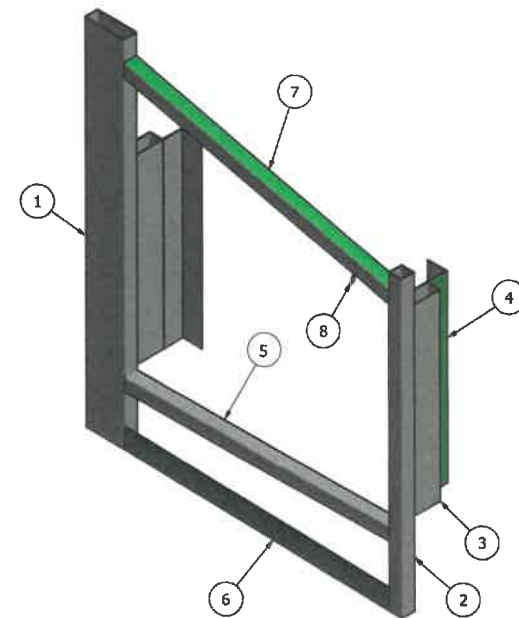
TOP VIEW



BACK VIEW



SIDE VIEW



ISOMETRIC VIEW

\*\*\*ALL MATERIALS GALVANIZED\*\*\*

Note:

1). Viewed from Exterior.

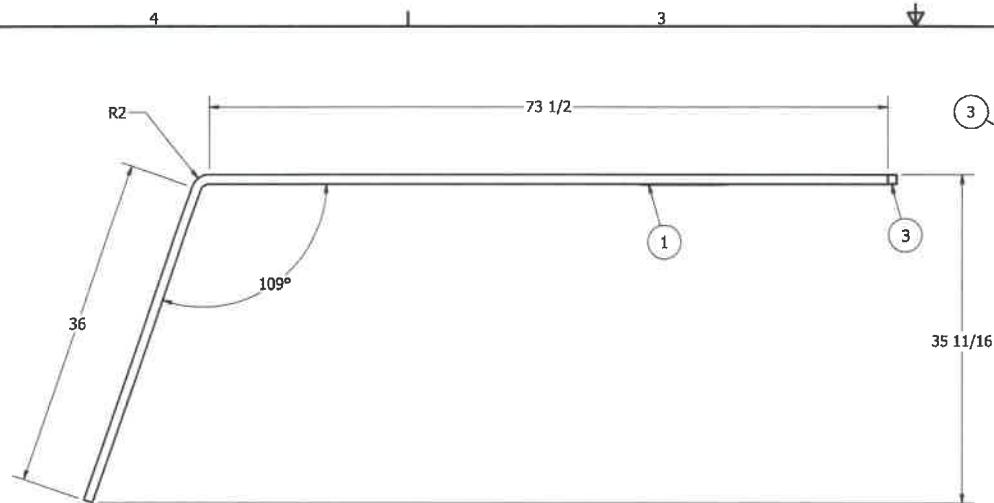
REVISION HISTORY				
ZONE	REV	DESCRIPTION	DATE	APPROVED
31-28	"A"	Released For Production	9/21/07	ELF
31-28	"B"	Update From Auto Cad To Inventor.. Updated To Match What Production Is Currently Building	11/14/07	TAS
31-28				

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	1x3x27.25	Steel Tube 16ga. 1"x 3"x 27-1/4"
2	1	1x1x22.5	Steel Tube 16ga. 1"x 1"x 22-1/2"
3	2	1x2x14	Steel Tube 16ga. 1"x 2"x 14"
4	2	02071056-14	STEEL ANGLE 11ga.x 1-1/2"x 1-1/2"x 14" lg. A-513
5	1	1x1x20.25	Steel Tube 16ga. 1"x 1"x 20-1/4"
6	1	02071056-20.25	STEEL ANGLE 11ga.x 1-1/2"x 1-1/2"x 20-1/4" lg. A-513
7	1	1x1x21.125 Angle Cut	Steel Tube 16 ga. 1"x 1"x 15-1/4" Angle Cut
8	1	.25-20 x 1.25 Stud Grade 8	1/2" 13 x 2" Grade 8 Hex Head Bolt

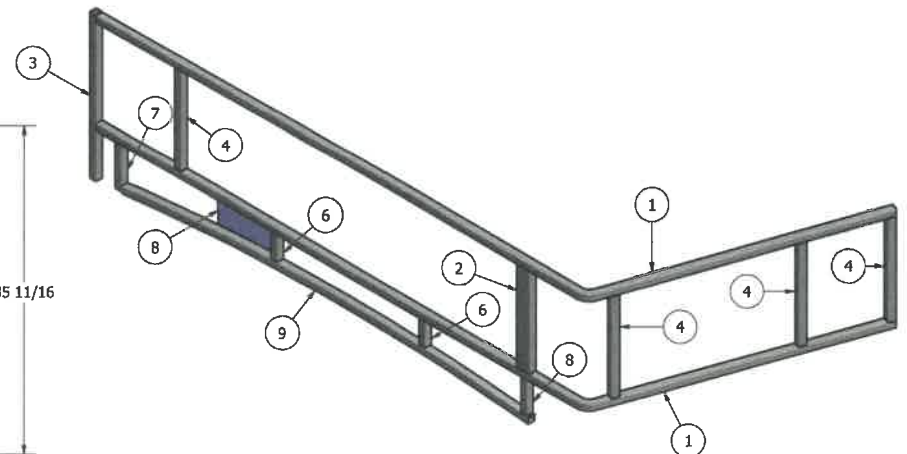


DFTSN:	TAS	TITLE	Ford Electrical Panel Frame
DATE:	11/07/11	DWG NO	31-28-0299-11
		SHEET	1 OF 1

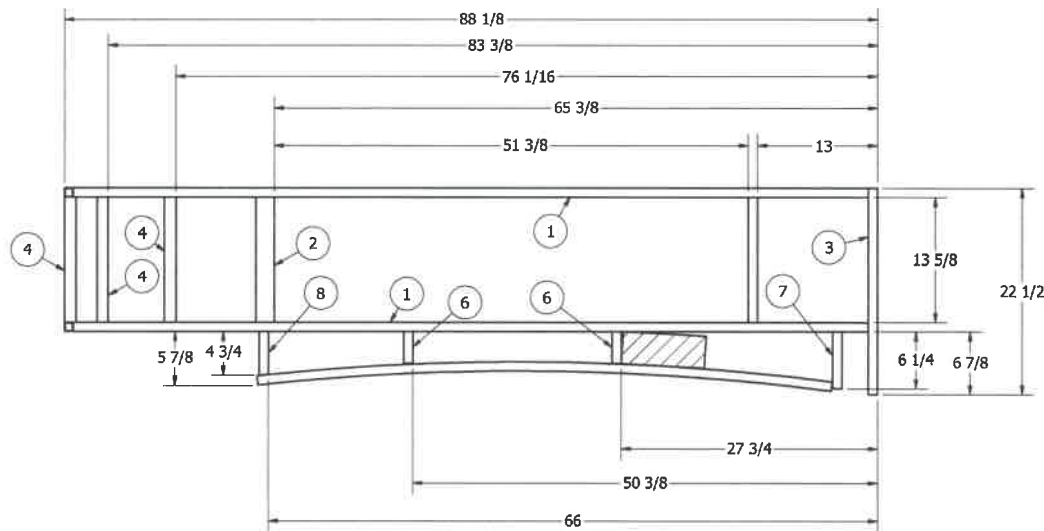




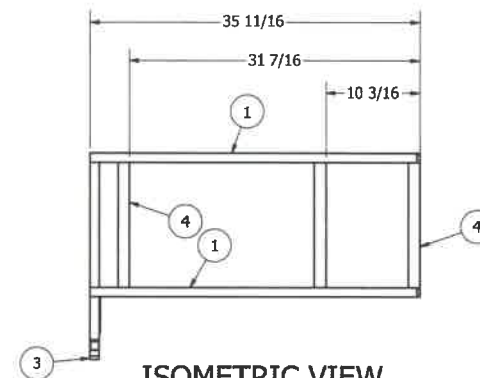
TOP VIEW



ISOMETRIC VIEW



BACK VIEW



ISOMETRIC VIEW

\*\*\* ALL MATERIALS GALVANIZED \*\*\*

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	31-28-0747-11	Ford 1"x 1"x 16ga. Front Wrap Steel Tube
2	2	1x2x13.625	Steel Tube 16ga. 1"x 2"x 13-5/8"
3	1	1x1x22.5	Steel Tube 16ga. 1"x 1"x 22-1/2"
4	5	1x1x13.625	Steel Tube 16ga. 1"x 1-1"x 13-5/8"
5	1	1x1x15.625	Steel Tube 16ga. 1"x 1"x 15-5/8"
6	2	1x1x3.5	Steel Tube 16ga. 1"x 1"x 3-1/2"
7	1	1x1x6.25	Steel Tube 16ga. 1"x 1"x 6-1/4"
8	1	1x1x4.75	Steel Tube 16ga. 1"x 1"x 4-3/4"
9	1	1 x1 66.25 CAB CURVE	Ford 1"x 1"x 62-1/4" Steel Cab Radius Tube
10	1	1x1x4.375	Steel Tube 16ga. 1"x 1"x 4-3/8"

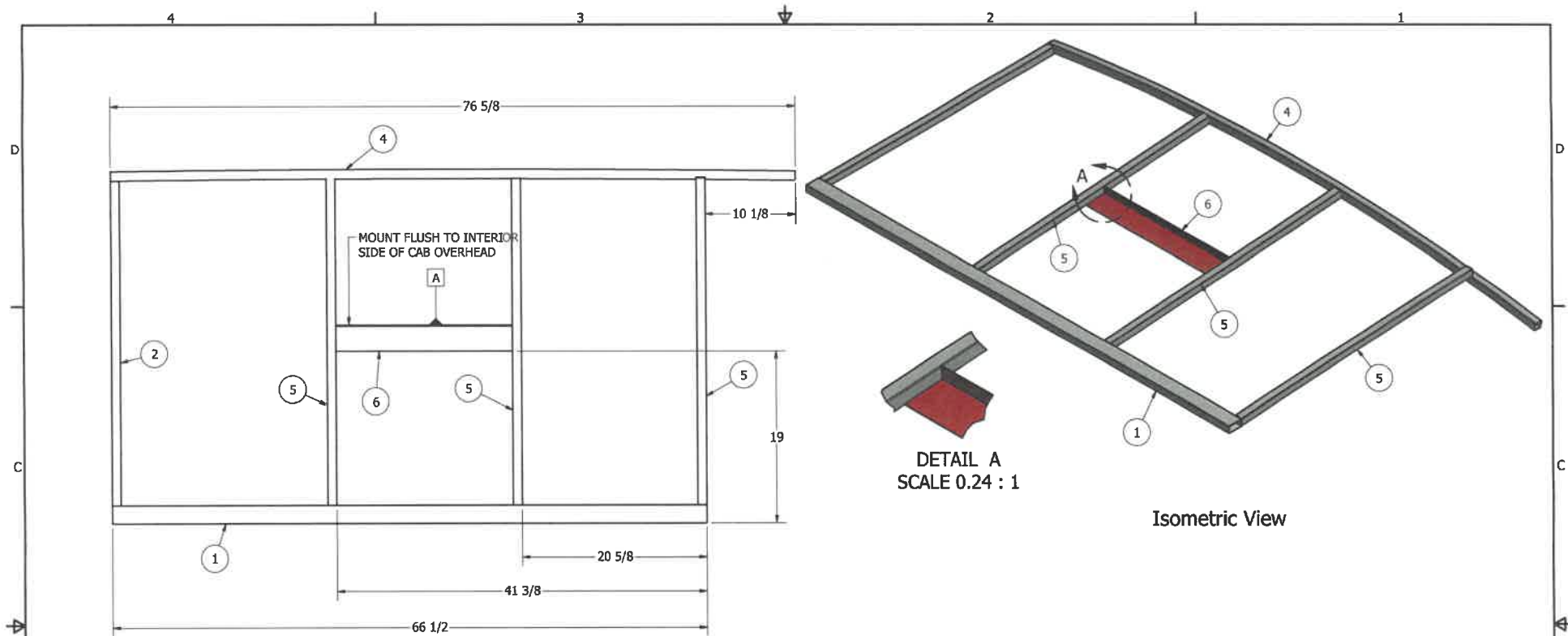


Note:

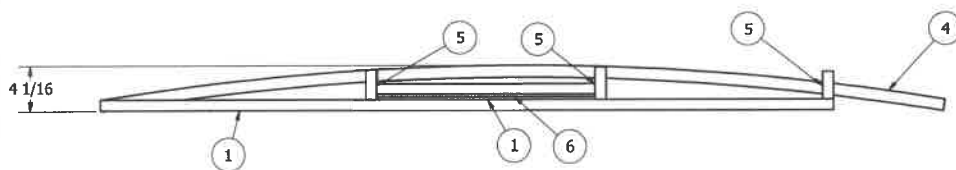
1). Viewed from Exterior.

REVISION HISTORY				
ZONE	REV	DESCRIPTION	DATE	APPROVED
31-28	"A"	Release To Production	10/26/2007	ELF
31-28	"B"	Changed Length of The Wrap Around Tubes	04/28/09	MDK
31-28	"C"	Update From Auto Cad To Inventor... Updated To Match What Production Is Currently Building	11/14/2011	TAS
31-28	"D"	New Revised Standard 2015 Halo	02/05/2015	TAS

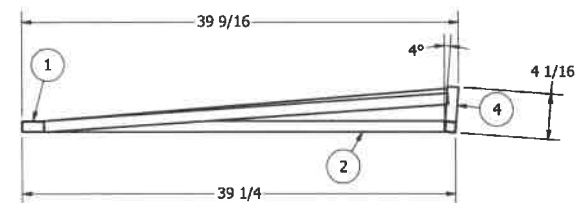
DFTSN:	TAS	TITLE	FORD Front Cab Wrap Around
DATE:	11/07/11	DWG NO	31-28-0307-11
		SHEET	1 OF 1



Top View



Front View



Side View

Note:

1). Viewed from Exterior.

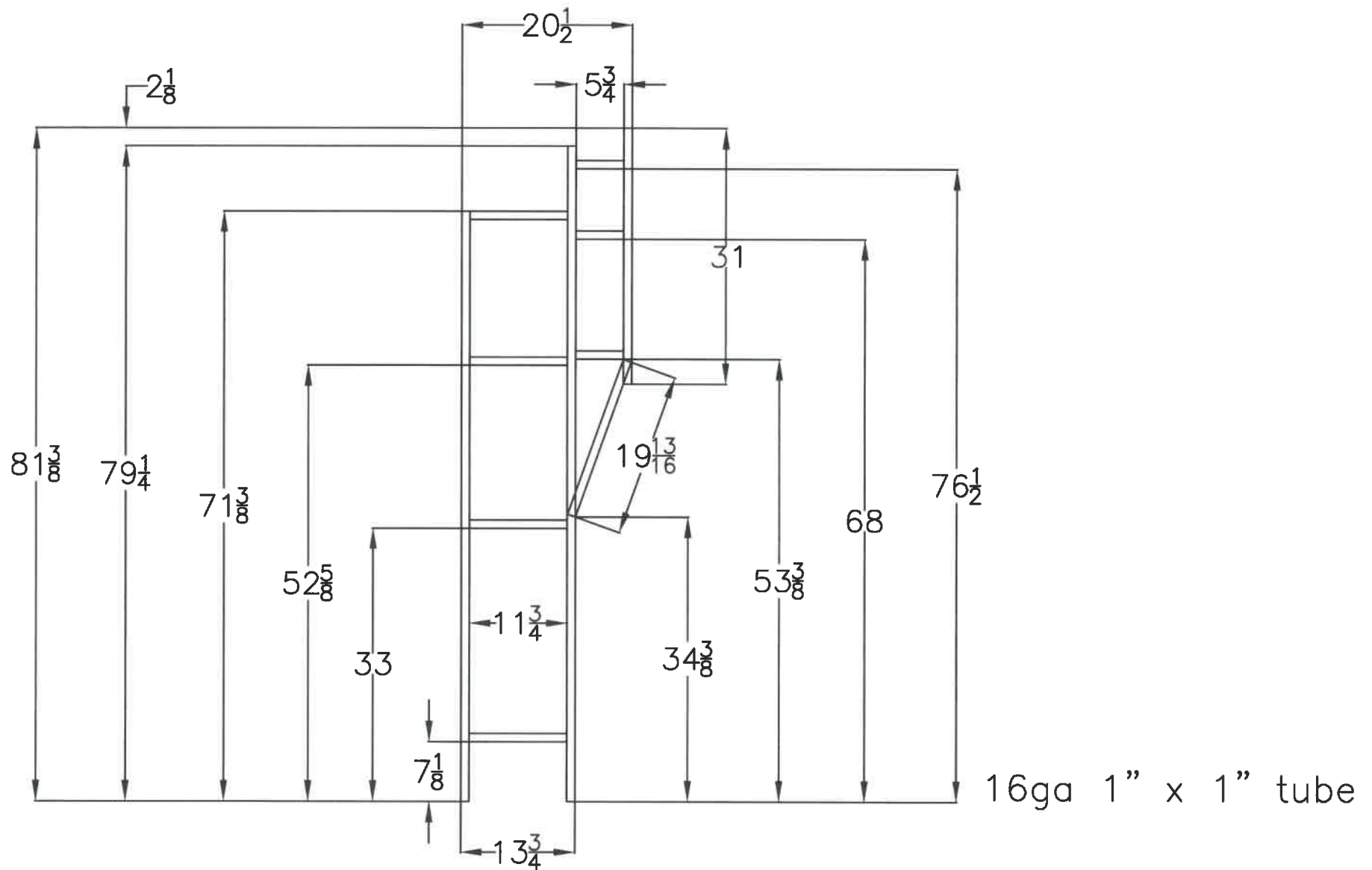
\*\*\* ALL MATERIALS GALVANIZED \*\*\*

Parts List				
ITEM	QTY	PART NUMBER	DESCRIPTION	
1	1	1x2x66.5	Steel Tube 16ga. 1"x 2"x 66-1/2"	
2	1	1x1x36.25	Tube 16ga. 1"x 1"x 36-1/4"	
3	1	1x3x7	Steel Tube 16ga. 1"x 3"x 7"	
4	1	31-28-0750-11	Ford Allstar Radius Tube 1"x 1"x 76-5/8"	
5	3	1x1x36.625	Aluminized Steel Tube 16ga. 1"x 1"x 36-5/8"	
6	1	3 x 1x 19.75	STEEL ANGLE 16ga.x 3"x 1"x 19-3/4" lg. A-513	
11	1	3 x 1x 19.75	STEEL ANGLE 16ga.x 3"x 1"x 19-3/4" lg. A-513	



DFTSN: TAS	TITLE: FORD New Syle Cab Overhead
DATE: 11/07/11	DWG NO: 31-28-0745-11
	SHEET 1 OF 1

REVISION HISTORY				
ZONE	REV	DESCRIPTION	DATE	APPROVED
31-28	"A"	ADDED ANGLE FOR BACKER CENTER CEILING STRIPE	3/22/2015	TAS



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REV.  
LET.

DESCRIPTION OF CHANGE

BY

CHK

DATE

ECN No.

TOLERANCE UNLESS  
OTHERWISE SPECIFIED

WOOD

OTHER

$\pm 1/8"$

$\pm 1/16"$

$\pm 1"$

$\pm 1/2"$



**Glaval Bus**

a division of Forest River, Inc.

DATE: 7/27/17

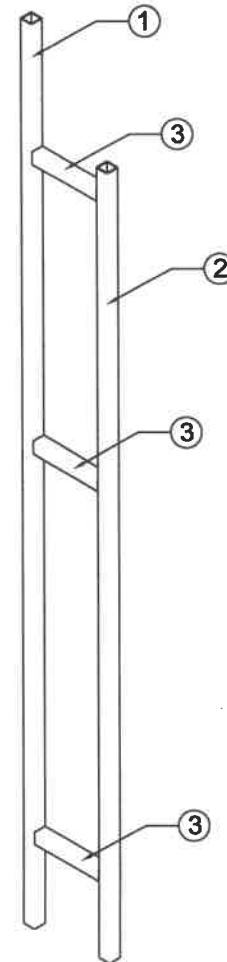
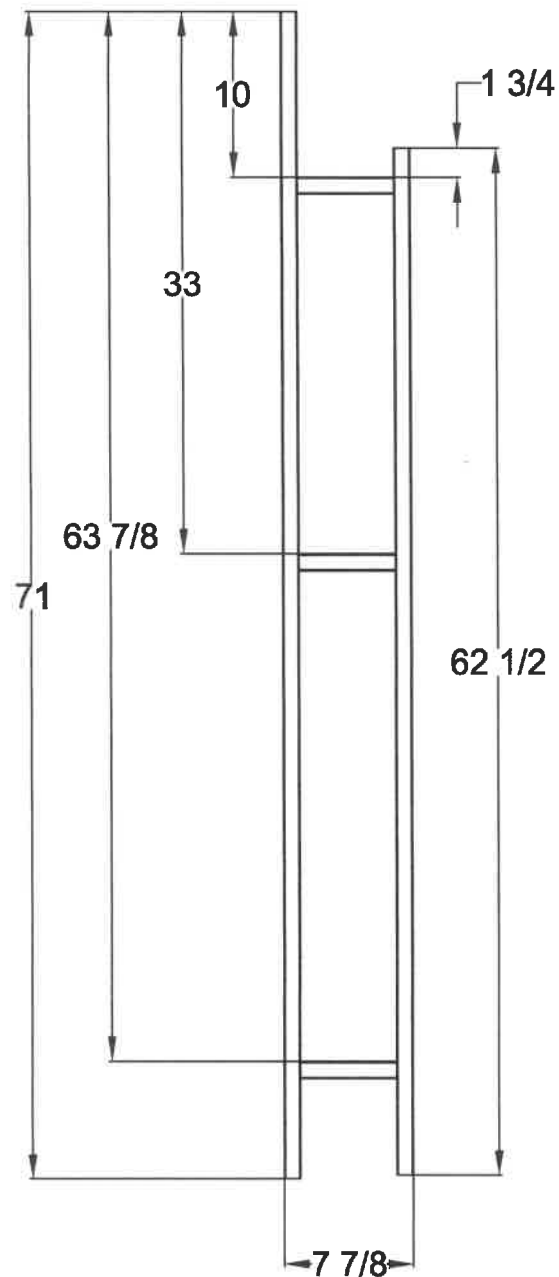
NAME: MK

DWG. No. 31-28-0955-14

TITLE:

**streetside pillar**





16ga 1" x 1" tube

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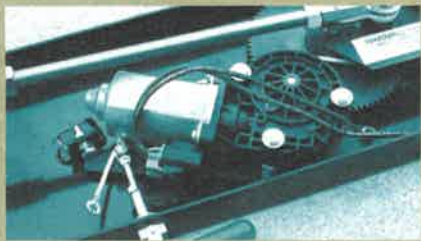
REV.	LET.	DESCRIPTION OF CHANGE	BY	CHK	DATE	ECN No.	TOLERANCE UNLESS OTHERWISE SPECIFIED		DATE: 7/27/17	NAME: MK	TITLE: curbside pillar
							WOOD	OTHER			
							± 1/8"	± 1/16"			
							± 1"	± 1/2"			

**Glaval Bus** a division of Forest River, Inc.

FLOOR-3  
SE FLOOR ASSEMBLY

## Quality in Design

Looking past the simplicity in design, you'll see a quality product—from powdercoated base plates to plated rods, from zinc plating to tempered glass. Indeed, "reliability" is a descriptor that applies to the entire product. With confidence, we offer a comprehensive one-year warranty. Beyond the warranty period however, you can expect years of trouble-free operation. In the unlikely event that service is ever required, the design also facilitates unparalleled ease of access.



## Custom Design

While we do offer specific product families to address the needs of most manufacturers, A&M Systems specializes in designing to your specifications. Pin to pin lengths can vary between 26 and 46 inches. Header width can range from 7 to 11.5 inches. Our ability to manufacture to specification has lead top manufacturers to abandon their own production and design efforts and to choose the A&M Systems product.

In addition, those operating in the after-market have found that our actuators can be used as drop-in, direct replacement for older, less reliable door headers.

## About A&M Systems

For years we've specialized in designing and manufacturing problem-free door actuators. In more recent times, we took our expertise to the door leaves as well.

We are a service-oriented company with keen insight into the industry. We offer agile manufacturing, short lead times, and just-in-time production. Our cost-conscious approach pleases the purchasing agent. Ease-of-installation pleases production personnel. Ease-of-operation pleases the end user. And the quality and reliability of our products pleases everyone.

We are committed to quality in design, quality in production, and quality in service.

## Contact Information

A&M Systems, Inc.  
1845 Fieldhouse  
Elkhart, IN 46517  
Phone: 574.522.5000  
Fax: 574.522.9099

Email: [sales@anmsystems.com](mailto:sales@anmsystems.com)

[www.anmsystems.com](http://www.anmsystems.com)



## Transit Bus Doors & Actuators

## Simple is Better

One look at our product line reveals our design approach: simple is better. We carefully engineer bus doors and actuators (headers) to operate smoothly and reliably while eliminating the problem-prone and complex design elements that plague our competitors' products. The result is a product line which has become the number one choice for manufacturers of small and medium-size buses.

Simplicity in design leads to simplicity in installation and simplicity in operation. It also means that we can offer a superior product at the best possible pricing to you.

Simplicity in design does not mean shortcuts in our production, however. We've put years of engineering effort into perfecting the design of our manual and electric door actuators and door leaves. Operational testing is conducted 24/7. Life-cycle testing has produced in excess of a quarter million trouble-free cycles.

Innovation is not lost in our efforts to maintain simplicity. For example, the variable ratio closing on our manual actuator is a patent-pending design. Consider also the re-engagement of our electric actuator following emergency opening. This scenario resulted in extremely complex approaches in competitive products. Our actuator easily and automatically recycles when the motor is reengaged.

In operation, our products are unsurpassed, achieving perpendicular door openings with either electric and manual models as well as secure closings—even at highway speeds.



## Product Line Overview

The A&M product line consists of door leaves (often called “flops”) and manual and electric door actuators (often referred to as “headers”). In working together, these products create an attractive, functional, efficient, and robust entry system for small and medium-size buses in the transit industry.

In this system you will find a harmony of movement that speaks to design and manufacturing excellence. Every A&M door system produces completely perpendicular door openings—every time. In the A&M system, the forward door opens first and closes last—always. In the A&M system there is not a reliance on troublesome components (such as spring-loaded push-pull rods)—ever.

You can rely on A&M Systems to provide a distinctive entry system that opens smoothly and closes securely. Likewise, we will provide a business relationship guaranteed to help you succeed.



## Manual Actuators Features

- ◆ Low-profile design
- ◆ Powder-coated base plate
- ◆ Plated push rods
- ◆ Permanently lubricated pivot points
- ◆ 1-year warranty

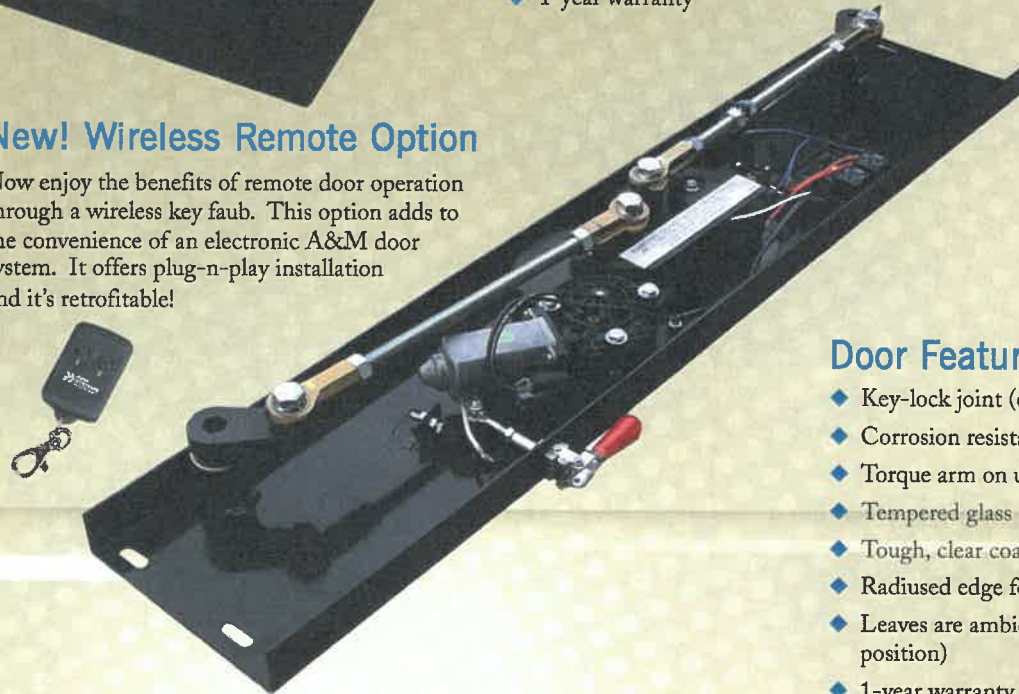


## Electric Actuators Features

- ◆ Low-profile design
- ◆ Powder-coated base plate
- ◆ Plated push rods
- ◆ Permanently lubricated pivot points
- ◆ Motor control PC board
- ◆ Proprietary, heavy-duty motor
- ◆ Available wireless remote
- ◆ 1-year warranty

## New! Wireless Remote Option

Now enjoy the benefits of remote door operation through a wireless key fob. This option adds to the convenience of an electronic A&M door system. It offers plug-n-play installation and it's retrofitable!



## Door Features

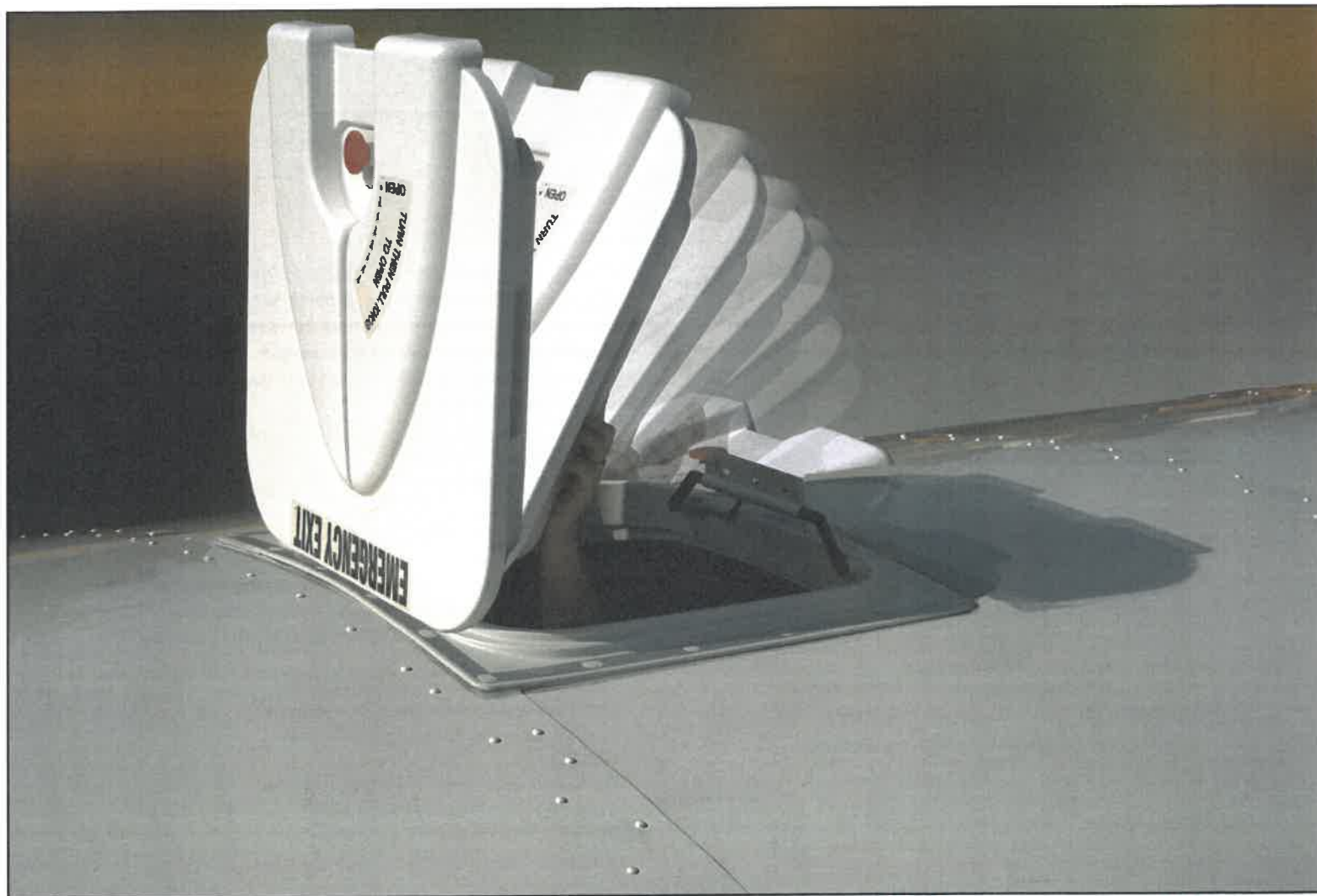
- ◆ Key-lock joint (extremely rigid, no-weld design)
- ◆ Corrosion resistance aluminum and stainless steel
- ◆ Torque arm on upper hinge (unique and zinc plated)
- ◆ Tempered glass
- ◆ Tough, clear coat, anodized finish (204 R1 rated)
- ◆ Radius edge for clean mating to seal
- ◆ Leaves are ambidextrous! (Use in either forward or aft position)
- ◆ 1-year warranty



# SCHOOL AND SHUTTLE BUS ROOF HATCHES

**TRANSPEC**<sup>®</sup>  
A Safe Fleet Brand

**SAFE EGRESS. PROVEN PERFORMANCE.**



#### **ADAPTABLE**

Low profile design  
adapts to wide range of  
roof surfaces



#### **MADE IN THE USA**

Proudly manufactured  
in North Carolina  
with 35 years proven  
product performance



#### **MAINTENANCE**

No external fasteners  
required for installation



#### **WARRANTY**

5 year



#### **STRENGTH**


Constructed of high  
strength UV stable  
materials



Serves as a vent on hot summer days

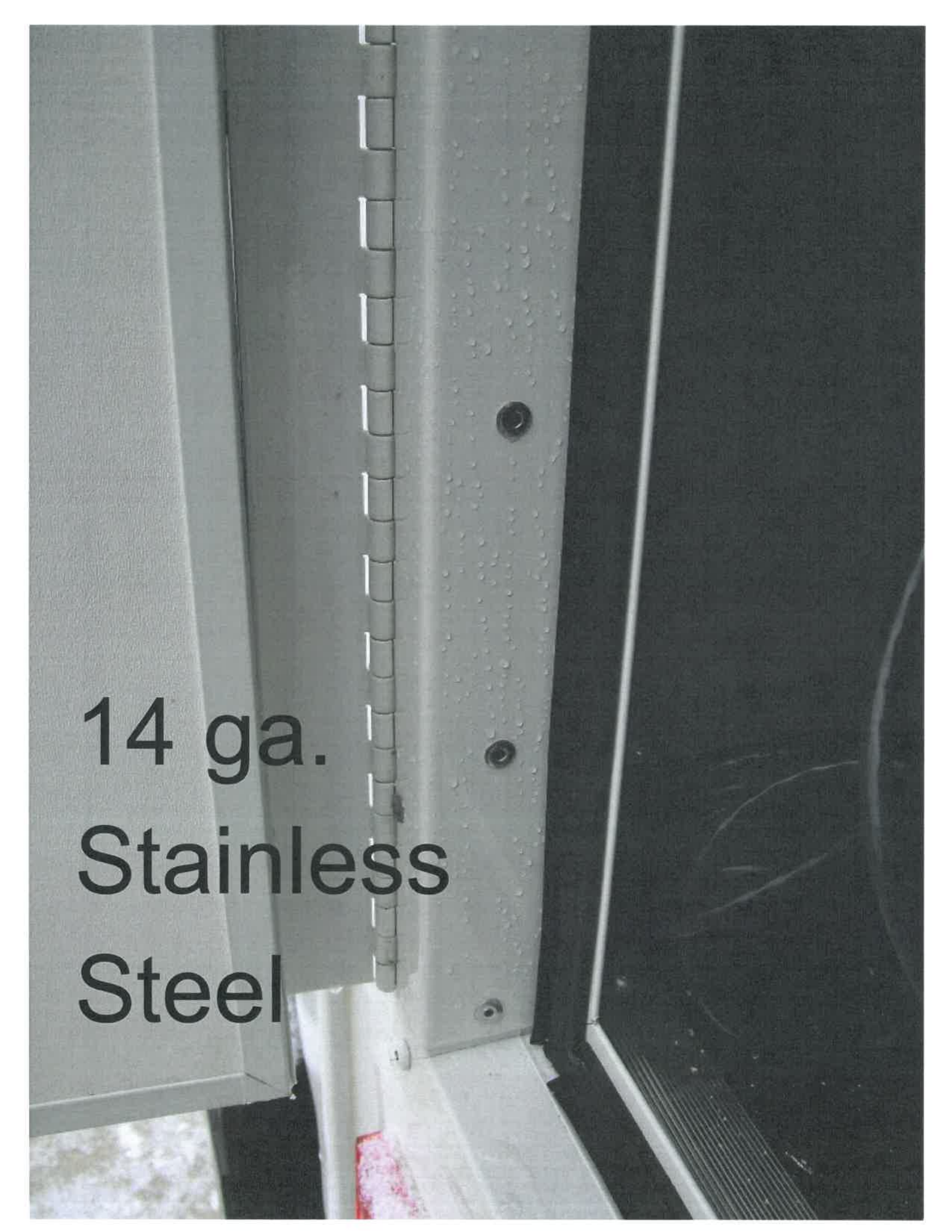






Stainless  
Steel  
Rivets



A close-up photograph of a stainless steel door hinge and frame. The metal surface is covered in numerous small droplets of condensation. The hinge is visible on the left, and the door frame is on the right. The background is dark and out of focus.

14 ga.  
Stainless  
Steel

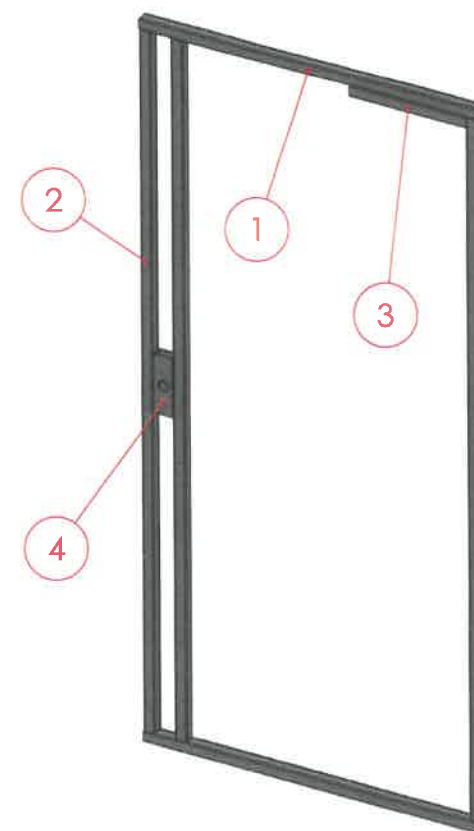
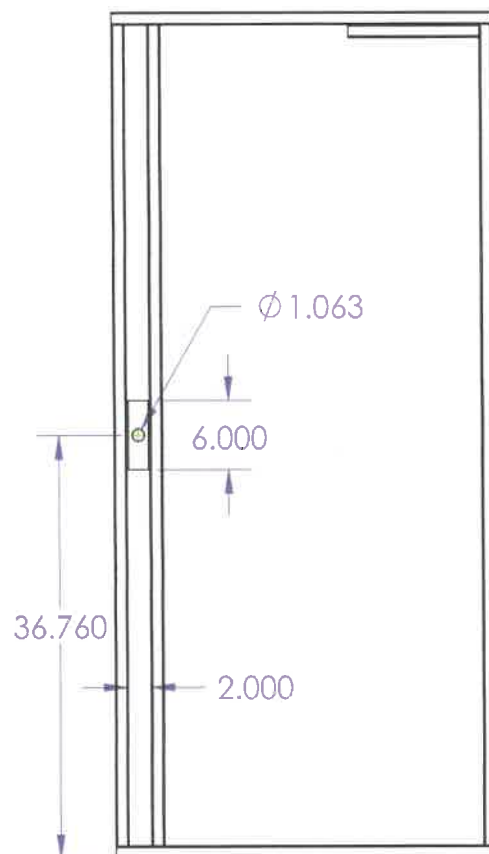









DET	LENGTH	DESCRIPTION	QTY
1	33.219	TUBE, SQUARE 1.13 X 1.13 X .06	2
2	71.27	TUBE, SQUARE 1.13 X 1.13 X .06	3
3	11.438	TUBE, SQUARE 1.13 X 1.13 X .06	1
4	6	TUBE, RECTANGULAR 1.00 X 2.000 X .06	1

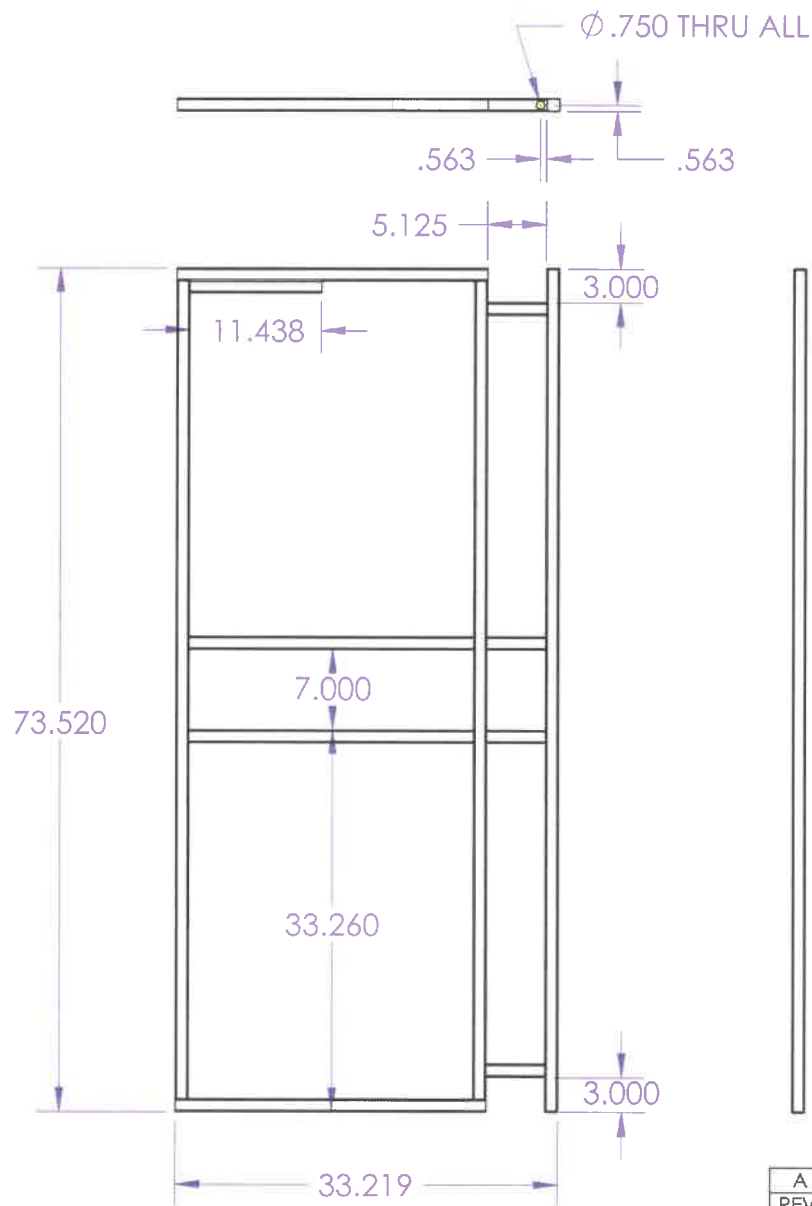


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 E-MAIL: rlefave@challengerdor.com

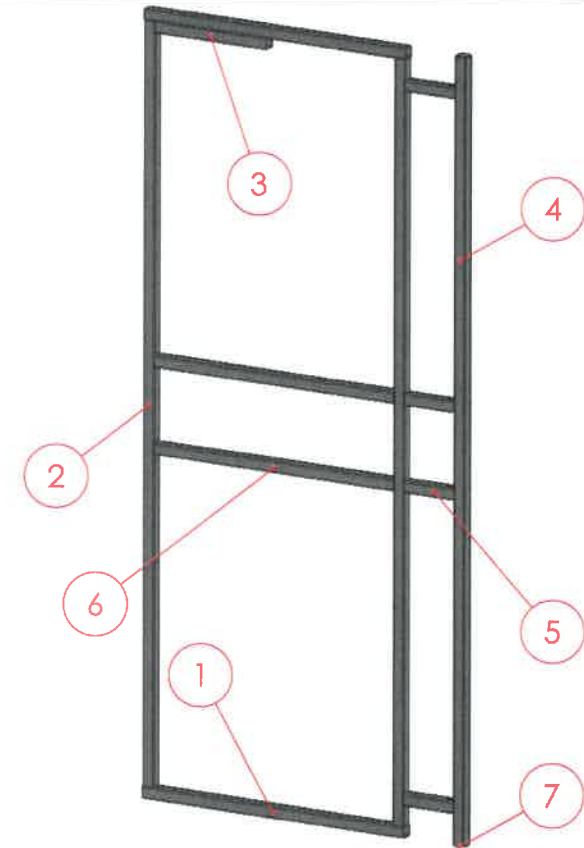
A	PRODUCTION RELEASE	08/05/11	RLL	-
REV.	DESCRIPTION	DATE	DRW	CHK
DIMENSIONS ARE IN INCHES			NAME	DATE
TOLERANCES:				
ANGULAR: MACH ± 1.0		DRAWN	RLL	08/05/11
TWO PLACE DECIMAL ± .03		CHECKED	.	.
THREE PLACE DECIMAL ± .015		AREA	.	.
Material	N/A	PERIMETER	.	CHALLENGER DOOR 24785 US 6 E PO Box 67 Nappanee IN 46550
FINISH	N/A	COMMENTS:		
DO NOT SCALE DRAWING				



DESCRIPTION		
<b>70.000 X 75.000 LH DOOR TUBE</b>		
SIZE	DWG. NO.	REV.
<b>A</b>	<b>160041</b>	<b>A</b>
SCALE: 1:16	WEIGHT: 7.18 FT/LB	SHEET 1 OF 2



DET	LENGTH	DESCRIPTION	QTY
1	26.969	TUBE, SQUARE 1.13 X 1.13 X .06	2
2	71.27	TUBE, SQUARE 1.13 X 1.13 X .06	2
3	11.438	TUBE, SQUARE 1.13 X 1.13 X .06	1
4	73.32	TUBE, SQUARE 1.13 X 1.13 X .06	1
5	5.125	TUBE, SQUARE 1.13 X 1.13 X .06	4
6	24.719	TUBE, SQUARE 1.13 X 1.13 X .06	2
7	N/A	.100 END CAP	2



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 E-MAIL: rlefave@challengerdor.com

A	PRODUCTION RELEASE	08/05/11	RLL	-
REV.	DESCRIPTION	DATE	DRW	CHK
DIMENSIONS ARE IN INCHES		NAME	DATE	
TOLERANCES:		DRAWN	08/05/11	
ANGULAR: MACH ± 1.0		CHECKED	.	
TWO PLACE DECIMAL ± .03		AREA	.	
THREE PLACE DECIMAL ± .015		PERIMETER	.	
Material	N/A	CHALLENGER DOOR 24785 US 6 E PO Box 67 Naponee IN 46550		
FINISH	N/A			
DO NOT SCALE DRAWING				



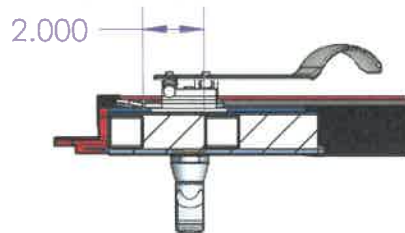
**DESCRIPTION**  
**70.00 X 75.00 DOUBLE LATCH DOOR TUBE**

SIZE <b>A</b>	DWG. NO. <b>160041</b>	REV. <b>A</b>
SCALE: 1:16	WEIGHT: 8.35 FT/LB	SHEET 2 OF 2





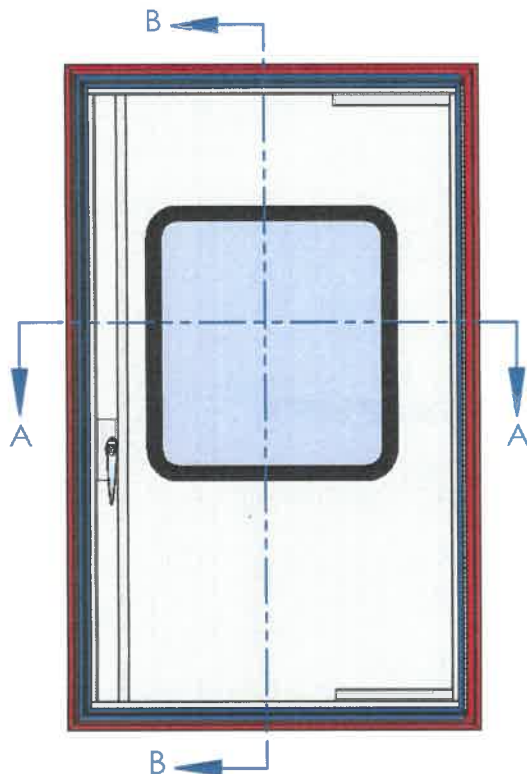
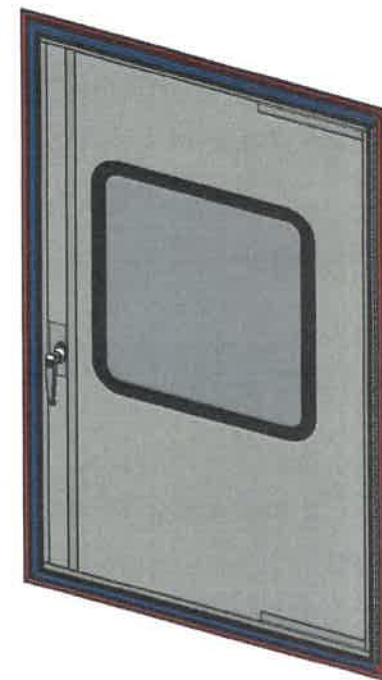
SECTION A-A



DETAIL C  
SCALE 1 : 6



DETAIL D  
SCALE 1 : 6



SECTION B-B



DETAIL E  
SCALE 1 : 6

.050  
INNER

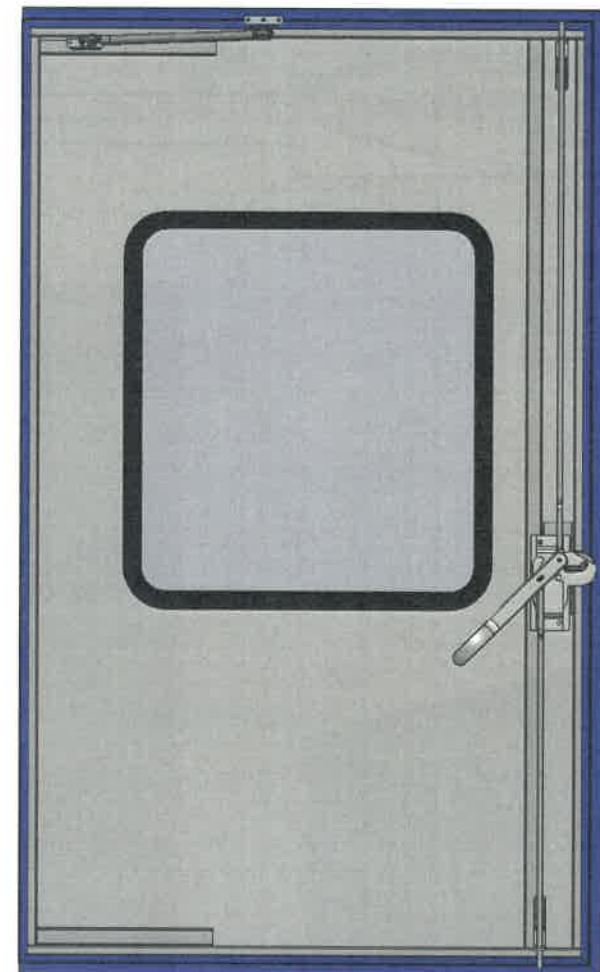
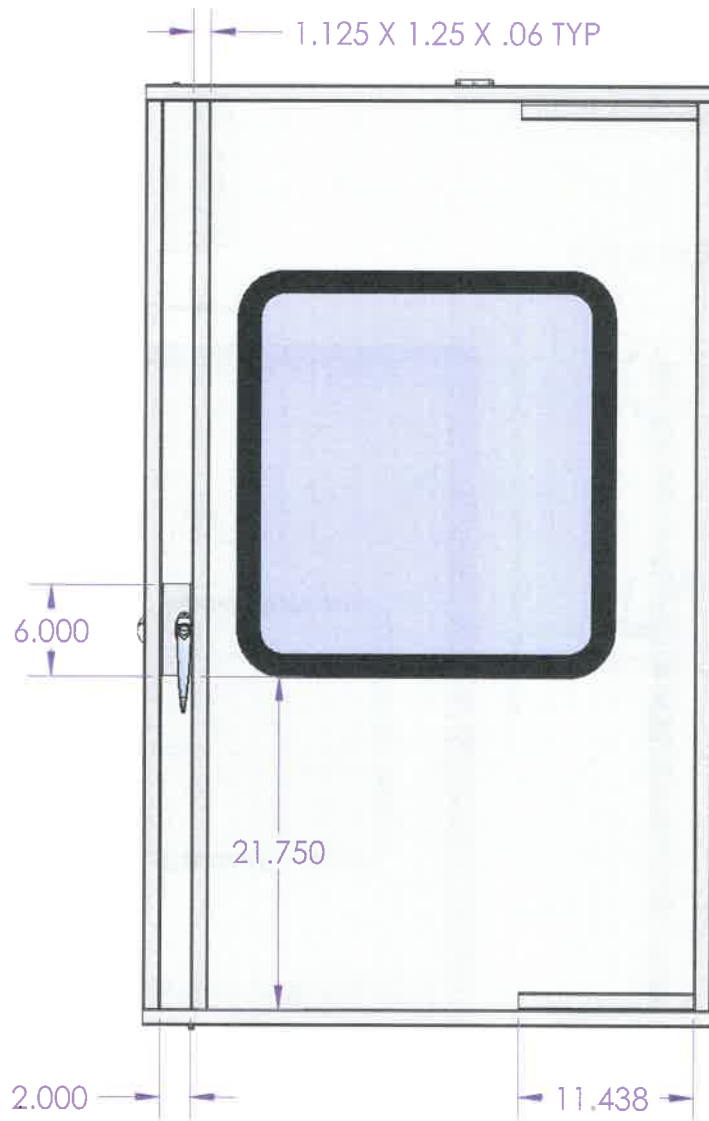
.065  
OUTER

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E-MAIL: refave@challengerdoor.com

REV.	DESCRIPTION	DATE	DRW	CHK
	DIMENSIONS ARE IN INCHES	NAME	DATE	
	TOLERANCES:			
	ANGULAR: MACH ± 1.0	DRAWN	RLL	12/15/09
	TWO PLACE DECIMAL ± .03	CHECKED	.	.
	THREE PLACE DECIMAL ± .015	AREA	.	.
	Material N/A	PERIMETER	.	.
	FINISH N/A	COMMENTS:		
	DO NOT SCALE DRAWING			

**CHALLENGER DOOR**  
24785 US 6 E  
PO Box 57  
Nappanee IN 46550


DESCRIPTION			
<b>805 - SINGLE BUS DOOR ASSY</b>			
SIZE	DWG. NO.	REV.	
<b>A</b>	<b>850016</b>	<b>A</b>	
SCALE: 1:18	WEIGHT:	98.302 FT/LB	SHEET 1 OF 2



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DIMENSIONS ARE IN INCHES  
 TOLERANCES:  
 ANGULAR: MACH  $\pm 1.0$   
 TWO PLACE DECIMAL  $\pm .03$   
 THREE PLACE DECIMAL  $\pm .015$   
 Material N/A  
 FINISH N/A  
 DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	RLI	12/15/09
CHECKED	.	.
AREA	.	.
PERIMETER	.	.
COMMENTS:	<b>CHALLENGER DOOR</b> 24785 US 6 E PO Box 67 Nappanee IN 46550	

		
DESCRIPTION		
<b>805 - SINGLE BUS DOOR ASSY</b>		
SIZE	DWG. NO.	REV.
<b>A</b>	<b>850016</b>	<b>A</b>
SCALE: 1:18	WEIGHT: 98.302 FT/LB	SHEET 2 OF 2

## **GLAVAL CONSTRUCTION METHOD DETAIL**

The following information is submitted for all Glaval Bus products proposed on as supporting documentation of the structural soundness and impact resistance of the bodies manufactured. All vehicles are built using virtually the same materials with some minor differences in the height and width of cross members due to entry floor heights and/or body width variations.

### **3.0 Body Construction – General Frame Construction**

Manufactured from all aluminized steel products, the floor, roof, side walls, rear wall, driver halo assembly and entry door assembly are all wire welded (MIG) together to form an integral aluminized steel frame that is thoroughly coated in our primer paint shop, then mounted with specified hardware to the rubber body mount points (pucks) supplied by the chassis manufacturer. Once joined to the chassis, the bus finishing process begins.

#### **3.0.1 Floor frame construction and assembly –**

- 3.0.1.1 Cross Members -- The floor cross members form the base structural support for the rest of the frame components. Our cross members are constructed of 14 gauge aluminized steel, formed to a capital “C” shape. Cross members over the fuel tank are made to provide the clearance needed to conform with FMVSS301, and include formed internal reinforcements welded in place for additional strength. All additional longitudinal and latitudinal structure is flush welded in place to form a one piece floor upon completion.
- 3.0.1.2 Aluminized steel “Hat Posts” – 1”x1”x4” run the length of the floor between cross members and are welded into place. This extremely strong form is used to weld our HSLA aluminized steel seat track in place.
- 3.0.1.3 Aluminized steel C Channel – 1”x1.5” C channel is welded in between cross members the full length of the floor in 5 places. Coupled with the Hat Posts this provides a one-piece strong “ladder” type frame for the flooring.
- 3.0.1.4 Seat Track – 12 gauge roll formed high strength/low alloy aluminized steel is wire welded in place for seat mounting down each side of the bus, with lengths predicated on the floor plan chosen. This is yet another stiffener in our extensive construction process.
- 3.0.1.5 Wheel Wells -- Constructed of 14 gauge aluminized steel, wheel wells are also welded in during the floor construction process. All seams in the wheel well are welded to create a one piece water resistant wheel housing structure. The wheel wells also provide additional strength to the body assembly, when welded in place.
- 3.0.1.6 Structural Aluminized steel Angle – 1/8” thick 1.5” x 2.5” structural aluminized steel angle is used the full perimeter length of each floor assembly, welded to the ends of all floor cross members. This provides not only a flat plane for joining the sidewall

assembly, but also ties all cross members together and provides additional side impact resistance.

- 3.0.1.7 Additional structure – When adding vertical stanchions, wheel chair lifts and/or tie down options, additional structure is welded into the floor at locations specified by our engineering department on CAD drawings.

### **3.0.2 Sidewall Construction –**

- 3.0.2.1 Sidewall vertical member – The heart of our sidewall is the vertical structure, a roll formed 18 gauge aluminized steel capital “C” channel with 8 bends that create extreme strength and rigidity. The vertical member is installed in full lengths and in shorter sections above and below window frames. Additional vertical structure is used at both ends of the sidewall enabling the structure to withstand the forces applied by the vehicle when in motion. Using the open C member also enables a thorough primer application.
- 3.0.2.2 Aluminized steel Tubing – 1”x1” lower and 1”x3” upper 16 gauge aluminized steel tubing is welded in horizontally between vertical members to frame in window openings. This adds front to rear reinforcement as well.
- 3.0.2.3 Seat Track – 11 gauge high strength low alloy roll formed aluminized steel track is welded down each sidewall below the window frame. While serving as a seat attaching device, it adds excellent structure to the sidewall and also adds excellent side impact resistance.
- 3.0.2.4 Wheelchair Options – Add another layer of metal. Depending on track locations, another structure of aluminized steel is welded in place between each vertical member for attaching a shoulder belt mount. Also, additional structure is added to accommodate wheelchair door frames.
- 3.0.2.5 Full length aluminized steel tubing – 1”x1” 16 gauge aluminized steel tubing is stitch welded to the sidewall bottom and top at each vertical member for attaching to the floor and roof sections, respectively.

### **3.0.3 Rear Wall Construction –**

- 3.0.3.1 Rear wall vertical member – The vertical sidewall capital “C” channel with 8 bends is also used in the rear wall assembly. Full length structure is used at varying places, depending on choice of rear window, or rear door. Shorter cut pieces are used above windows and doors. Additional side windows used with the rear door also change the configuration.
- 3.0.3.2 Aluminized steel Tubing – 1”x1” 16 gauge aluminized steel tubing is welded horizontally between vertical members to provide a window frame in the standard product, and used as an upper door frame in the optional rear assembly.
- 3.0.3.3 Full length aluminized steel tubing – 1”x1” 16 gauge aluminized steel tubing is stitch welded to the rear wall top and bottom as in the sidewall assembly.



### **3.0.4 Roof Construction –**

- 3.0.4.1 Roof Bows – Radius formed one-piece 16 gauge aluminized steel roof bows formed as a modified hat post design with eight bends for exceptional strength, including 4 bends in the web similar to our vertical sidewall aluminized steel provide a roof structure capable of taking severe loads. They are then capped with top flat pieces from flange to flange to provide abundant surface area for securing the exterior roof material.
- 3.0.4.2 Aluminized steel Tubing – 1"x1" 16 gauge aluminized steel tubing is welded in horizontally to frame all lower window openings and 1" x 3" 16 gauge aluminized steel tubing to all upper window openings as required. A full perimeter is also welded on to mate the roof to the sidewall and rear wall, with short vertical pieces providing support on the front and rear ends. The 3" wide aluminized steel tube supplies a structural mounting surface for shoulder belt attachment and has been pull tested to federal standards.

### **3.0.5 Driver Compartment Overhead Halo –**

- 3.0.5.1 Aluminized steel Tubing – 1"x1" 16 gauge aluminized steel tubing is cut and jig welded into an integrated one piece structure spanning from the front roof bow of the body to the newly cut roof line of the cab. Also created during the structure manufacture is the housing for mounting the electronic circuit board.
- 3.0.5.2 11 Gauge Aluminized steel – formed to make brackets used to mount to the chassis roof.

### **3.0.6 False Floor (Cab to body transition) –**

- 3.0.6.1 Aluminized steel Tubing – 2" x2" 16 gauge aluminized steel tubing is welded together forming a flat body floor transition from the step area back to the actual body area. An overhang on the curbside provides a secure attach point frontally for the entry door frame added later.
- 3.0.6.2 Structural aluminized steel angle – 11 gauge 1.5"x1.5" structural angle is added in short lengths five places to provide attachment points to the chassis floor.

### **3.0.7 Interior Vertical Transition Frames –**

- 3.0.7.1 Aluminized steel Tubing – 1"x1" 16 gauge aluminized steel tubing is used vertically and a ladder type assembly is made welding the 1x 1 tube to .75"x.75" 11 gauge aluminized steel tube that is used horizontally in the assemblies. These pieces transition from the body fronts on each side to the driver halo side assembly and the entry door frame assembly on the curbside.

### **3.0.8 Entry Door & Step Assembly Frame –**

3.0.8.1 Aluminized steel Tubing – 1"x1" 16 gauge and .75"x.75" 11 gauge aluminized steel tube is cut to length and welded together in a ladder type construction forming a rigid frame for attaching the entry door/step assembly.

### **3.0.9 Entry Door/Step Assembly –**

3.0.9.1 11 Gauge Aluminized steel – The step riser/tread piece is manufactured from one-piece 11 gauge aluminized steel and uses 90° bends at all risers and treads. The bottom tread also adds an additional 90° bend for additional strength and safety. Upper and lower side pieces are then attached and an 11 gauge flat plate with holes is used to bridge the lower and upper side pieces, then is stitch welded and plug welded to form a strong one piece assembly.

## **APPLICATION OF EXTERIOR SIDEWALL MATERIAL**

### **FIBERGLASS/FRP/COMPOSITE SIDEWALLS**

Composite FRP exterior sidewall panels are installed using Manus Bond 75-UHVFC solvent and isocyanate-free structural adhesive. The adhesive is applied to the vertical and horizontal frame members in the sidewall structure, then the one piece panel is set into place and clamped until the structural adhesive reaches initial "green" strength that gives it the ability to support the weight of the sidewall panel without additional aid.

Manus 75-UHVFC is used due to the excellent adhesion, yield strength and elongation percentage of the product once cured. Designed as a replacement for mechanical fasteners, the adhesive also allows the material to expand and contract without undue stress since the elongation of the product is 250%. Faster curing two-part adhesives can be used but their lack of elongation can lead to cracking of the skin due to stresses applied by typical heat/cold cycles encountered.

Manus 75-UHVFC is also the adhesive used by Glaval to ensure permanent bonding of the plywood floor substrate to the coated aluminized steel frame members.

A product data sheet for Manus 75-UHVFC Structural Adhesive is attached for further information.

Should any further questions arise, please contact your Glaval Bus representative.

### **PAINTED ALUMINUM OR ALUMINIZED STEEL SIDEWALLS**

Mill painted aluminum or aluminized steel exterior sidewall panels are installed using a combination of Very High Bond tape with an acrylic adhesive and Manus Bond 75-UHVFC solvent and isocyanate-free structural adhesive. The side vertical wall bows have two flanges facing the exterior. Tape is applied to one vertical flange for fast adhesion while Manus 75-UHVFC structural adhesive is applied to the other vertical flange. The metal is put in place then pressure is applied by rollers to secure the metal to the tape and ensure good contact with the bead of structural adhesive.

As normal practice dictates, metal is overlapped moving up the sidewall for water shedding. The metal is held in place initially by the VHB tape, then subsequently by window ring flanges and belt line molding that is secured with stainless aluminized steel fasteners. The structural adhesive “greens” (initial grab strength) within two hours, depending on temperature and humidity conditions, then moves to a full cure within a few days.

As above, product data sheets are attached for Manus 75-UHVFC and also the VHB tape for your information. A pictorial information sheet of the process is also attached to enable a visual understanding of the process as well.

Should you have any questions, please contact your Glaval Bus representative.

## **ZPG-9902S**

A premium quality, durable thixotropic rust preventing sealant.

This rust inhibiting sealant is a blend of petroleum base materials and organometallic complex products dispersed in water. It is easily applied using airless spray equipment. When applied to metal surfaces a barrier film is formed, thereby extending the useful life of the treated material.

### **PHYSICAL PROPERTIES**

Color and appearance	Black, viscous liquid
Odor	Slight ammonia
Weight per gallon	10.4±0.4
Solids	55% by weight 45% by volume
Viscosity (Brookfield, #%)	5000 - 8000 cps at 20 rpm 1500 - 4000 cps at 100 rpm
Dry film	Firm/Flexible
Wet Film	No sag at 20 - 30 mils
VOC (less water)	0.2 pounds per gallon (24 g/l)

### **PERFORMANCE CHARACTERISTICS**

Gravelometer ASTM D3170	5A or better at 0° F
Corrosion Resistance	Passes ASTM B117 (1000 hours)
High Temperature Resistance	Dry film will not flow at temperatures below 450° F
Dry Time (12 mils wet) at 72° F 50% R.H., moderate air flow	To touch - 2 hours Fully dried - 48 hours
Bend Resistance ASTM D522	Passes 0.5 inch mandrel at 0° F

See Warranty/Caution on Back

### **BENEFITS**

- High film build capability

- High temperature (<450°F) flow resistance/low temperature flexibility
- Suitable for severe atmospheric corrosion protection
- Hydro-erosion resistant
- Superior chemical resistance
- Meets military performance standards
- Superior seam penetration

#### **PREPARATION AND USE**

This formula is ready to use direct from the drum. Certain steps, however, are required in preparation for its proper and effective use:

- Apply between 60° - 90° F. 80° - 90° F material temperature provides optimum process ease.
- Agitate prior to use.
- Use in well ventilated areas.
- Do not allow to freeze.

#### **APPLICATION**

- Formulated to use on metal surfaces, automotive or industrial where superior, long term corrosion protection is required.
- Designed for use with airless or high pressure air assisted airless equipment: contact Applications Department for recommended equipment.
- Readily removed with mineral spirits.
- Coverage at 130 sq. Ft. Per gallon (at 12 mils wet recommended thickness).

#### **CAUTIONS**

Safety glasses, neoprene gloves and an O.S.H.A. approved respirator are recommended. Continuous exposure without safety equipment may cause headaches, nausea, dizziness and eye or skin irritation. If impairment persists, seek medical attention. If swallowed, do not induce vomiting. Call physician.



Creative Bus Sales

☐ 3.21      **Wheelbase: provide length of proposed wheelbase.**

Creative Bus Sales will build our buses in response to this RFP on a 156" wheel base.

Please see the below **floorplan drawings provided,** which show the wheelbase measurements.

# FEATHER WEIGHT

## FOLDAWAY BV & AM STYLES

Freedman Seating gives you the largest selection of Foldaways in the industry. Whether you need space for luggage or wheel chairs, we have the right seat. Easy to install and easier to operate, our Foldaways will provide you with miles and miles of happy riders and drivers. Maybe we should say, "smiles and smiles". Freedman Seating, "Not just seats — seating solutions."



Notch-Back, standard Bench-Back and High-Back are shown.

Not Just Seats



THE FEATHER WEIGHT SERIES BY

**FREEDMAN**

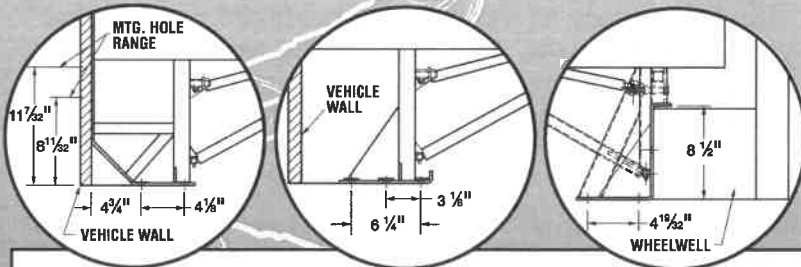
SEATING COMPANY

an ISO 9001:2000 certified company

Seating Solutions™

# FEATHER WEIGHT

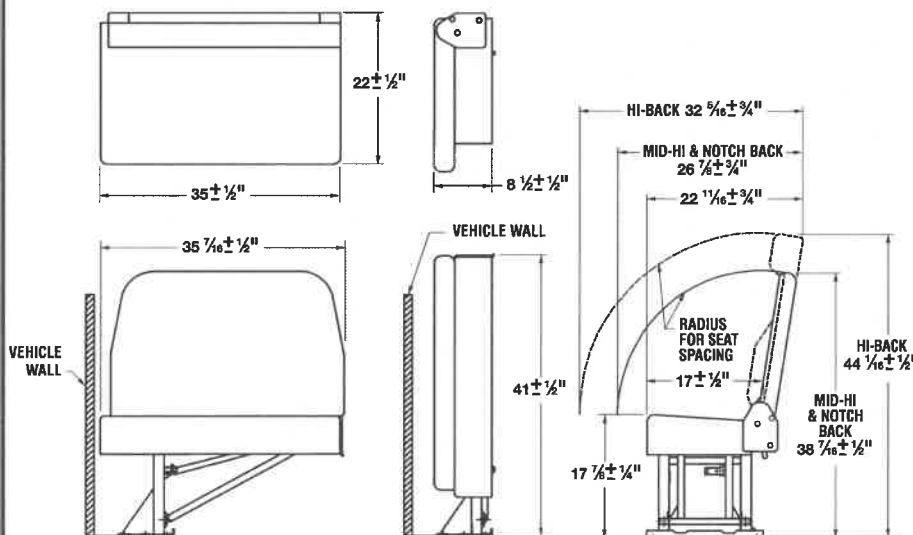
## Foldaway BV & AM STYLES



AM2 Floor/Wall Mount

BV Floor Mount

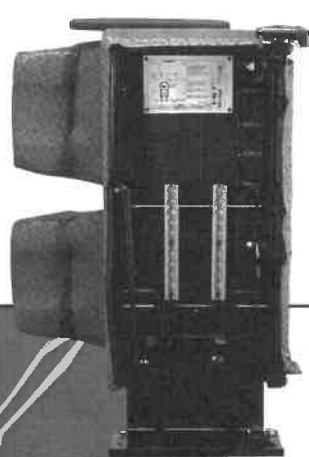
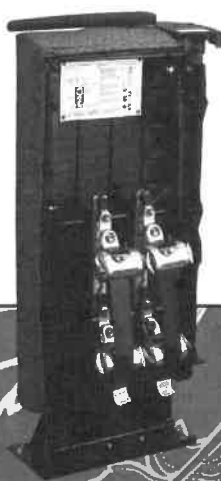
BVWW3 Floor Mount



Corner Grabs

TDSS with belts

TDSS without belts



Belts not included.

### Standard Features:

- BV Foldaways mount to the vehicle with four bolts to the floor (no wall mount)
- AM Foldaways mount to the vehicle with four bolts to the floor and two to the wall mount
- Seat belt ready (FMVSS 210 compliant with no leg or tether)
- Ultra-thin backrest for added hip-to-knee room and lumbar support
- High quality molded polyurethane seat and back cushions

- Folds up to less than 10" thick when in the stowed position
- Cantilever design provides reduced installation time; no floor cutting for aisle leg and easy vehicle clean up
- Wire mesh grid seat springs for even support
- 2 locking mechanisms to hold seat in stowed position

### Options:

- Single or double seats
- Bench back, notch back or high back
- Wheel well seats
- Wide variety of vinyl's or cloths
- Molded U.S. arms or upholstered arms
- Black or yellow top grabs (not on high backs)
- Black or yellow corner grabs (black side only on high back)
- Vertical stitching
- FTA foam
- ABS backs (Notchback only)
- Adjustable headrests (Single and Notchback only)
- Shrouds to cover the Foldaway when stowed
- USR seat belts (Under Seat Retractors)
- CRS-225 hooks and tethers
- TDSS (Tie Down Storage System)

## Not Just Seats



THE FEATHER WEIGHT SERIES BY

**FREEDMAN**  
SEATING COMPANY

an ISO 9001:2000 certified company

4545 W. Augusta Blvd., Chicago, IL 60651  
(773) 524-2440 (800) 443-4540 Fax: (773) 252-7450  
WWW.FREEDMANSEATING.COM  
e-mail: sales@freedmanseat.com

We are constantly updating and improving our seats; therefore we reserve the right to change or modify specifications or materials without notice. All Freedman Seating Company seats meet or exceed FMVS standards.

Seating Solutions™



# FEATHER WEIGHT

**MID-HI SEAT  
"ROCK SOLID"**



## Sustainable Seating Solutions

Freedman Seating Company's Feather Weight seats are designed to be like feathers on a bird: light and airy to satisfy weight restrictions and ensure a smooth ride, yet durable for years of service and low maintenance.

Freedman Seating Feather Weight seats are the most severely tested in the company's history, and meet all applicable federal motor vehicle safety standards for strength and safety (including 210 for seat belts).

Less weight means one thing to bus builders and operators: they can get more passengers per bus.

And when we say more passengers, ***we mean more happy passengers.***



Not Just Seats



Seating Solutions™

THE FEATHER WEIGHT SERIES BY

**FREEDMAN**

SEATING COMPANY

an ISO 9001:2000 certified company

# FEATHER WEIGHT

## MID-HI SEAT "ROCK SOLID"



### Sustainable Seating Solutions

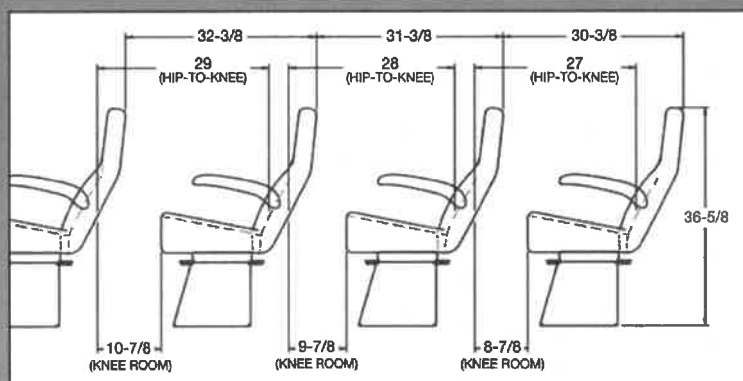
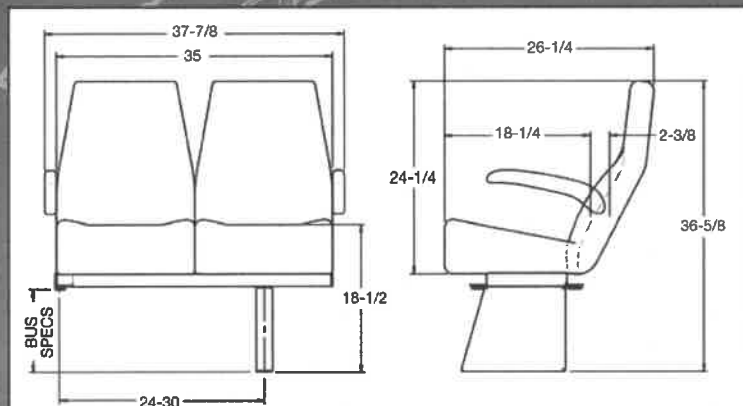
Whether your bus is for tour/charter, para-transit, or shuttle, Feather Weight Mid-Hi works for you. Optional adjustable headrests and reclining back-rests give you luxuries for long journeys, while grab rails and ABS plastic backs provide the function and safety required for shorter trips. The ultra-thin backrest gives outstanding support and creates more hip-to-knee room than any other seat in its class. The steel frame system meets or exceeds all applicable government standards for safety and durability. And, it's light as a feather!

#### Feather Weight Mid-Hi features include:

- An ultra-thin *Knee-Saver* type backrest for added hip-to-knee room and lumbar support
- Molded polyurethane seat and back cushions for comfort and long lasting support
- 17½" wide seat cushions
- 22½" back height off the seat cushion, 37" off the floor
- Wire mesh-grid seat springs for even support
- FMVSS 210 compliance—all *Feather Weight* seats are seat belt ready
- Transit style—rigid backrests (starting weight without options—43 lbs.)
- Touring style—reclining backrests (starting weight without options—47 lbs.)
- Covers that can be removed and replaced easily and without the use of special tools

#### Feather Weight Mid-Hi options include:

- Black molded U.S. Arms or upholstered flip-up armrests
- Adjustable headrests
- Black or yellow corner AV grab rails
- Black or yellow top AV grab rails
- ABS plastic backs
- Mesh map pockets
- Vertical stitching
- FTA foam
- Snack trays
- Aluminum folding footrests
- Pillow seat cushions
- Rear row quick disconnect
- Side sliders
- 16", 18" or 19" wide seats available
- Rigid or reclining backrests
- Seat belts
  - Non-retracting seat belts
  - Retracting seat belts
  - USR (Under Seat Retractors)
- S3 Bio-Cushions (Made with vegetable oil)
- A wide variety of cloths and vinyls
- S3 cloths (Made with recycled yarn)



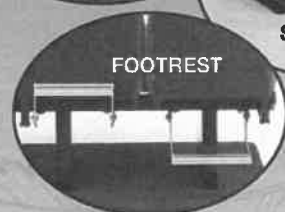
#### OPTIONS



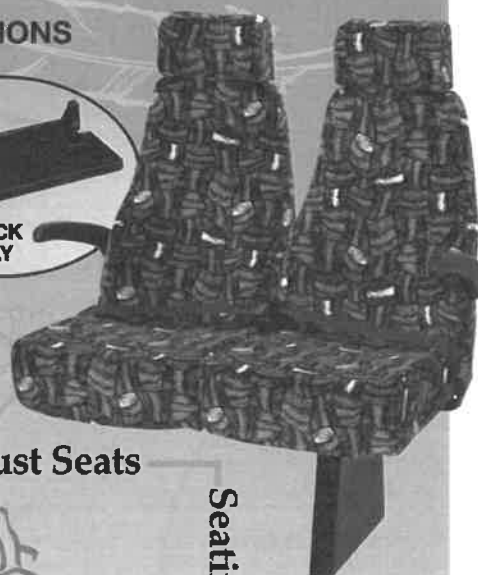
PILLOW SEAT



SNACK TRAY



FOOTREST



### Not Just Seats



Seating Solutions™

**FREEDMAN**  
SEATING COMPANY

an ISO 9001:2000 certified company

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(773) 524-2440 (800) 443-4540 Fax (773) 252-7450  
e-mail: sales@freedmanseat.com  
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ISO 9001:2000 registered

As Freedman Seating does not have a brochure specific to their USR (Underseat Retractable) seat belts, we have included a snip of their website showing some details and a photo.

The warranty for the seat belts is equal to the warranty of the seats themselves.

We would be happy to provide any additional information the State may require.



[About](#) [News](#) [Design Your Seat](#) [Videos](#) [Careers](#) [FAQs](#) [Calendar](#) [FMS Seating](#) [Seating Catalog](#) [Upholstery Catalog](#) [Showcase](#) [Parts Book](#) [Test Lab](#) [Contact Us](#)

[HOME](#) / [SEAT ITEMS](#) / [OPTIONS/ACCESSORIES](#) /  
[USR KIT \(UNDER SEAT RETRACTOR\)](#)

## USR KIT (UNDER SEAT RETRACTOR)

FREEDMAN USR KITS ARE PROVEN SAFE FOR PASSENGERS &  
EASY TO MAINTAIN

The solution to your seat belt needs. Our system places the seat  
belts right where you expect them. No more belts falling to the  
floor, safety concerns, or maintenance hassles.

[FMVSS/CMVSS Notice](#)

California residents [see Prop 65 WARNING](#).

<https://www.freedmanseating.com/fsc.htm>

Product Line: Options/Accessories



## Standard Features

- Designed to be FMVSS 210 compliant
- Works on forward-facing and existing Feather Weight frames
- Light weight and durable
- All belts are permanently kept in the correct position
- Belts stay off the floor



# FREEDMAN SEATING ICS

(Integrated Child Seat)

**KIDS &  
SAFETY**

**WHAT COULD  
BE MORE  
IMPORTANT?**

Also available  
the ICS-10,  
for children  
up to 10 years old.



Not Just Seats



THE FEATHER WEIGHT SERIES BY

**FREEDMAN**  
SEATING COMPANY

Seating Solutions™

# FREEDMAN

# SEATING ICS

## (Integrated Child Seat)

Kids and safety, what could be more important? Nothing!

That's the underlying principle behind the Freedman ICS (Integrated Child Seat) and ICS-10.

The ICS is designed for children from 22–51 lbs. and the ICS-10 can accommodate children up to 10 years old, 22–78 lbs. Both ICS seats are comfortable for adults and safe for children.

A tapered back provides unrestricted viewing for drivers, and best of all, the shoulder belts can be adjusted in seconds without taking the seat apart or clumsy operations.

### Standard Features:

- Accommodates children 22–51 lbs. (22–78 lbs for the ICS-10)
- Matching companion seat available
- Fold down tongue can be folded to act as a booster seat
- Easily adjustable shoulder straps
- Standard with FMVSS 213 and 210 seat belt anchorage compliance
- Retrofittable; Fits on most Feather Weight frames!

### Options:

- Available in a wide variety of vinyls and cloths
- Upholstered or US Arms
- Adjustable footrests
- Freedman USR (Under Seat Retractor)
- Available as a single or double
- Grab rails

Not Just Seats



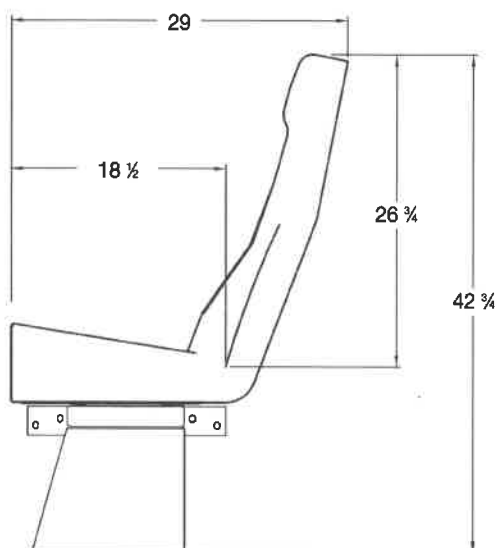
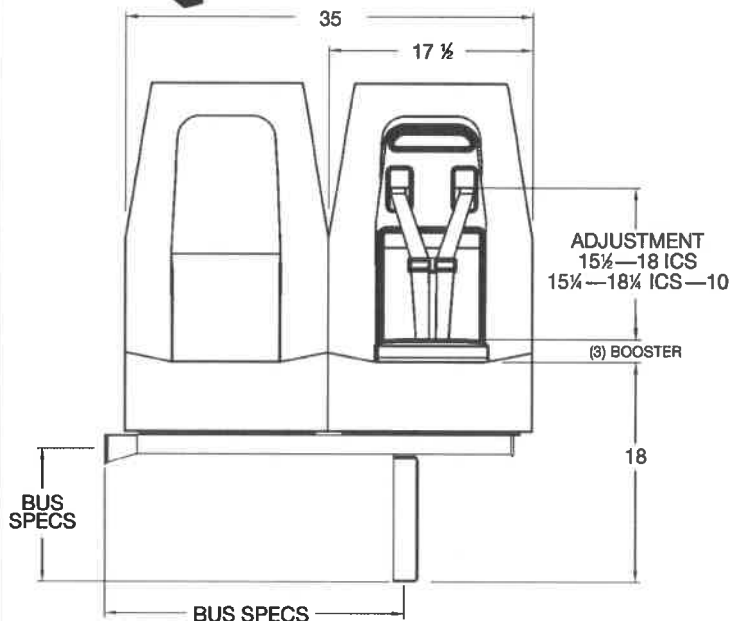
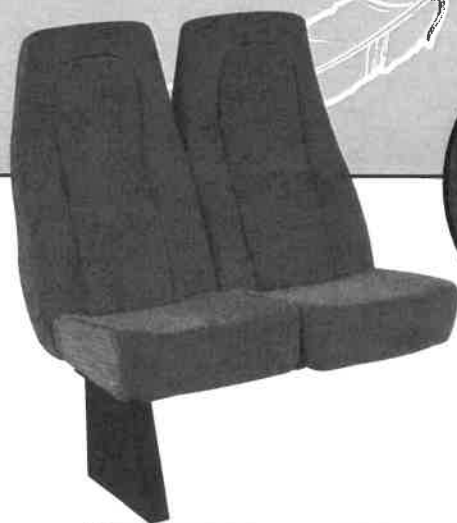
Seating Solutions™

THE FEATHER WEIGHT SERIES BY

**FREEDMAN**  
SEATING COMPANY

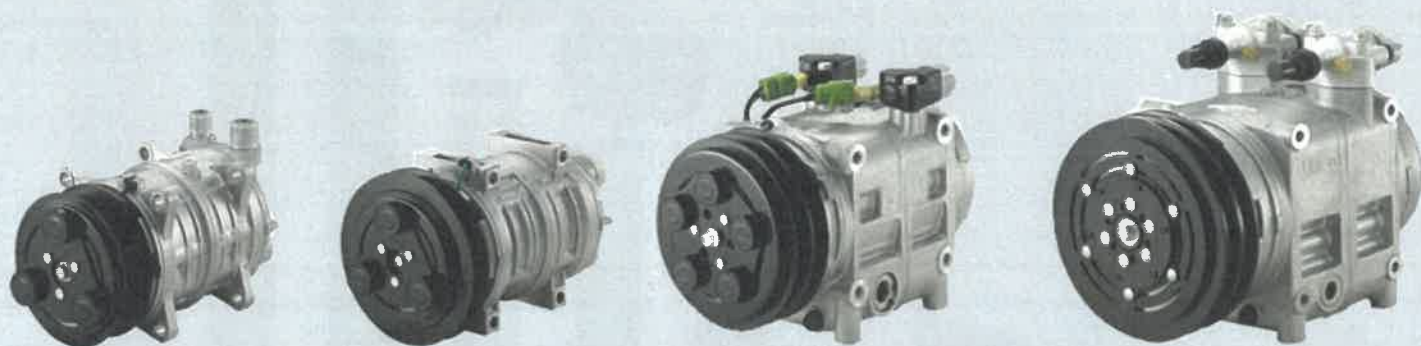
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AIR CONDITIONING COMPONENTS

# COMPRESSORS



## THE RIGHT COMPRESSOR FOR YOUR APPLICATION

ACC Climate Control, a Valeo brand offers several compressor options, granting flexibility in their power to supply products with specific application needs.

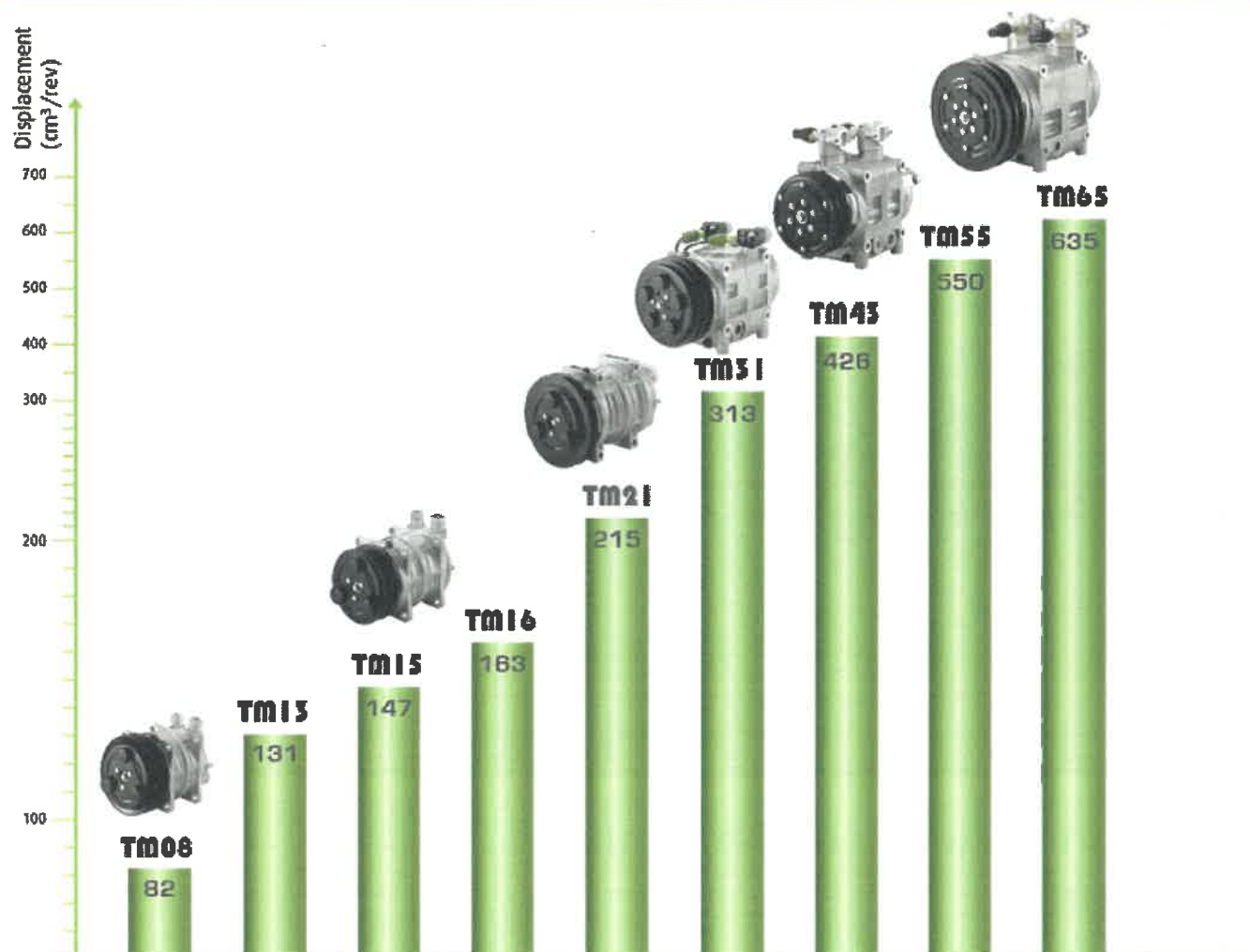
[BEST-BUS-CLIMATE.COM](http://BEST-BUS-CLIMATE.COM)





# COMPRESSORS

## HIGHLIGHTS



## TECHNICAL DATA

Model	Permissible Speed	Clutch Coil	Rotation	Displacement	Refrigerant	Mounting
TM16	700-6000 RPM	12-24 VDC	Clockwise & Counterclockwise	162.99 CC	R 134a	Pad & Ear
TM21	700-6000 RPM	12-24 VDC	Clockwise & Counterclockwise	214.7 CC	R 134a	Direct
TM31	600-7000 RPM	12-24 VDC	Clockwise	313 CC	R 134a	Direct
TM43	600-5000 RPM	12-24 VDC	Clockwise	425 CC	R 134a	Direct
TM55	600-4000 RPM	12-24 VDC	Clockwise	550 CC	R 134a	Direct
TM65	600-4000 RPM	12-24 VDC	Clockwise	635 CC	R 134a	Direct



Valeo Thermal Commercial Vehicles North America, Inc. - 22150 Challenger Drive Elkhart, IN 46514  
 Phone 574-264-2190 - Toll free 888-960-4849 - Fax 574-266-6744  
[www.valeo-thermalbus.com/us](http://www.valeo-thermalbus.com/us) - [ths.tbs-info.mailbox@valeo.com](mailto:ths.tbs-info.mailbox@valeo.com)



SPLIT SYSTEMS FOR SHUTTLE AND SCHOOL BUSES

# TROPICOOOL

23022 CEILING SERIES



## EXTREME CLIMATE EVAPORATORS

A series of extreme climate ceiling mounted evaporators. With maximum flexibility in system configurations, a properly balanced system is obtainable due to our wide array of evaporator models.

[BEST-BUS-CLIMATE.COM](http://BEST-BUS-CLIMATE.COM)



# 23022 CEILING EVAPORATOR

## HIGHLIGHTS



### Design

- Dynamically balanced twin shaft blower assemblies
- Standard relay board with electrical diagnostic LEDS
  - Mounted beside evaporator or vehicles electrical panel
- Standard manual controls or fully automatic



### Environmental Friendliness

- Orifice tube/accumulator with an enhanced drier
- Highly efficient rifled copper tube & aluminum fin coil for maximum capacity output & durability.
- Low-profile, side mount design available

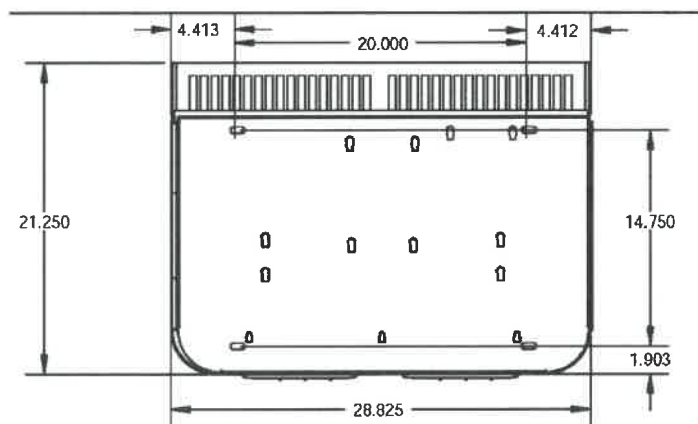
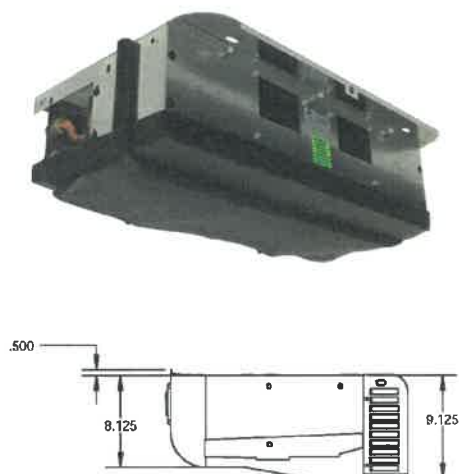


### Features

- 3 speed fans
- Optional w/heat 40k BTU/h heat capacity
  - Optional heat coil: 11471618B
- Plenum available if application applies
- Color Options
  - White
  - Grey
  - Black

### Key Components

- Coil: 11471511C
- Blower Assembly: 26060048A
- Orifice Tube: 08800502A



## TECHNICAL DATA

Model	Up to Cooling Capacity	Evaporator Airflow	Power Consumption	Nominal Voltage	Optional Heating Capacity	Dimensions L x W x H	Weight
23022	45,000 BTU/h	800 CFM	19 Amps	12V	40,000 BTU/h	28.5 x 17.5 x 9 in	52 lbs.



Valeo Thermal Commercial Vehicles North America, Inc. - 22150 Challenger Drive Elkhart, IN 46514  
 Phone 574-264-2190 - Toll free 888-960-4849 - Fax 574-266-6744  
[www.valeo-thermalbus.com/us](http://www.valeo-thermalbus.com/us) - [ths.tbs-info.mailbox@valeo.com](mailto:ths.tbs-info.mailbox@valeo.com)



Creative Bus Sales

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### 3.26 FRONT AND REAR HEAT AND AIR CONDITIONING

Creative Bus Sales will provide OEM, chassis included, front heat and air conditioning. The Ford warranty applies, which is 3 Year 36,000 mile.

For the Rear Air Conditioning Creative will include an ACC R226216 60,000 BTU system. The system will include model 23022 skirt evaporator and TM16 10 CID compressor. Please find the included product literature for these items.

For the Rear Heat, Creative will include a 35,000 BTU low profile floor heater, by PROAIR LLC. This 3-speed motor auxiliary heater produces the maximum of 35,000 BTU with outstanding 313CFM's. The unit size is 7" X 10" X 9" and it weighs 5.2 lbs. Please see the included product literature for this component. The warranty period on the heater is 1 year 12,000 miles.

# TECHNICAL DATA SHEET



## COMPONENT SPECIFICATIONS

### ProAir 435 / 445 / 465 Low Profile Heaters

Where a smaller height is required and high heat is of utmost importance the 435, 445 and 465 Low Profile auxiliary heaters deliver maximum BTUs with outstanding CFMs.

**Features:** Long Life Motor, 3 Year Warranty, Standard Plug-In on Harness and Filter Option Available

#### 435 / 445 Heater Performance

35,000 Btu/hr 435 Heater and 45,000 Btu/hr 445 Heater Capacity

##### Power Requirement

12 Volts DC

Draw is 5.0 Amps @ 13.5 Volts

##### Air Flow

313 CFM @ 0 static Pressure

##### Weight

8 Lbs. 435 Heater 9 Lbs. 445 Heater

##### Physical Size

W 10.25" x H 7.5" x D 9.5"



#### 465 Heater Performance

65,000 Btu/hr Heating Capacity

##### Power Requirement

12 Volts DC

Draw is 10.0 Amps @ 13.5 Volts

##### Air Flow

640 CFM @ 0 static Pressure

##### Weight

15 Lbs.

##### Physical Size

W 21" x H 7.5" x D 9.5"



##### Warranty

ProAir systems are covered by an industry-leading two-year warranty. Complete terms are outlined in our Warranty Statement, Consult ProAir for detailed information.

## Cooling System Specifications

Engine								Fan Specifications		
	Core Size (in.)			Rows of Tubes	Fins Per Inch	Cooling System Capacity (qts.)	In-tank Trans. Cooler	Type	No. of Blades	Blade Dia. (in.)
	Height	Width	Thick-ness							
3.5L PFDI V6	19.25	30.31	0.99	1	21.6	12.4 (Base) 13.6 (Aux.)	NA	Twin Electric	7+7	12.2 15.16
3.5L EcoBoost V6	19.25	30.31	0.99	1	21.6	12.4 (Base) 13.6 (Aux.)	NA	Twin Electric	7+7	12.2 15.16

## Electrical

250 Amperes Alternator  
Alternator Specifications

Battery Applications  
Cold Weather Recommendations  
Light Specifications and Usage

Standard Lighting/Reflector Equipment  
Trailer Towing Wiring Harness

## Alternator Specifications

Output (ampere) <sup>(1)</sup>	250
Output (watts)	3,375

(1) Actual output is temperature- and application-dependent.

## 250 Amperes Alternator

Engine	Pulley Ratio	Model Application
3.5L EcoBoost V6, 3.5L PFDI V6	2.67:1	Transit

**DESCRIPTION**

Backing			NT	MK
Thickness	ISO 24 346	mm	2.25 ± 0.15	6.20 ± 0.30
Weight	ISO 23 997	kg/m <sup>2</sup>	2.20 ± 0.15	3.65 ± 0.30
Roll width		cm	200 (-0 +1)	196 (-0 +1)
Roll length		lm	24	15

**PERFORMANCE**

Dimensional stability	ISO 23 999 ASTM D 1204	%	≤ 0.3	
Abrasion resistance	TABER ISO 9352	mg	≤ 300	
Slip resistance	DIN 51130		R10	R10
Indentation test	ISO 24 343-1	mm	≤ 0.2	≤ 1.0
Low temperature resistance	D 42 1235 A	°C	- 20	- 20
Thermal conductivity	ISO 22007-2	W / wK		0.089
Phonic Insulation	ISO 717/2	dB	ΔI = 5	ΔI = 22
Colour fastness	ISO 105 B02 ISO 4582/80 ASTM D 4459		≥ 7	
Fire resistance	FMVSS 302		Conform	
	ASTM E648	W/cm <sup>2</sup>	Class 1	
	R118-2		Conform	
Resistance to chemicals	ISO 26 987	-	Unaffected by diluted acids and bases Unaffected by domestic products (excluding solvents for plasticized PVC)	



**REVISED DTL REPORT NUMBER**  
**110450085Rev.1**



**Since 1903**

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**DETROIT TESTING LABORATORY, INC.**

**PREPARED FOR**  
**FLINT HILLS RESOURCE**  
**501 BRUNNER STREET**  
**PERU IL 61354**

**ATTENTION**  
**DENNIS PANIER**

**CUSTOMER PURCHASE ORDER NUMBER**  
**PEP10677**

**REPORT DATE**  
**JULY 14, 2011**

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**Detroit Testing Laboratory, Inc.**  
27485 George Merrelli Drive  
Warren, Michigan 48092 USA  
Phone: 586.754.9000  
Fax: 586.754.9045  
[www.dtl-inc.com](http://www.dtl-inc.com)

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**DTL**



Revised DTL Report Number: 110450085  
July 14, 2011

**REPORTED / APPROVED BY:**

**DETROIT TESTING LABORATORY, INC.**

  
David Smith, Department Manager  
Materials Testing

  
Timothy R. Geiger, Group Manager  
Materials Testing

DS/TRG/krs





## PURPOSE

The purpose of this test report is to present the test results obtained during the performance of a test program. This report includes a brief description of the samples presented for test, a list of the documents presented as test instructions, and a summary of the testing performed and the results obtained. Applicable requirements and conclusions are based on the criteria provided by our client, or as specified in the reference document(s).

## WORK REQUESTED / REFERENCE DOCUMENT(s)

Compression (As Received) per ASTM D1621-10  
Compression (After Heating) per ASTM D1621-10  
Flammability (As Received) per FMVSS 302-98  
Compression (As Received) per ASTM D1621-10, Re-test  
Compression (After Heating) per ASTM D1621-10, Re-test

## SAMPLE DESCRIPTION

Three (3) foam materials identified as 5354 104P75040 1.0pcf, 2.0pcf and 3.0pcf  
Additional samples of 104P75040 2.0 pcf received 6/24/11.

## SAMPLE CONDITIONING

Prior to testing, the samples were conditioned at 23 °C  $\pm$  2 °C and 50%  $\pm$  5% relative humidity, as applicable.

## TESTING PERFORMED

### COMPRESSION (AS RECEIVED) PER ASTM D1621-10

**Procedure** Foam specimens were tested as received. The samples measured three inches wide by three inches long and were one inch thick. The test speed was 2.5mm/min.

#### Results

Specimen	Average Compressive strength at 10% strain (MPa)	Average Compressive strength at 25% strain (MPa)	Average Compressive strength at 50% strain (MPa)
5354 104P75040 1.0 PCF density	0.0795	0.1050	0.1490
5354 104P75040 2.0 PCF density	0.1690	0.2030	0.2560
5354 104P75040 3.0 PCF density	0.3590	0.4020	0.4780

**Requirements** No specific criteria provided.

**Conclusion** To be determined by Flint Hills Resource.

### COMPRESSION (AFTER HEATING) PER ASTM D1621-10

**Procedure** Foam specimens were tested after 24 hours of heat aging at 82° C. The samples measured three inches wide by three inches long and were one inch thick. The test speed was 2.5mm/min.

#### Results

Specimen	Average Compressive strength at 10% strain (MPa)	Average Compressive strength at 25% strain (MPa)	Average Compressive strength at 50% strain (MPa)
5354 104P75040 1.0 PCF density	0.0840	0.1080	0.1540
5354 104P75040 2.0 PCF density	0.1830	0.2180	0.2720
5354 104P75040 3.0 PCF density	0.3930	0.4380	0.5240

**Requirements** No specific criteria provided.

**Conclusion** To be determined by Flint Hills Resource.

FLAMMABILITY (AS RECEIVED) PER FMVSS 302-98

Results

**5354 104P75040 1.0 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	SE
2	0	0	SE
3	0	0	SE
4	0	0	SE
5	0	0	SE

**5354 104P75040 2.0 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	SE
2	0	0	SE
3	0	0	SE
4	0	0	SE
5	0	0	SE

**5354 104P75040 3.0 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	SE
2	0	0	SE
3	0	0	SE
4	0	0	SE
5	0	0	SE

SE= Self Extinguishing

Requirements      Maximum Burn Rate of 102 mm/min

Conclusion          Specimens met the stated requirement.



**COMPRESSION (AS RECEIVED) PER ASTM D1621-10, RE-TEST**

**Procedure**                Foam specimen 5354 104P75040 2.0 PCF density was tested as received. The samples measured three inches wide by three inches long and were one inch thick. The test speed was 2.5 mm/min..

**Results**

<b>Specimen</b>	<b>Average Compressive strength at 10% strain (MPa)</b>	<b>Average Compressive strength at 25% strain (MPa)</b>	<b>Average Compressive strength at 50% strain (MPa)</b>
5354 104P75040 2.0 PCF density	0.1990	0.2370	0.3060

**Requirements**                No specific criteria provided.

**Conclusion**                To be determined by Flint Hills Resource.

**COMPRESSION (AFTER HEATING) PER ASTM D1621-10, RE-TEST**

**Procedure**                Foam specimen 5354 104P75040 2.0 PCF density was tested after 24 hours of heat aging at 82 °C. The samples measured three inches wide by three inches long and were one inch thick. The test speed was 2.5 mm/min

**Results**

<b>Specimen</b>	<b>Average Compressive strength at 10% strain (MPa)</b>	<b>Average Compressive strength at 25% strain (MPa)</b>	<b>Average Compressive strength at 50% strain (MPa)</b>
5354 104P75040 2.0 PCF density	0.2070	0.2450	0.3130

**Requirements**                No specific criteria provided.

**Conclusion**                To be determined by Flint Hills Resource.



## SAMPLE DISPOSITION

Samples will be retained at Detroit Testing Laboratory, Inc. for 30 days and then disposed of, unless otherwise specified by client.

Remark: This test report was revised to include retest data from samples received 6/24/11.

## TEST EQUIPMENT

Detroit Testing Laboratory, Inc.'s calibration system meets the requirements of ISO 17025:2005.

DTL ID	Description	Manufacturer	Model Number	Cal Due
07298	DIGITAL THERMOMETER	Omega	HH81	01/12
EC109	Environmental Chamber	Thermotron	1.2	NCR
07257	LOAD CELL (20000LB/100kN)	Instron	2518-801	07/11
07095	T/C TEST MACHINE (100 kN)	Instron	4505	07/11
07570	DIGITAL CALIPERS	Mitutoyo	CD-6" P	06/11
07258	Load Cell	Instron	2518-805	07/11
07133	Tensile Tester	Instron	4201	07/11
14286	Stop Watch	VWR / Control Company	62379-460	11/11
12190	Thermohumidigraph	Newport Electronics Inc.	CT485B	06/11
08462	Flammability Chamber	Sunspot Products	None	NCR
00850	Oven	Blue M	OV-490A-2	NCR
10890	Hydra Data Bucket	Fluke	2625A	02/12

NCR -- No Calibration Required

**APPENDICES:**    Appendix A:    Test Data

Customer: Flint Hills Resource

Job#: 110450085

Compression Deflection per D1621-10

Tested By: Dave Marlett

Material identification: 5354 104P75040 1.0 PCF density

Material conditioning: As received

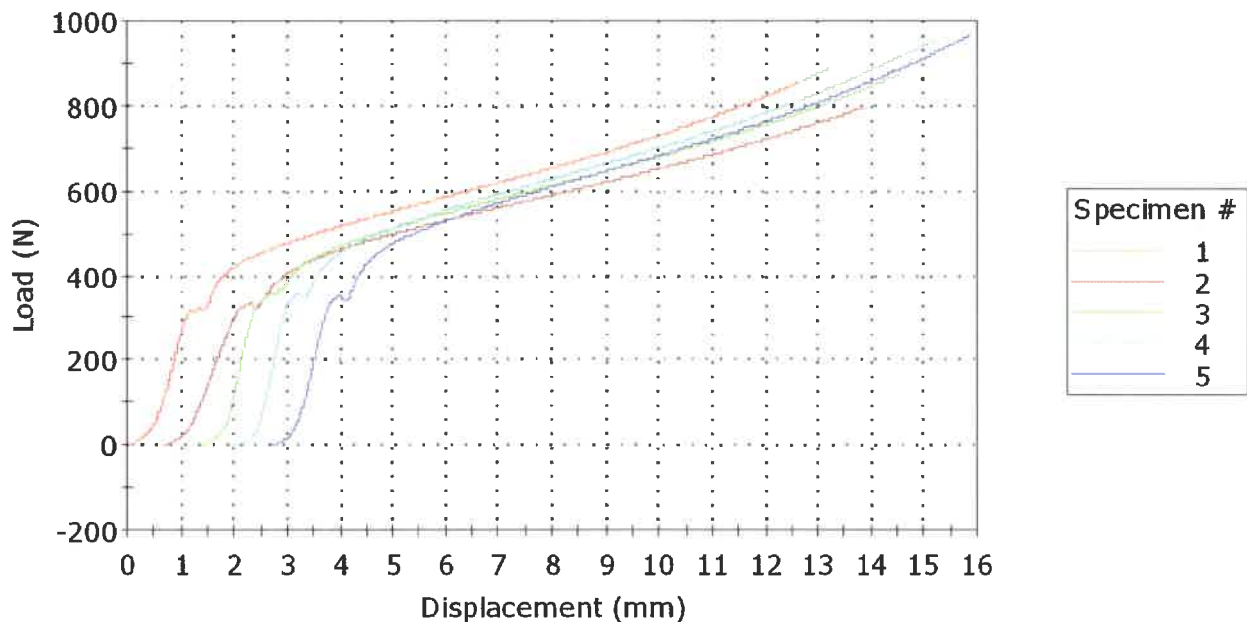
Test conditions: 23° C / 50% RH

Speed: 2.5mm/min

Load frame: 07133

Load cell: 07258

### Specimen 1 to 5



Customer: Flint Hills Resource

Job#: 110450085

Compression Deflection per D1621-10

Tested By: Dave Marlett

Material identification: 5354 104P75040 2.0 PCF density

Material conditioning: As received

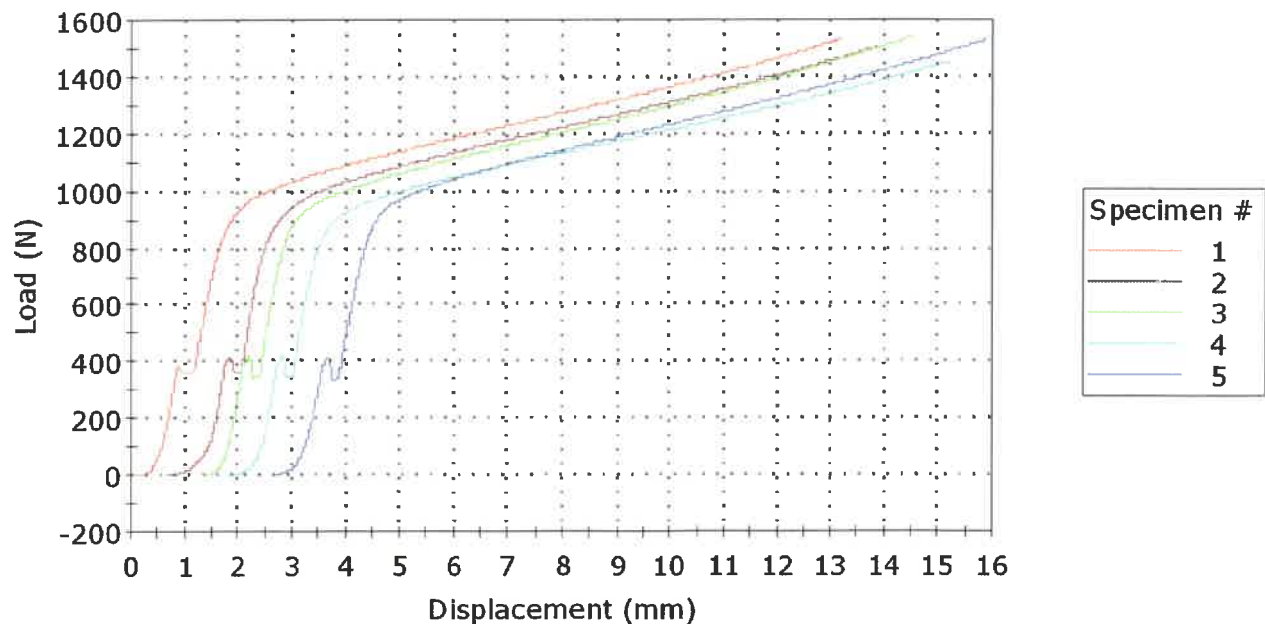
Test conditions: 23° C / 50% RH

Speed: 2.5mm/min

Load frame: 07133

Load cell: 07258

### Specimen 1 to 5



Customer: Flint Hills Resource

Job#: 110450085

Compression Deflection per D1621-10

Tested By: Dave Marlett

Material identification: 5354 104P75040 3.0 PCF density

Material conditioning: As received

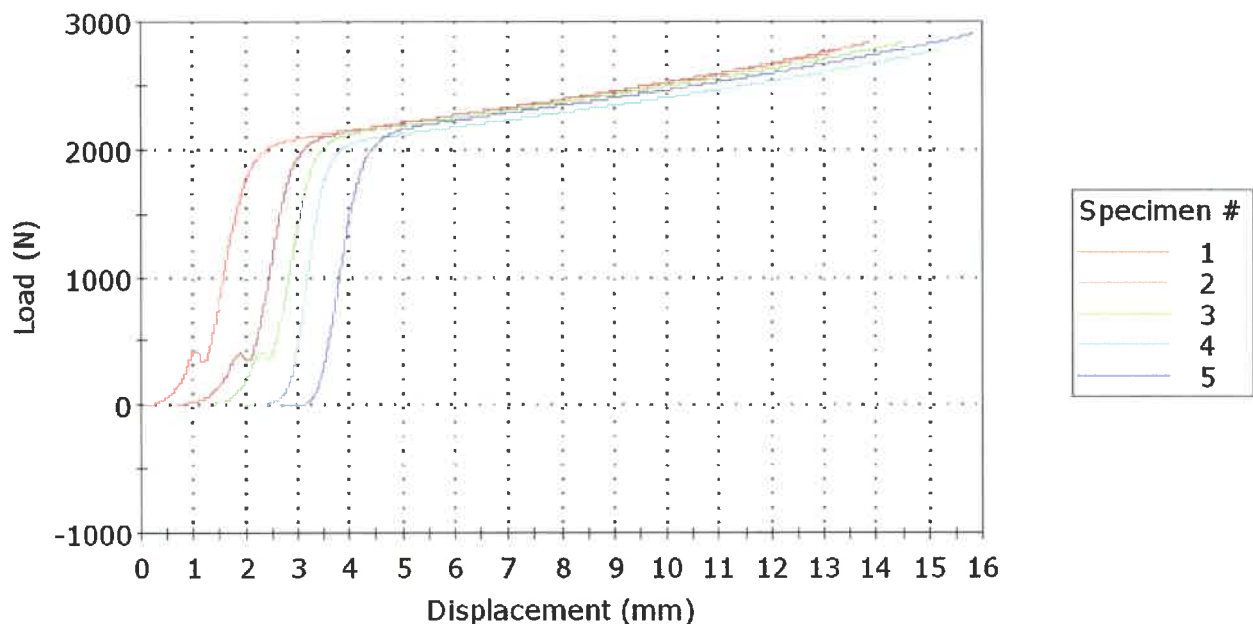
Test conditions: 23° C / 50% RH

Speed: 2.5mm/min

Load frame: 07133

Load cell: 07258

Specimen 1 to 5







Customer: Flint Hills Resource

Job#: 110450085

Compression Deflection per D1621-10

Tested By: Dave Marlett

Material identification: 5354 104P75040 1.0 PCF density

Material conditioning: Heat aged

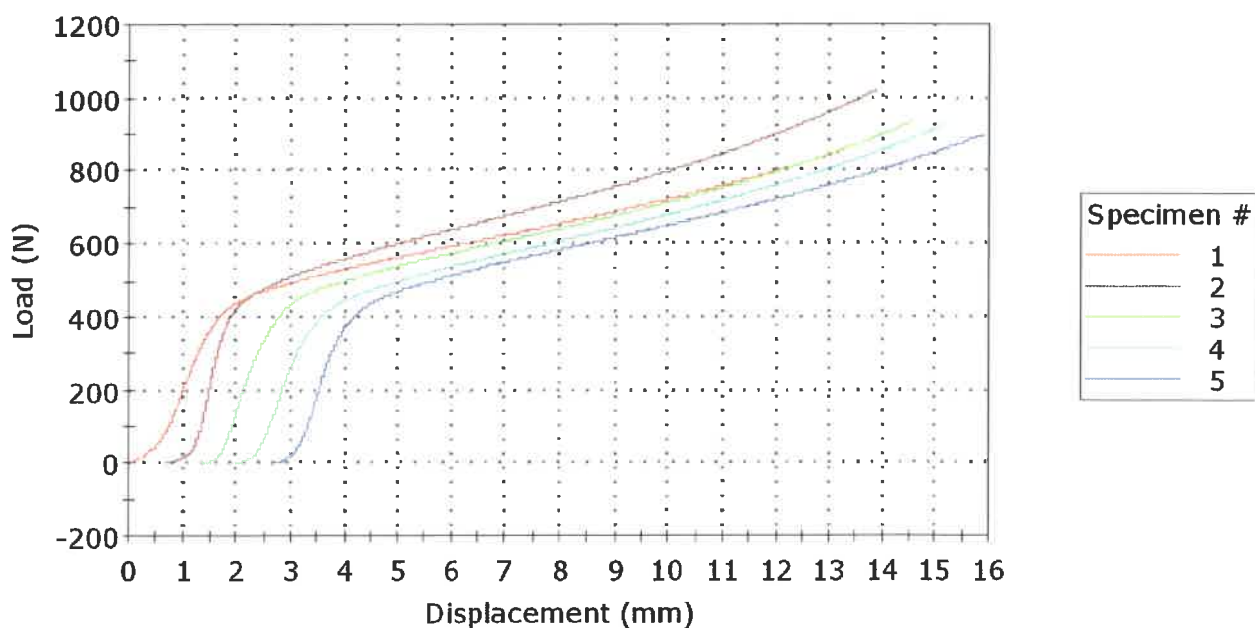
Test conditions: 23° C / 50% RH

Speed: 2.5mm/min

Load frame: 07095

Load cell: 07257

### Specimen 1 to 5



Customer: Flint Hills Resource

Job#: 110450085

Compression Deflection per D1621-10

Tested By: Dave Marlett

Material identification: 5354 104P75040 2.0 PCF density

Material conditioning: Heat aged

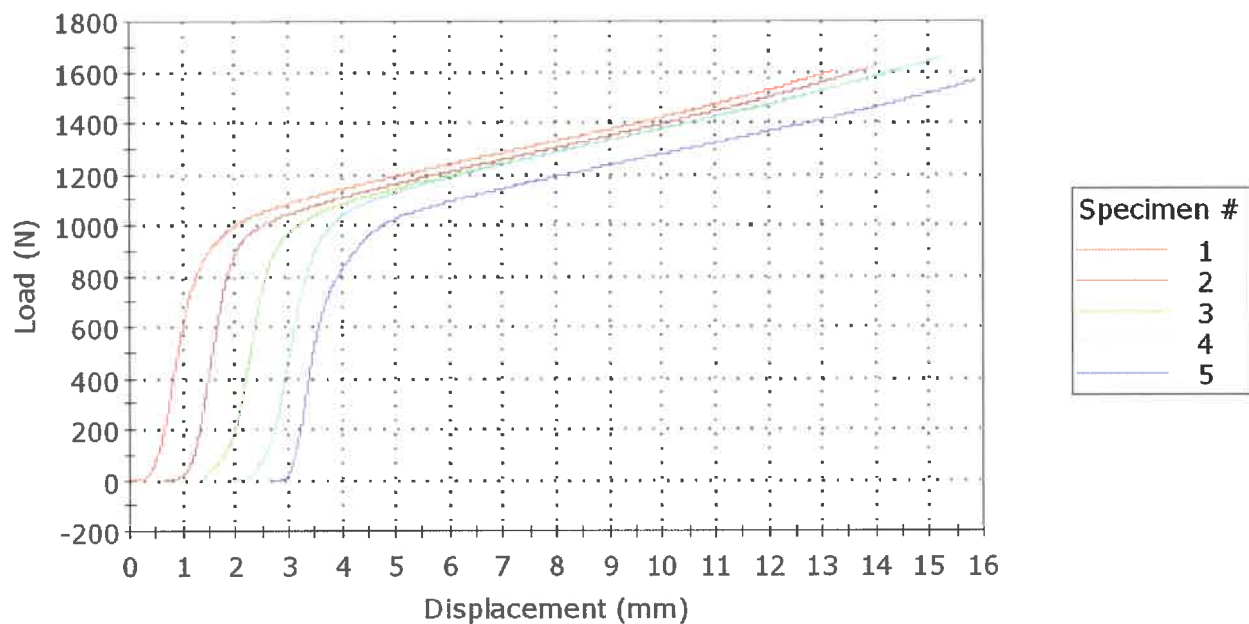
Test conditions: 23° C / 50% RH

Speed: 2.5mm/min

Load frame: 07095

Load cell: 07257

### Specimen 1 to 5





Customer: Flint Hills Resource

Job#: 110450085

Compression Deflection per D1621-10

Tested By: Dave Marlett

Material identification: 5354 104P75040 3.0 PCF density

Material conditioning: Heat aged

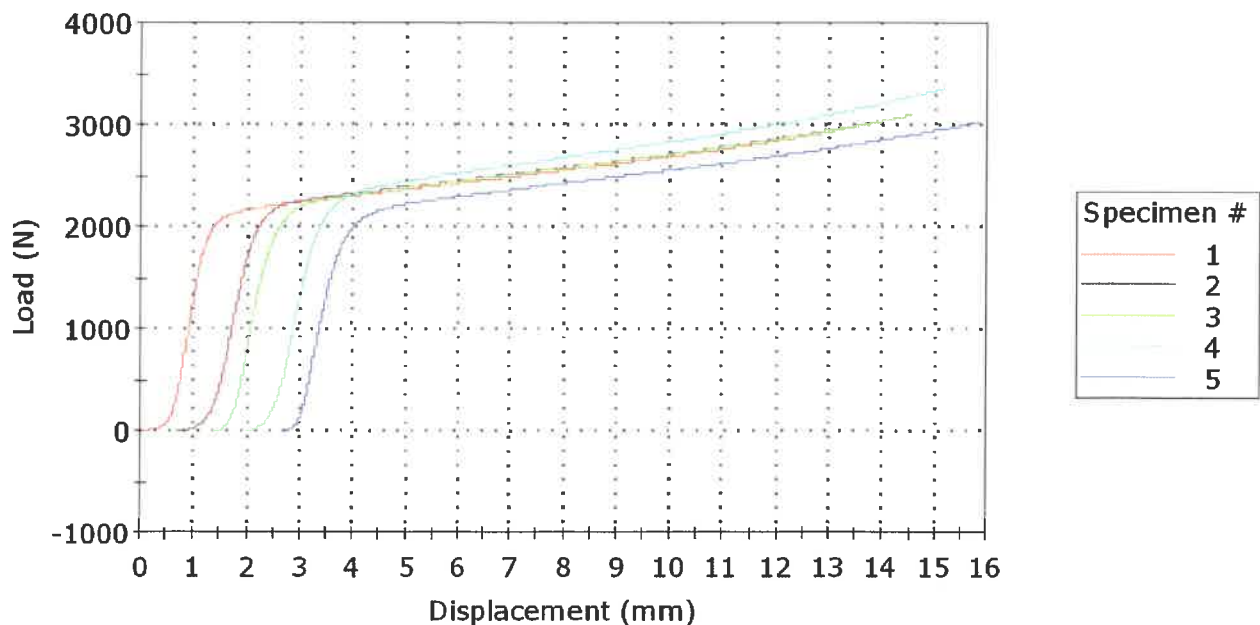
Test conditions: 23° C / 50% RH

Speed: 2.5mm/min

Load frame: 07095

Load cell: 07257

### Specimen 1 to 5



Customer: Flint Hills Resources

Job#: 110450085

Compression Deflection per D1621-10

Tested By: Dave Marlett

Material identification: 5354 104P75040 2.0 PCF density

Material conditioning: As received

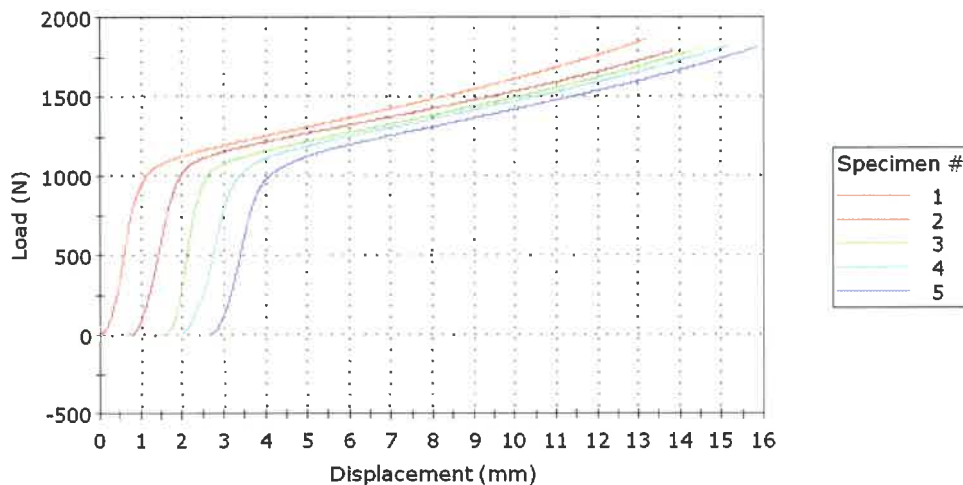
Test conditions: 23° C / 50% RH

Speed: 2.5mm/min

Load frame: 07095

Load cell: 07257

Specimen 1 to 5





	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.201	0.239	0.313
2	0.201	0.237	0.302
3	0.198	0.235	0.304
4	0.199	0.238	0.307
5	0.196	0.235	0.304
Mean	0.199	0.237	0.306
Std. Dev.	0.00	0.00	0.00

Customer: Flint Hills Resources

Job#: 110450085

Compression Deflection per D1621-10

Tested By: Dave Marlett

Material identification: 5354 104P75040 2.0 PCF density

Material conditioning: Heat Aged

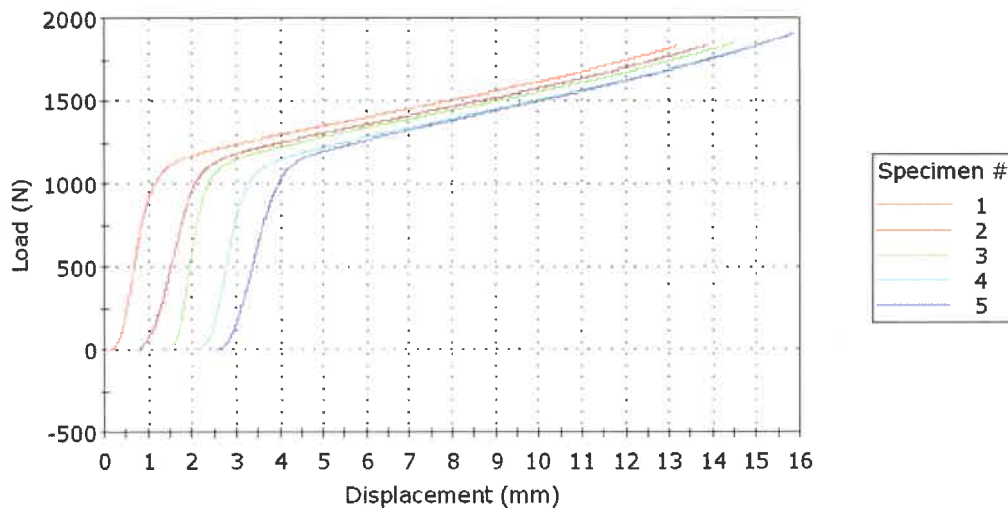
Test conditions: 23° C / 50% RH

Speed: 2.5mm/min

Load frame: 07095

Load cell: 07257

Specimen 1 to 5





	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.209	0.245	0.310
2	0.206	0.244	0.310
3	0.209	0.246	0.313
4	0.205	0.243	0.313
5	0.208	0.248	0.321
Mean	0.207	0.245	0.313
Std. Dev.	0.00	0.00	0.00

**DTL REPORT NUMBER**  
**110250008**



**Since 1903**

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**DETROIT TESTING LABORATORY, INC.**

**PREPARED FOR**  
**FLINT HILLS RESOURCES**  
**501 BRUNNER STREET**  
**PERU IL 61354**

**ATTENTION**  
**DENNIS PANIER**

**CUSTOMER PURCHASE ORDER NUMBER**  
**PEP10524**

**REPORT DATE**  
**JUNE 7, 2011**

**Detroit Testing Laboratory, Inc.**  
27485 George Merrelli Drive  
Warren, Michigan 48092 USA  
Phone: 586.754.9000  
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**DTL**





DTL Report Number: 110250008  
June 7, 2011

**REPORTED / APPROVED BY:**

**DETROIT TESTING LABORATORY, INC.**

  
David Smith, Department Manager  
Materials Testing

  
Timothy R. Geiger, Group Manager  
Materials Testing

DS/TRG/bsj



## PURPOSE

The purpose of this test report is to present the test results obtained during the performance of a test program. This report includes a brief description of the samples presented for test, a list of the documents presented as test instructions, and a summary of the testing performed and the results obtained. Applicable requirements and conclusions are based on the criteria provided by our client, or as specified in the reference document(s).

## WORK REQUESTED / REFERENCE DOCUMENT(s)

Compression (As Received) per ASTM D1621-10  
Compression (After Heating) per ASTM D1621-10  
Flammability (As Received) per FMVSS 302-98

## SAMPLE DESCRIPTION

Eleven foams identified as:

5454 101P25013 1.0 PCF density  
5454 101P25013 2.0 PCF density  
5454 101P25013 3.0 PCF density  
5654 101P15002 1.0 PCF density  
5654 101P15002 2.0 PCF density  
5654 101P15002 3.0 PCF density  
7654 101P17001 1.0 PCF density  
7654 101P17001 2.0 PCF density  
7654 101P17001 3.0 PCF density  
S7454 101P27002S 1.2 PCF density  
S7454 101P27002S 2.0 PCF density

## SAMPLE CONDITIONING

Prior to testing, the samples were conditioned at 23 °C  $\pm$  2 °C and 50%  $\pm$  5% relative humidity, as applicable.



## TESTING PERFORMED

### COMPRESSION (AS RECEIVED) PER ASTM D1621-10

**Procedure**                      Foam specimens were tested as received. The samples measured three inches wide by three inches long and were one inch thick. The test speed was 2.5mm/min.

### Results

Specimen	Compressive strength at 10% strain (MPa)	Compressive strength at 25% strain (MPa)	Compressive strength at 50% strain (MPa)
5454 101P25013 1.0 PCF density	0.0990	0.1240	0.1750
5454 101P25013 2.0 PCF density	0.1900	0.2260	0.2930
5454 101P25013 3.0 PCF density	0.3960	0.4470	0.5470
5654 101P15002 1.0 PCF density	0.0933	0.1150	0.1720
5654 101P15002 2.0 PCF density	0.2360	0.2720	0.3500
5654 101P15002 3.0 PCF density	0.4400	0.4880	0.5910
7654 101P17001 1.0 PCF density	0.0888	0.1110	0.1650
7654 101P17001 2.0 PCF density	0.2580	0.2950	0.3690
7654 101P17001 3.0 PCF density	0.4710	0.5480	0.6830
S7454 101P27002S 1.2 PCF density	0.1390	0.1670	0.2170
S7454 101P27002S 2.0 PCF density	0.2300	0.2700	0.3420

**Requirements**              No specific criteria provided.

**Conclusion**                To be determined by Flint Hills Resources.



## COMPRESSION (AFTER HEATING) PER ASTM D1621-10

**Procedure**                      Foam specimens were tested after heat aging, 24 hours at 82°C. The samples measured three inches wide by three inches long and were one inch thick. The test speed was 2.5mm/min.

### Results

<b>Specimen</b>	<b>Compressive strength at 10% strain (MPa)</b>	<b>Compressive strength at 25% strain (MPa)</b>	<b>Compressive strength at 50% strain (MPa)</b>
5454 101P25013 1.0 PCF density	0.1030	0.1290	0.1820
5454 101P25013 2.0 PCF density	0.2060	0.2440	0.3150
5454 101P25013 3.0 PCF density	0.4200	0.4760	0.5850
5654 101P15002 1.0 PCF density	0.1020	0.1250	0.1850
5654 101P15002 2.0 PCF density	0.2500	0.2920	0.3800
5654 101P15002 3.0 PCF density	0.4480	0.5040	0.6150
7654 101P17001 1.0 PCF density	0.0947	0.1190	0.1730
7654 101P17001 2.0 PCF density	0.2810	0.3220	0.4010
7654 101P17001 3.0 PCF density	0.5020	0.5820	0.7290
S7454 101P27002S 1.2 PCF density	0.1440	0.1720	0.2230
S7454 101P27002S 2.0 PCF density	0.2440	0.2840	0.3610

**Requirements**                No specific criteria provided.

**Conclusion**                    To be determined by Flint Hills Resources.

FLAMMABILITY (AS RECEIVED) PER FMVSS 302-98

Results

**5454 101P25013 1.0 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	DNI
2	0	0	DNI
3	0	0	SE
4	0	0	DNI
5	0	0	SE

**5454 101P25013 2.0 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	SE
2	0	0	SE
3	0	0	SE
4	0	0	SE
5	0	0	SE

**5454 101P25013 3.0 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	SE
2	0	0	SE
3	0	0	SE
4	0	0	SE
5	0	0	SE

**5654 101P15002 1.0 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	SE
2	0	0	SE
3	0	0	SE
4	0	0	SE
5	0	0	SE

FLAMMABILITY (AS RECEIVED) PER FMVSS 302-98 CONTINUED

**5654 101P15002 2.0 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	SE
2	0	0	SE
3	0	0	SE
4	0	0	SE
5	0	0	SE

**5654 101P15002 3.0 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	SE
2	0	0	SE
3	0	0	SE
4	0	0	SE
5	0	0	SE

**7654 101P17001 1.0 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	DNI
2	0	0	DNI
3	0	0	SE
4	0	0	SE
5	0	0	DNI

**7654 101P17001 2.0 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	SE
2	0	0	SE
3	0	0	SE
4	0	0	SE
5	0	0	SE



FLAMMABILITY (AS RECEIVED) PER FMVSS 302-98 CONTINUED

**7654 101P17001 3.0 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	SE
2	0	0	SE
3	0	0	SE
4	0	0	SE
5	0	0	SE

**S7454 101P27002S 1.2 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	SE
2	0	0	SE
3	0	0	DNI
4	0	0	SE
5	0	0	SE

**S7454 101P27002S 2.0 PCF density:**

Specimen	Burn Time (sec)	Burn Length (mm)	Burn Rate (mm/min)
1	0	0	SE
2	0	0	SE
3	0	0	DNI
4	0	0	SE
5	0	0	SE

SE = Self extinguished

DNI = Did not ignite

Requirements      Maximum Burn Rate of 102 mm/minute

Conclusion          Specimens met the stated requirement.



## SAMPLE DISPOSITION

Samples will be retained at Detroit Testing Laboratory, Inc. for 30 days and then disposed of, unless otherwise specified by client.

## TEST EQUIPMENT

Detroit Testing Laboratory, Inc.'s calibration system meets the requirements of ISO 17025:2005.

DTL ID	Description	Manufacturer	Model Number	Cal Due
12876	Stop Watch	VWR	62379460	09/11
12190	Thermohumidigraph	Newport Electronics Inc/	CT485B	06/11
08462	Flammability Chamber	Sunspot Products	None	NCR
00850	Oven	Blue M	OV-490A-2	NCR
10890	Hydra Data Bucket	Fluke	2625A	02/12
07570	DIGITAL CALIPERS	Mitutoyo	CD-6" P	06/11
07258	Load Cell	Instron	2518-805	07/11
07095	T/C TEST MACHINE (100 kN)	Instron	4505	07/11

NCR -- No Calibration Required

**APPENDICES:**    Appendix A:    Test Data



Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Friday, May 13, 2011

Tested By: Dave Marlett

Material identification: 5454 101P25013 1.0 PCF density

Material conditioning: As received

Test conditions: 23° C / 50% RH

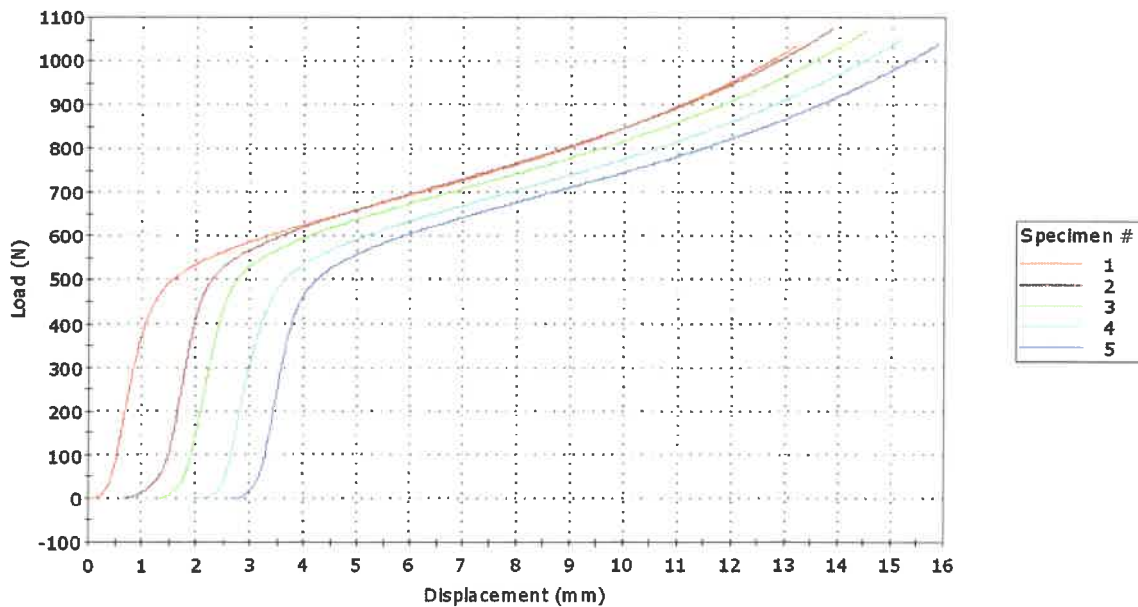
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.0976	0.121	0.172
2	0.100	0.126	0.178
3	0.101	0.126	0.178
4	0.0980	0.123	0.175
5	0.0980	0.122	0.173
Mean	0.0990	0.124	0.175
Std. Dev.	0.00	0.00	0.00

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Friday, May 13, 2011

Tested By: Dave Marlett

Material identification: 5454 101P25013 2.0 PCF density

Material conditioning: As received

Test conditions: 23° C / 50% RH

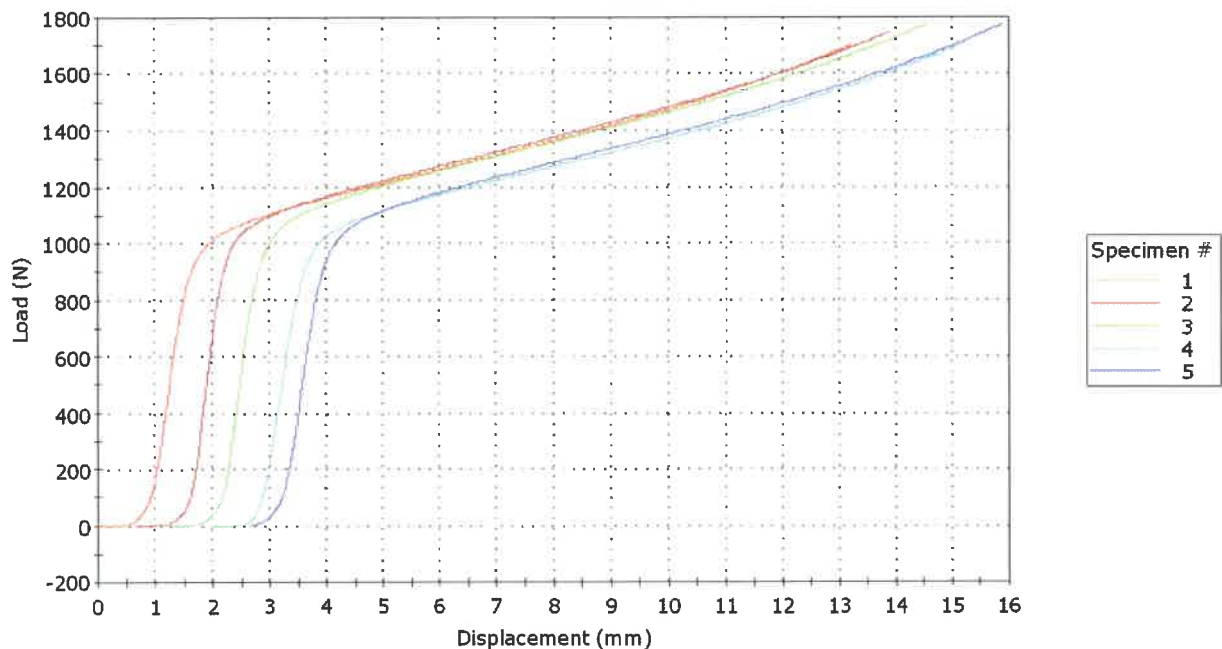
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.184	0.221	0.286
2	0.192	0.228	0.294
3	0.195	0.231	0.298
4	0.186	0.222	0.287
5	0.194	0.230	0.298
Mean	0.190	0.226	0.293
Std. Dev.	0.00	0.00	0.01



Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Friday, May 13, 2011

Tested By: Dave Marlett

Material identification: 5454 101P25013 3.0 PCF density

Material conditioning: As received

Test conditions: 23° C / 50% RH

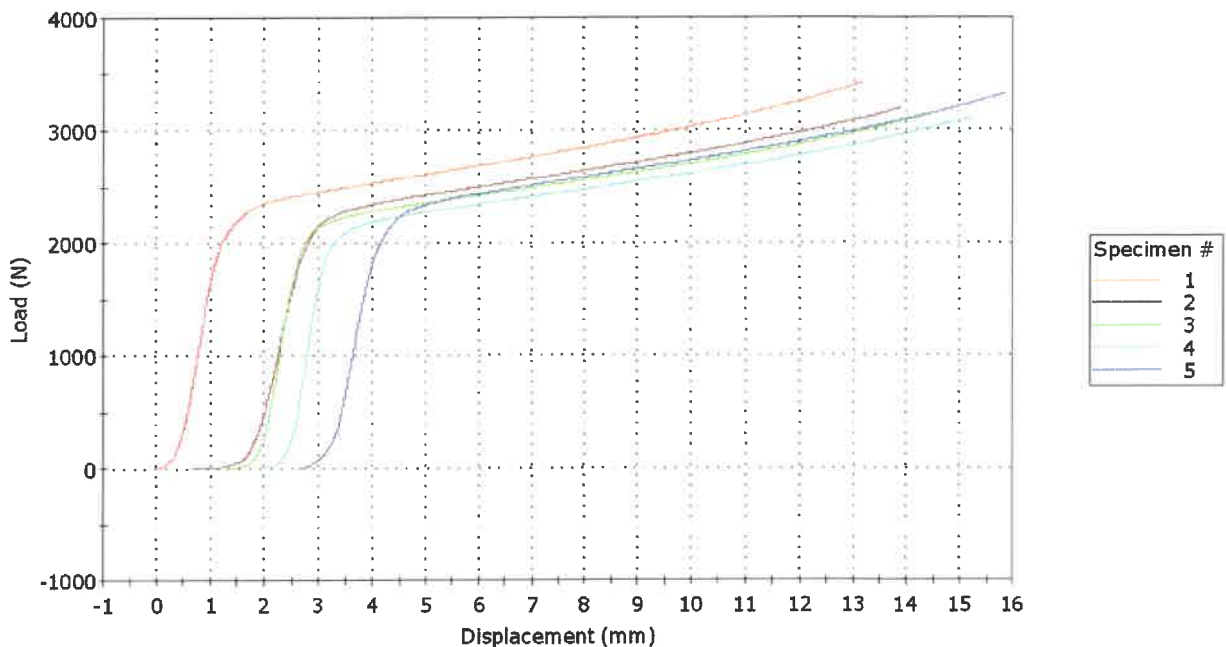
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.416	0.467	0.578
2	0.383	0.443	0.539
3	0.391	0.437	0.532
4	0.386	0.431	0.525
5	0.407	0.458	0.561
Mean	0.396	0.447	0.547
Std. Dev.	0.01	0.02	0.02

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Friday, May 13, 2011

Tested By: Dave Marlett

Material identification: 5654 101P15002 1.0 PCF density

Material conditioning: As received

Test conditions: 23° C / 50% RH

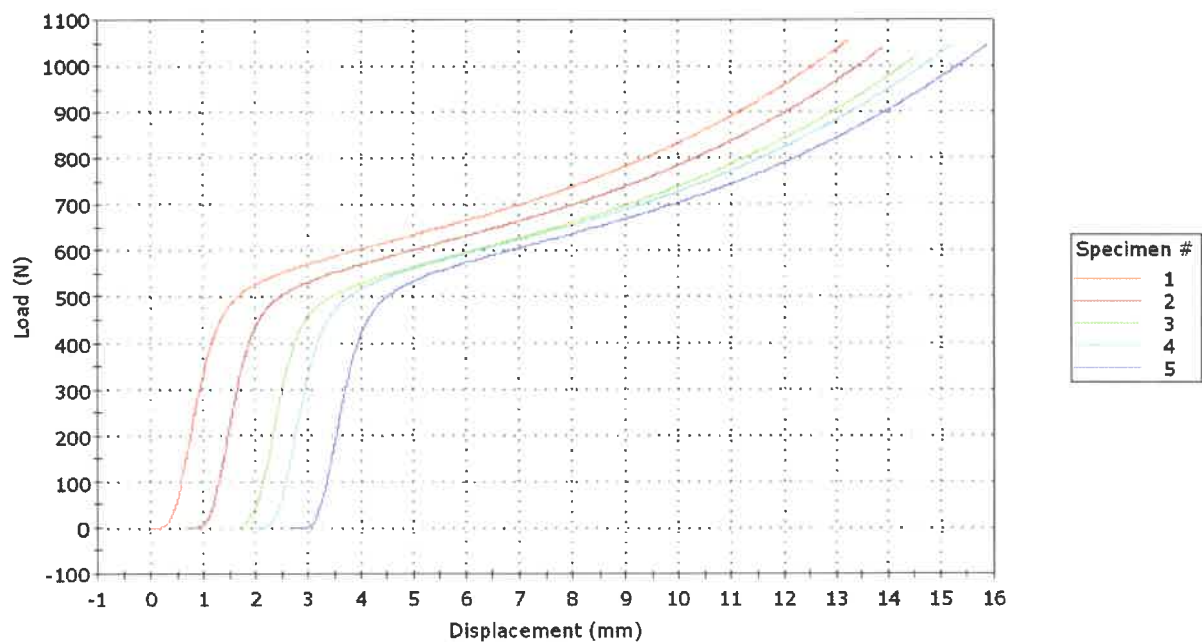
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.0956	0.117	0.174
2	0.0933	0.114	0.172
3	0.0902	0.112	0.169
4	0.0937	0.115	0.173
5	0.0936	0.115	0.173
Mean	0.0933	0.115	0.172
Std. Dev.	0.00	0.00	0.00

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Friday, May 13, 2011

Tested By: Dave Marlett

Material identification: 5654 101P15002 2.0 PCF density

Material conditioning: As received

Test conditions: 23° C / 50% RH

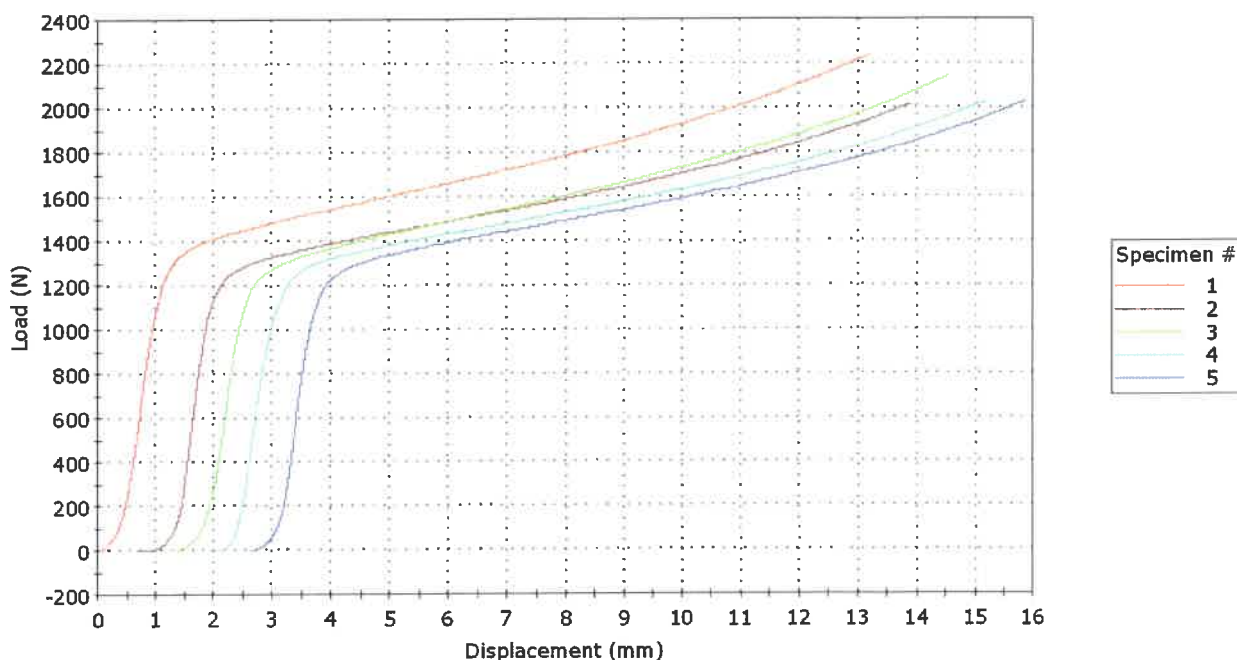
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.250	0.290	0.375
2	0.231	0.265	0.337
3	0.233	0.273	0.358
4	0.233	0.266	0.340
5	0.232	0.265	0.340
Mean	0.236	0.272	0.350
Std. Dev.	0.01	0.01	0.02

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Friday, May 13, 2011

Tested By: Dave Marlett

Material identification: 5654 101P15002 3.0 PCF density

Material conditioning: As received

Test conditions: 23° C / 50% RH

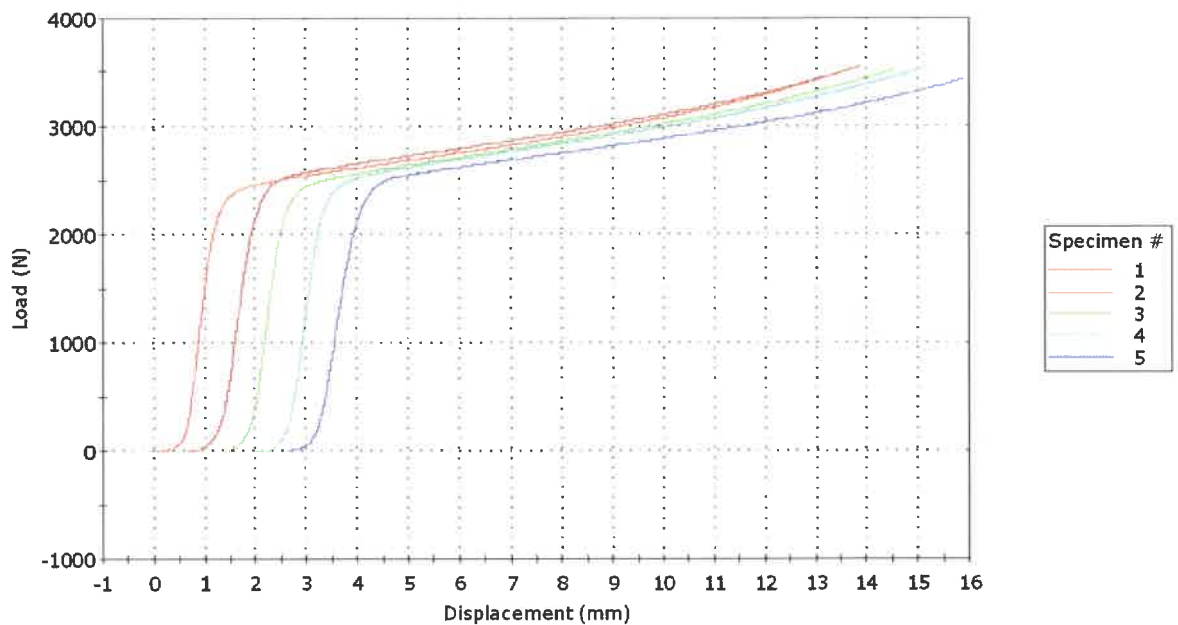
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.432	0.478	0.583
2	0.446	0.494	0.599
3	0.439	0.488	0.594
4	0.444	0.493	0.600
5	0.441	0.485	0.580
Mean	0.440	0.488	0.591
Std. Dev.	0.01	0.01	0.01



Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Thursday, May 12, 2011

Tested By: Dave Marlett

Material identification: 7654 101P17001 1.0 PCF density

Material conditioning: As received

Test conditions: 23° C / 50% RH

Speed: 2.5mm/min

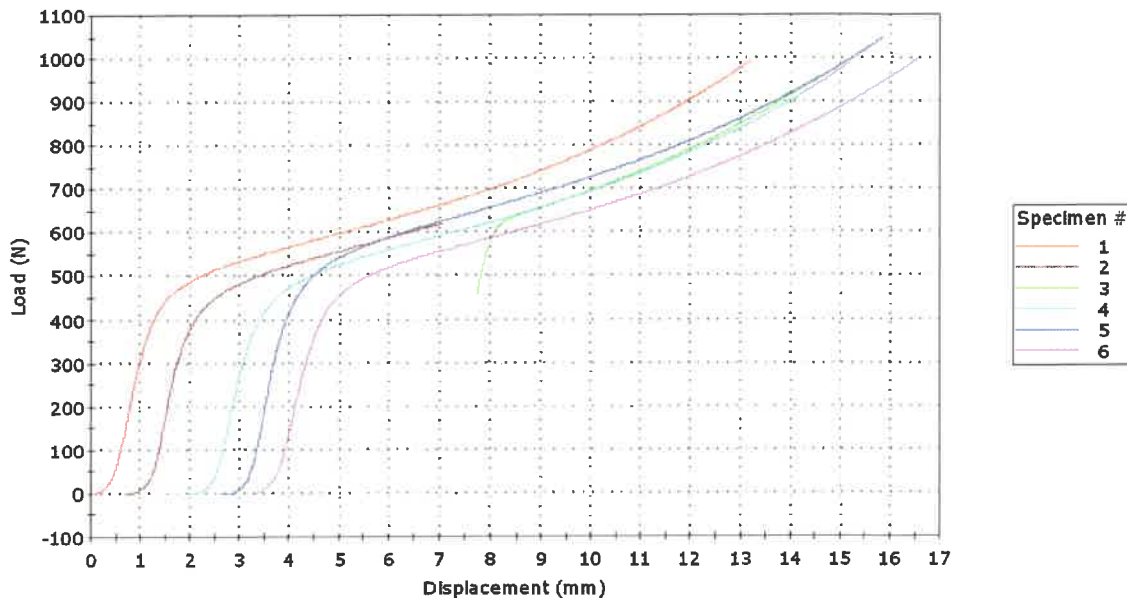
Load frame: 07095

Load cell: 07258

Tests #2 and #3 are for the same specimen.

Graph 1

Specimen 1 to 6



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.0888	0.110	0.164
2	0.0848	0.107	-----
3	-----	-----	0.158
4	0.0870	0.109	0.163
5	0.0953	0.119	0.174
6	0.0883	0.110	0.165
Mean	0.0888	0.111	0.165
Std. Dev.	0.00	0.00	0.01

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Thursday, May 12, 2011

Tested By: Dave Marlett

Material identification: 7654 101P17001 2.0 PCF density

Material conditioning: As received

Test conditions: 23° C / 50% RH

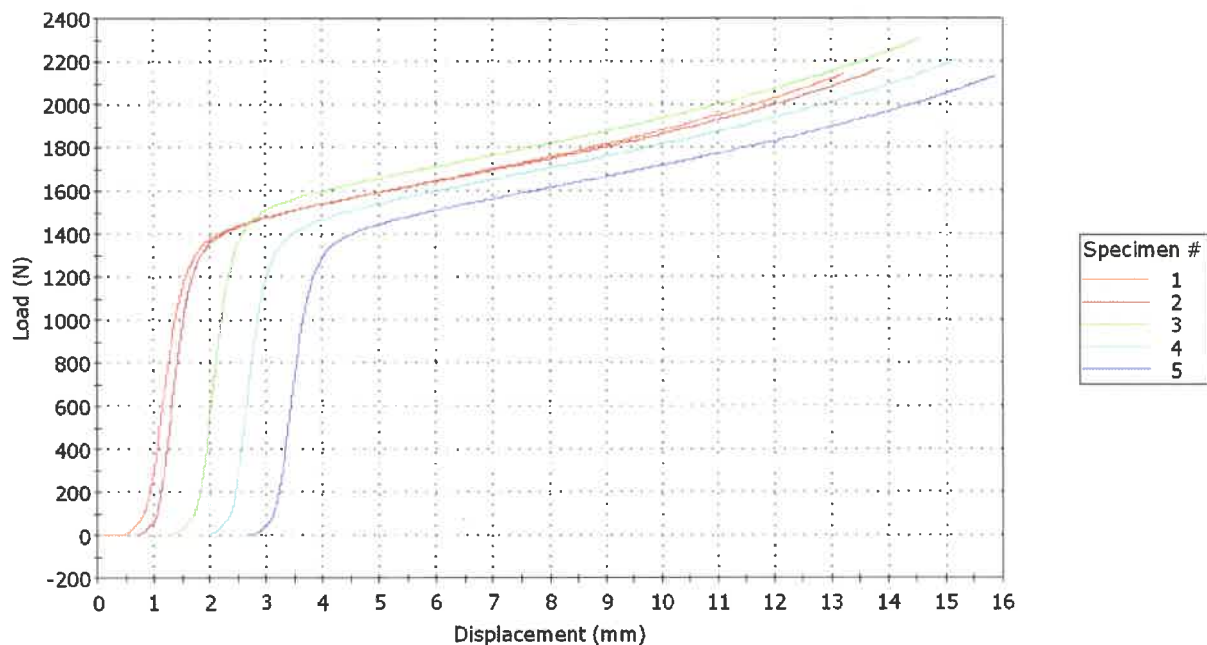
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.248	0.287	0.360
2	0.256	0.292	0.365
3	0.274	0.310	0.388
4	0.260	0.297	0.372
5	0.251	0.287	0.359
Mean	0.258	0.295	0.369
Std. Dev.	0.01	0.01	0.01



Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Friday, May 13, 2011

Tested By: Dave Marlett

Material identification: 7654 101P17001 3.0 PCF density

Material conditioning: As received

Test conditions: 23° C / 50% RH

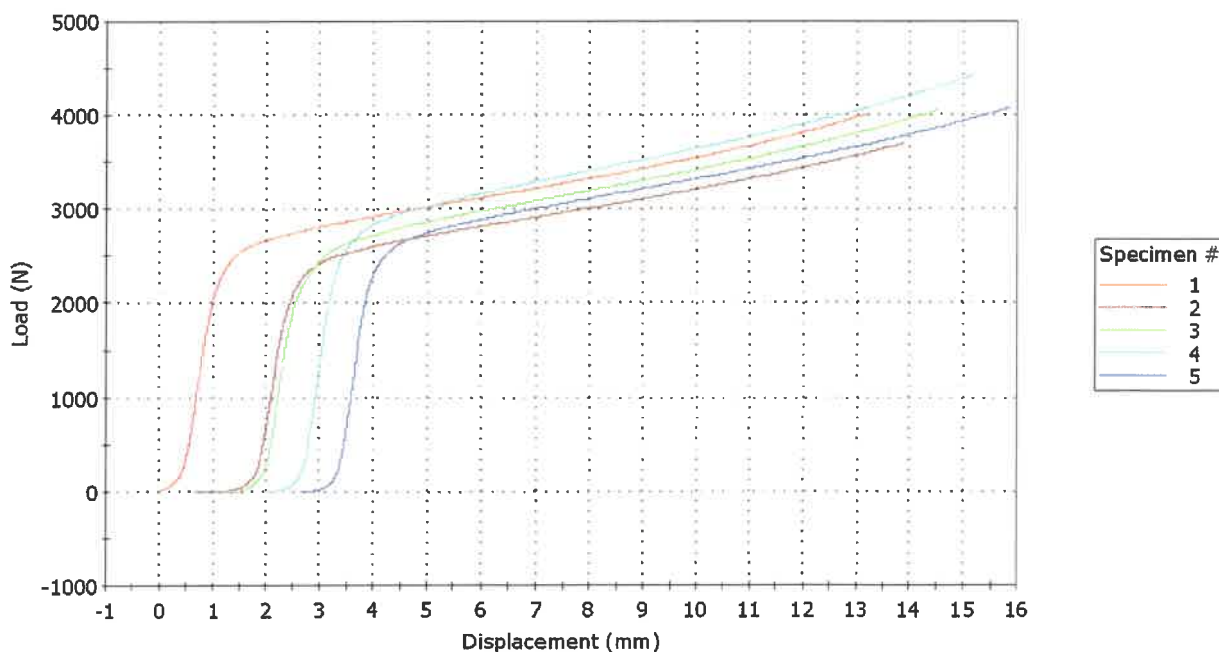
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.475	0.544	0.676
2	0.427	0.503	0.624
3	0.466	0.545	0.683
4	0.509	0.593	0.746
5	0.479	0.554	0.689
Mean	0.471	0.548	0.683
Std. Dev.	0.03	0.03	0.04

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Thursday, May 12, 2011

Tested By: Dave Marlett

Material identification: S7454 101P27002S 1.2 PCF density

Material conditioning: As received

Test conditions: 23° C / 50% RH

Speed: 2.5mm/min

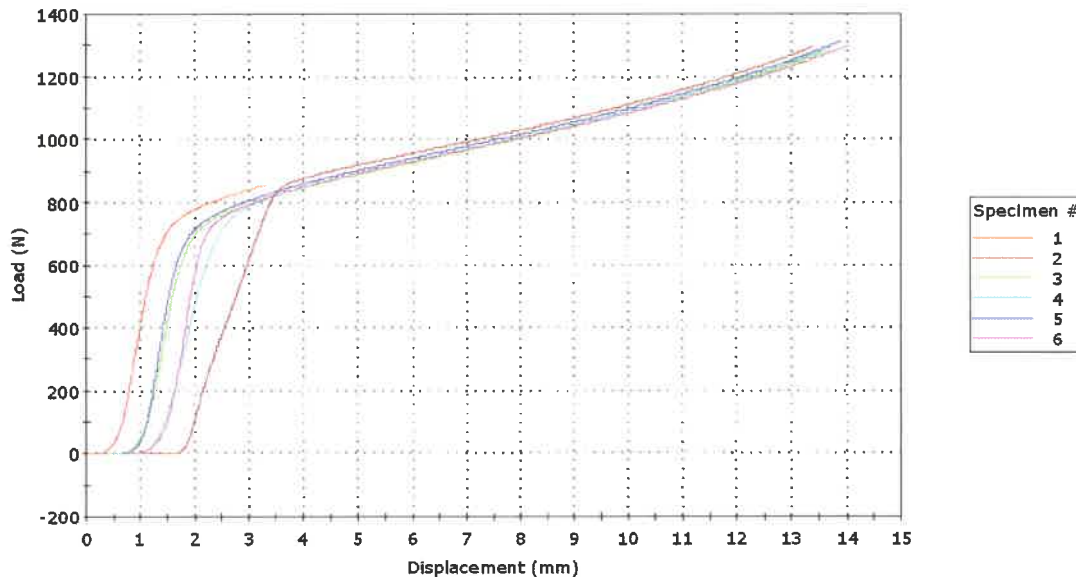
Load frame: 07095

Load cell: 07258

The 10% strain measurement for specimen #1 should be 0.140 MPa. The test did not continue past 13% strain and there were no extra samples so that specimen had to be run twice. The test averages for 10% strain are not corrected for this error on this sheet.

Graph 1

Specimen 1 to 6



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
X 1	0.140	-----	-----
2	0.0815	0.168	0.217
3	0.135	0.164	0.214
4	0.136	0.166	0.217
5	0.141	0.169	0.220
6	0.141	0.168	0.218
Mean	0.127	0.167	0.217
Std. Dev.	0.03	0.00	0.00

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Thursday, May 12, 2011

Tested By: Dave Marlett

Material identification: S7454 101P27002S 2.0 PCF density

Material conditioning: As received

Test conditions: 23° C / 50% RH

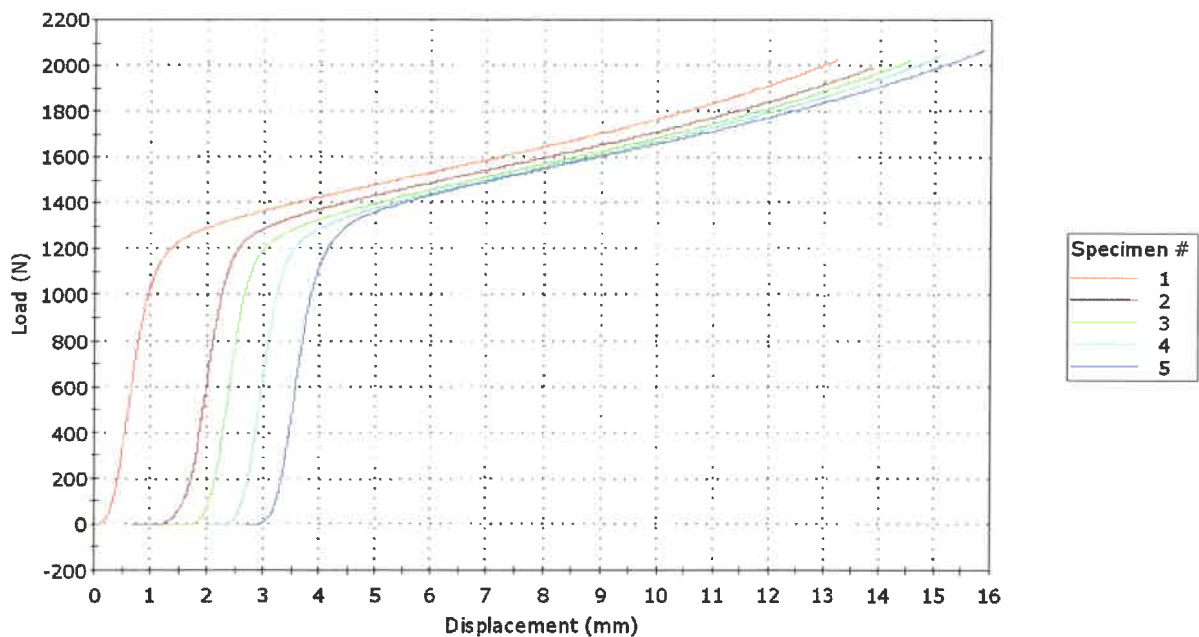
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.230	0.268	0.340
2	0.226	0.266	0.335
3	0.227	0.267	0.340
4	0.231	0.271	0.345
5	0.238	0.276	0.348
Mean	0.230	0.270	0.342
Std. Dev.	0.00	0.00	0.00

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Wednesday, May 18, 2011

Tested By: Dave Marlett

Material identification: S7454 101P27002S 2.0 PCF density

Material conditioning: Post heat aging 24Hrs at 82° C

Test conditions: 23° C / 50% RH

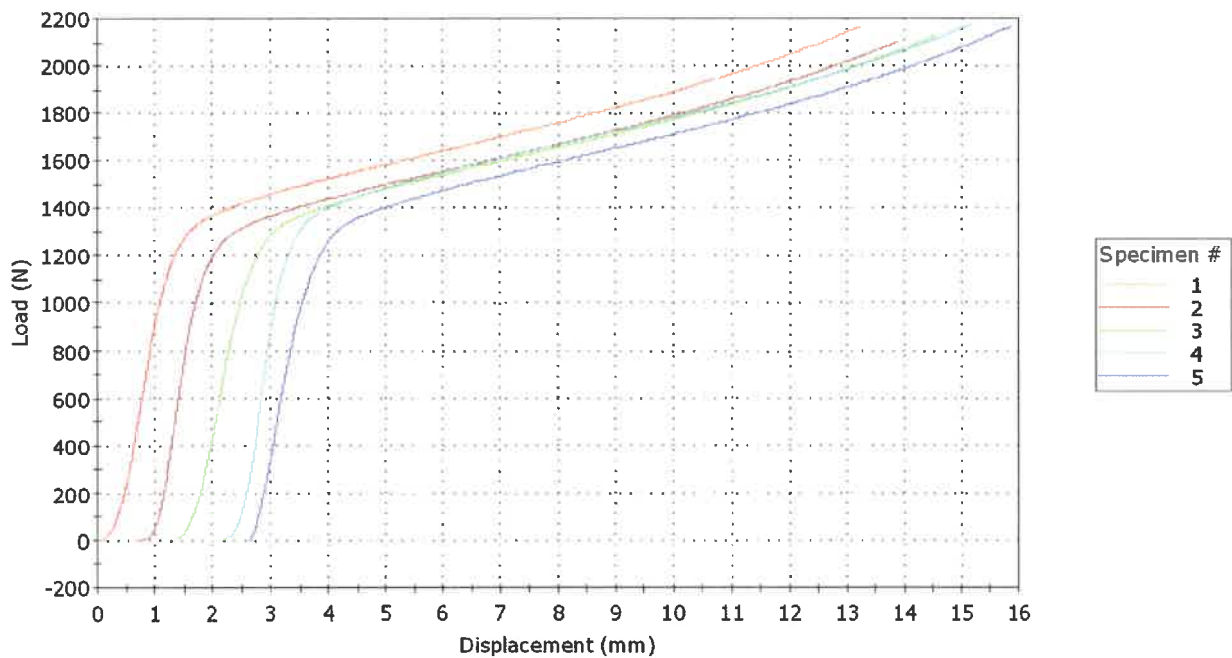
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.245	0.287	0.364
2	0.239	0.278	0.354
3	0.241	0.282	0.358
4	0.250	0.290	0.366
5	0.245	0.285	0.364
Mean	0.244	0.284	0.361
Std. Dev.	0.00	0.00	0.01

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Wednesday, May 18, 2011

Tested By: Dave Marlett

Material identification: 5454 101P25013 1.0 PCF density

Material conditioning: Post heat aging 24Hrs at 82° C

Test conditions: 23° C / 50% RH

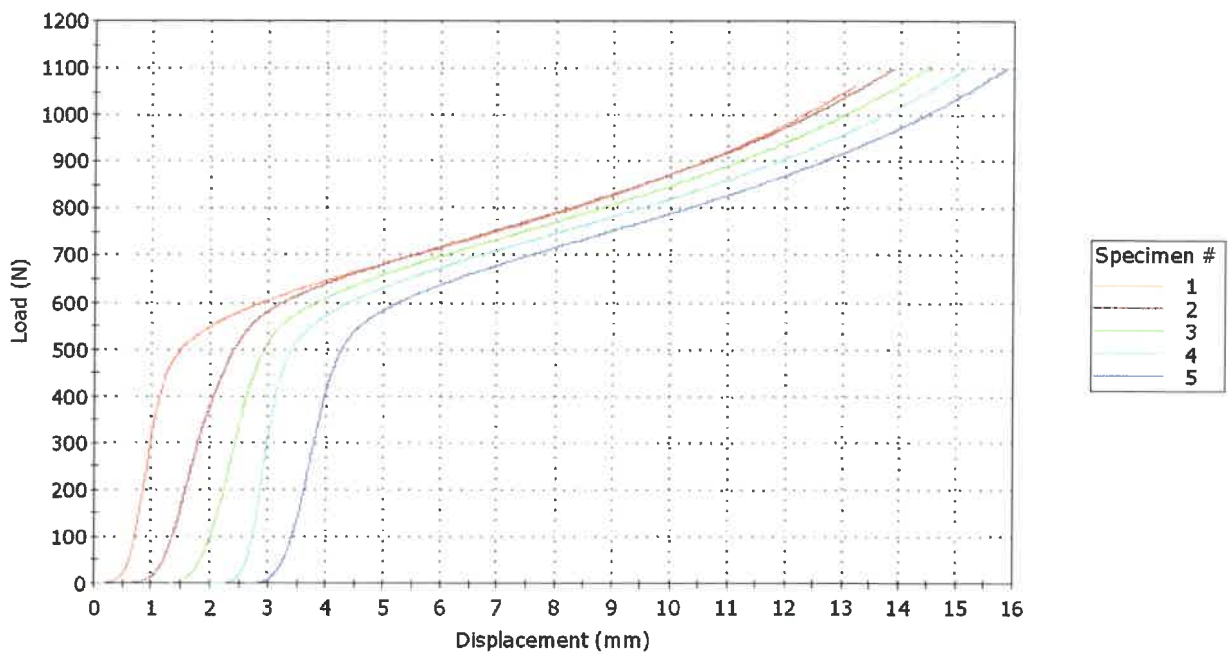
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.100	0.126	0.177
2	0.103	0.130	0.183
3	0.104	0.131	0.184
4	0.105	0.131	0.183
5	0.103	0.129	0.183
Mean	0.103	0.129	0.182
Std. Dev.	0.00	0.00	0.00

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Wednesday, May 18, 2011

Tested By: Dave Marlett

Material identification: 5454 101P25013 2.0 PCF density

Material conditioning: Post heat aging 24Hrs at 82° C

Test conditions: 23° C / 50% RH

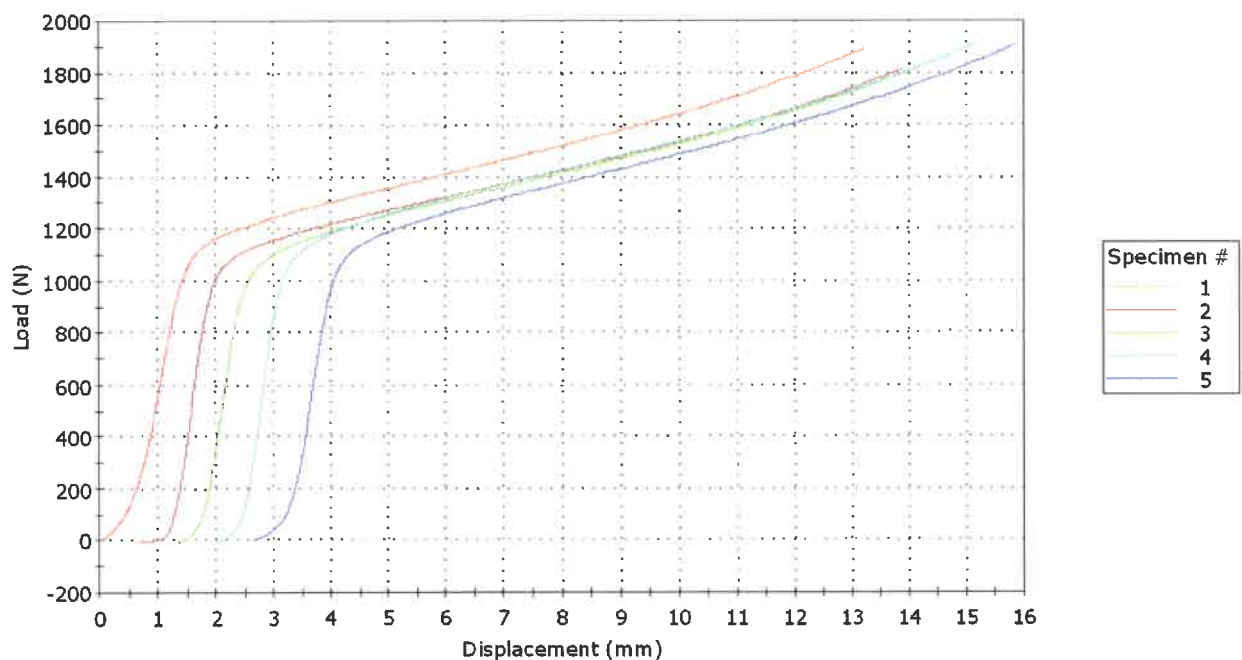
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.208	0.246	0.317
2	0.201	0.236	0.304
3	0.203	0.240	0.311
4	0.211	0.249	0.321
5	0.207	0.246	0.320
Mean	0.206	0.244	0.315
Std. Dev.	0.00	0.00	0.01



Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Wednesday, May 18, 2011

Tested By: Dave Marlett

Material identification: 5454 101P25013 3.0 PCF density

Material conditioning: Post heat aging 24Hrs at 82° C

Test conditions: 23° C / 50% RH

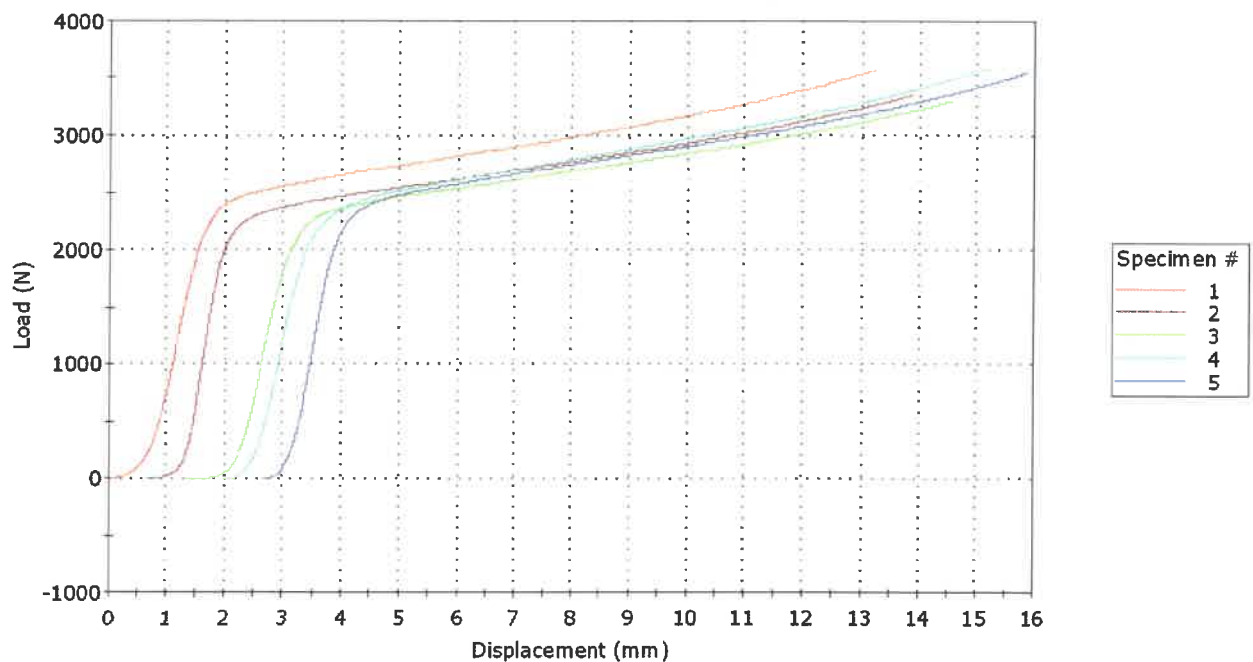
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.431	0.489	0.601
2	0.412	0.463	0.565
3	0.404	0.458	0.556
4	0.423	0.485	0.604
5	0.430	0.486	0.597
Mean	0.420	0.476	0.585
Std. Dev.	0.01	0.01	0.02

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Wednesday, May 18, 2011

Tested By: Dave Marlett

Material identification: 5654 101P15002 1.0 PCF density

Material conditioning: Post heat aging 24Hrs at 82° C

Test conditions: 23° C / 50% RH

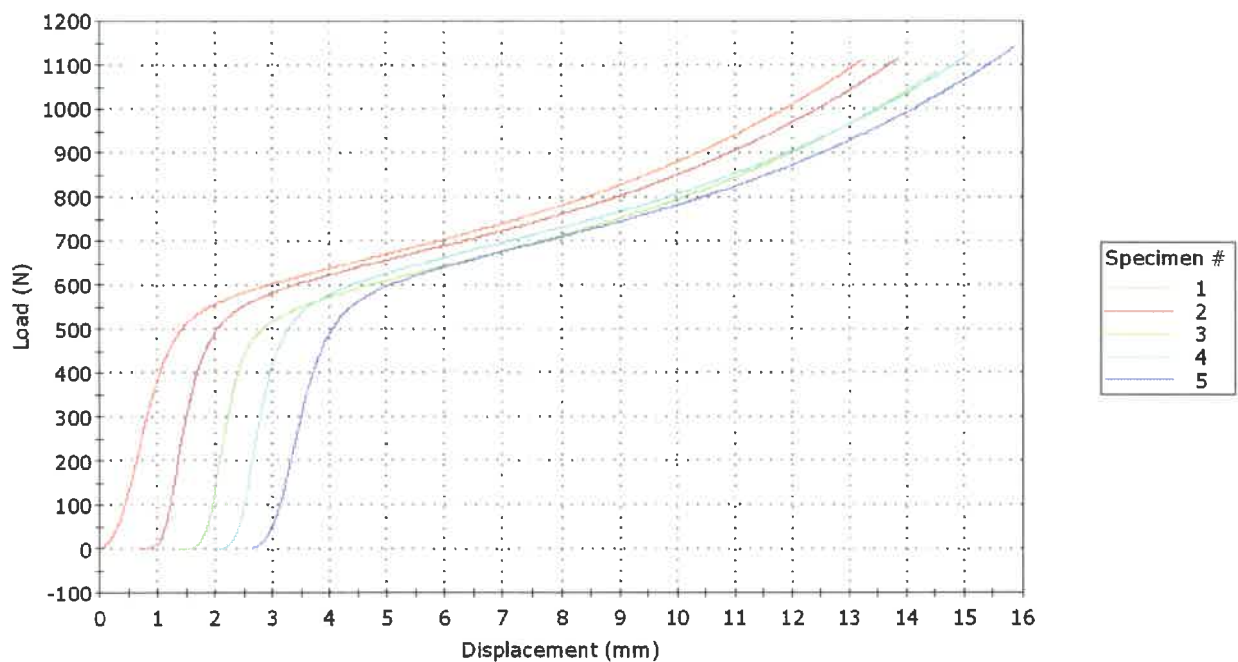
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.101	0.123	0.184
2	0.102	0.125	0.185
3	0.0976	0.121	0.180
4	0.105	0.128	0.188
5	0.105	0.128	0.189
Mean	0.102	0.125	0.185
Std. Dev.	0.00	0.00	0.00



Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Wednesday, May 18, 2011

Tested By: Dave Marlett

Material identification: 5654 101P15002 2.0 PCF density

Material conditioning: Post heat aging 24Hrs at 82° C

Test conditions: 23° C / 50% RH

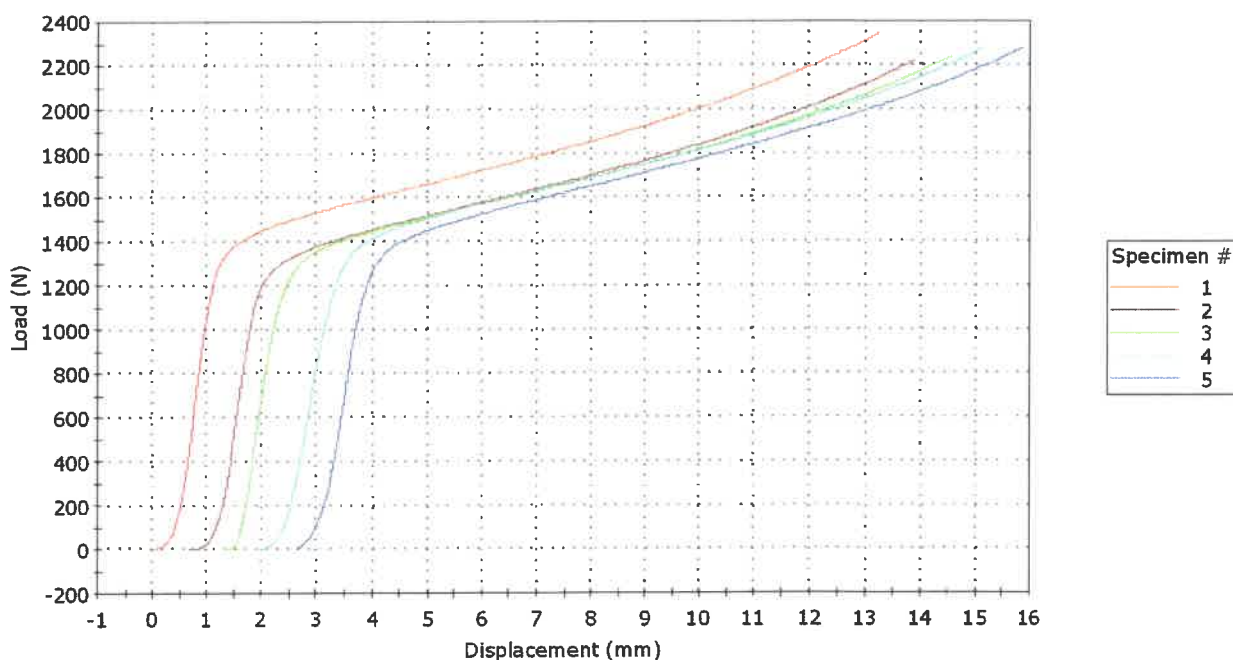
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.258	0.300	0.392
2	0.240	0.282	0.371
3	0.247	0.287	0.374
4	0.252	0.294	0.383
5	0.252	0.295	0.382
Mean	0.250	0.292	0.380
Std. Dev.	0.01	0.01	0.01

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Wednesday, May 18, 2011

Tested By: Dave Marlett

Material identification: 5654 101P15002 3.0 PCF density

Material conditioning: Post heat aging 24Hrs at 82° C

Test conditions: 23° C / 50% RH

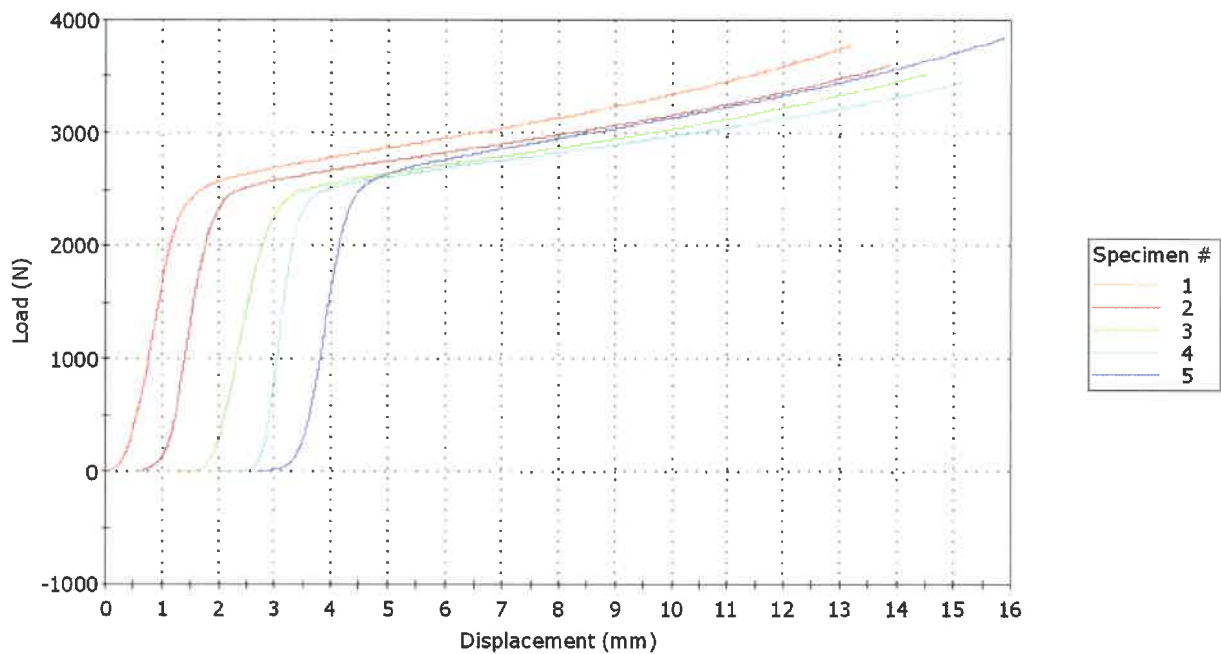
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.455	0.514	0.636
2	0.447	0.500	0.607
3	0.437	0.490	0.596
4	0.443	0.491	0.585
5	0.459	0.523	0.648
Mean	0.448	0.504	0.615
Std. Dev.	0.01	0.01	0.03

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Thursday, May 19, 2011

Tested By: Dave Marlett

Material identification: 7654 101P17001 1.0 PCF density

Material conditioning: Post heat aging 24Hrs at 82° C

Test conditions: 23° C / 50% RH

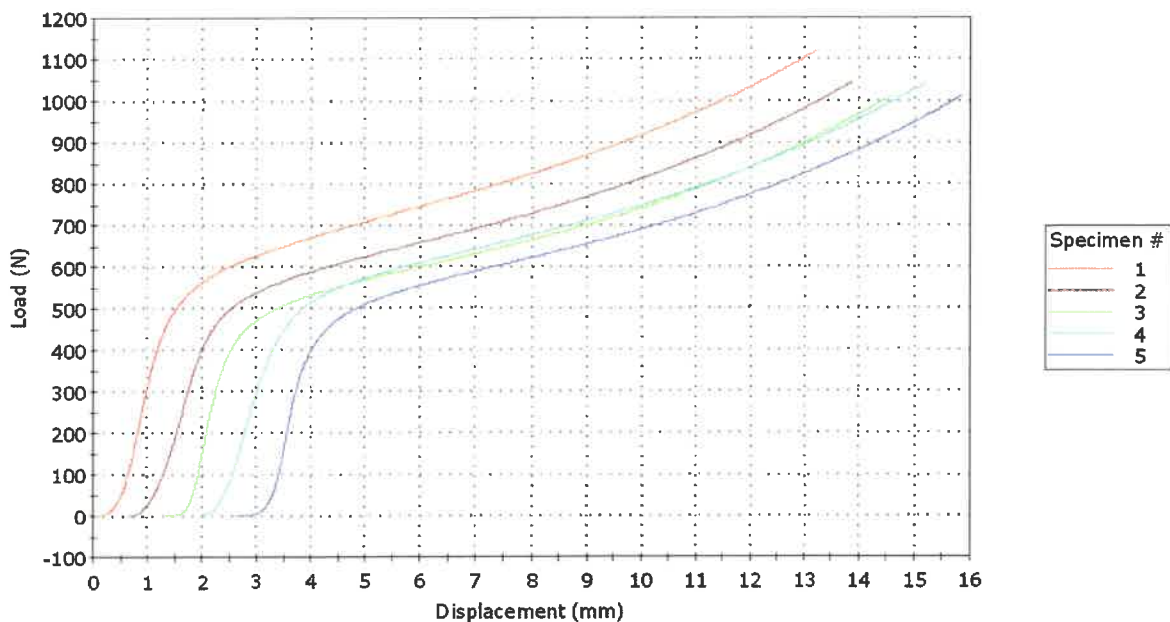
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.104	0.131	0.186
2	0.0949	0.119	0.173
3	0.0904	0.113	0.167
4	0.0947	0.118	0.173
5	0.0897	0.113	0.168
Mean	0.0947	0.119	0.173
Std. Dev.	0.01	0.01	0.01

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Thursday, May 19, 2011

Tested By: Dave Marlett

Material identification: 7654 101P17001 2.0 PCF density

Material conditioning: Post heat aging 24Hrs at 82° C

Test conditions: 23° C / 50% RH

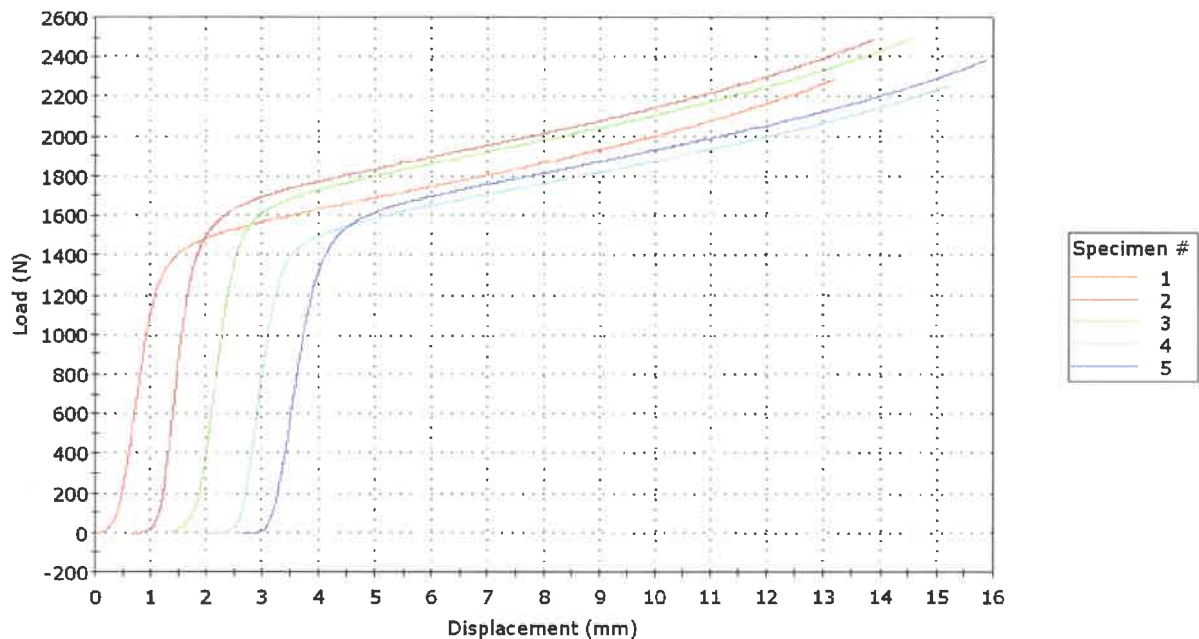
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.264	0.305	0.385
2	0.295	0.336	0.419
3	0.296	0.338	0.419
4	0.267	0.307	0.380
5	0.282	0.322	0.401
Mean	0.281	0.322	0.401
Std. Dev.	0.02	0.02	0.02



Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Thursday, May 19, 2011

Tested By: Dave Marlett

Material identification: 7654 101P17001 3.0 PCF density

Material conditioning: Post heat aging 24Hrs at 82° C

Test conditions: 23° C / 50% RH

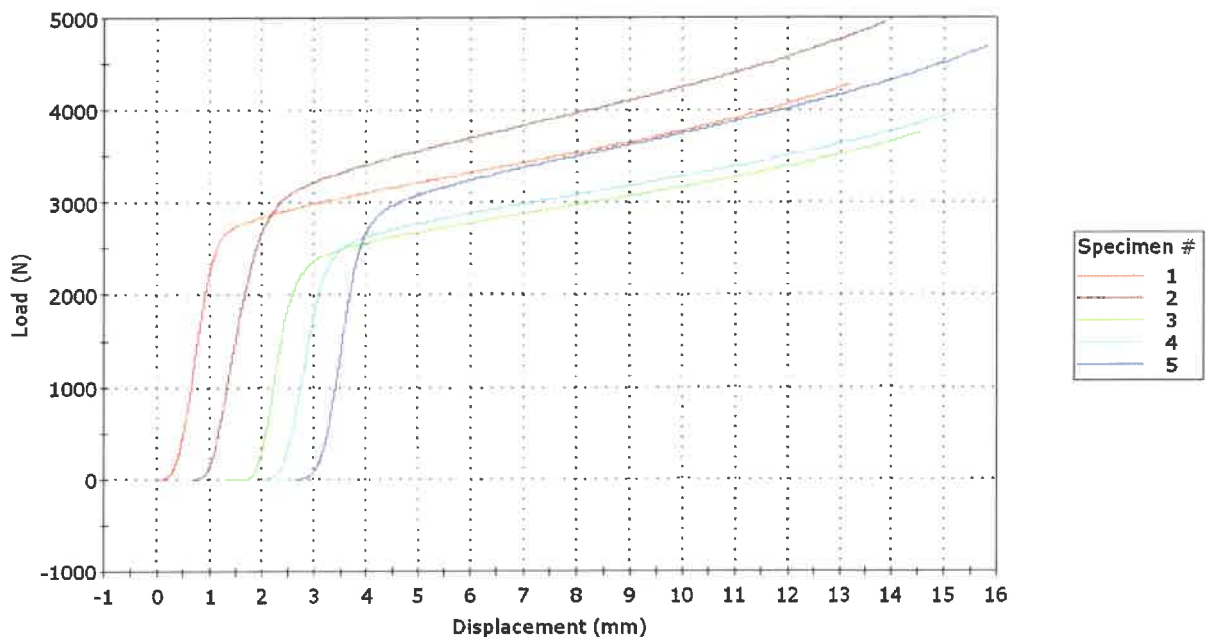
Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1

Specimen 1 to 5



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.504	0.579	0.721
2	0.563	0.661	0.834
3	0.439	0.507	0.632
4	0.467	0.537	0.669
5	0.537	0.625	0.789
Mean	0.502	0.582	0.729
Std. Dev.	0.05	0.06	0.08

Compression Deflection per D1621-10  
Customer: Flint Hills Resources  
Job#: 110250008

Date: Wednesday, May 18, 2011

Tested By: Dave Marlett

Material identification: S7454 101P27002S 1.2 PCF density

Material conditioning: Post heat aging 24Hrs at 82° C

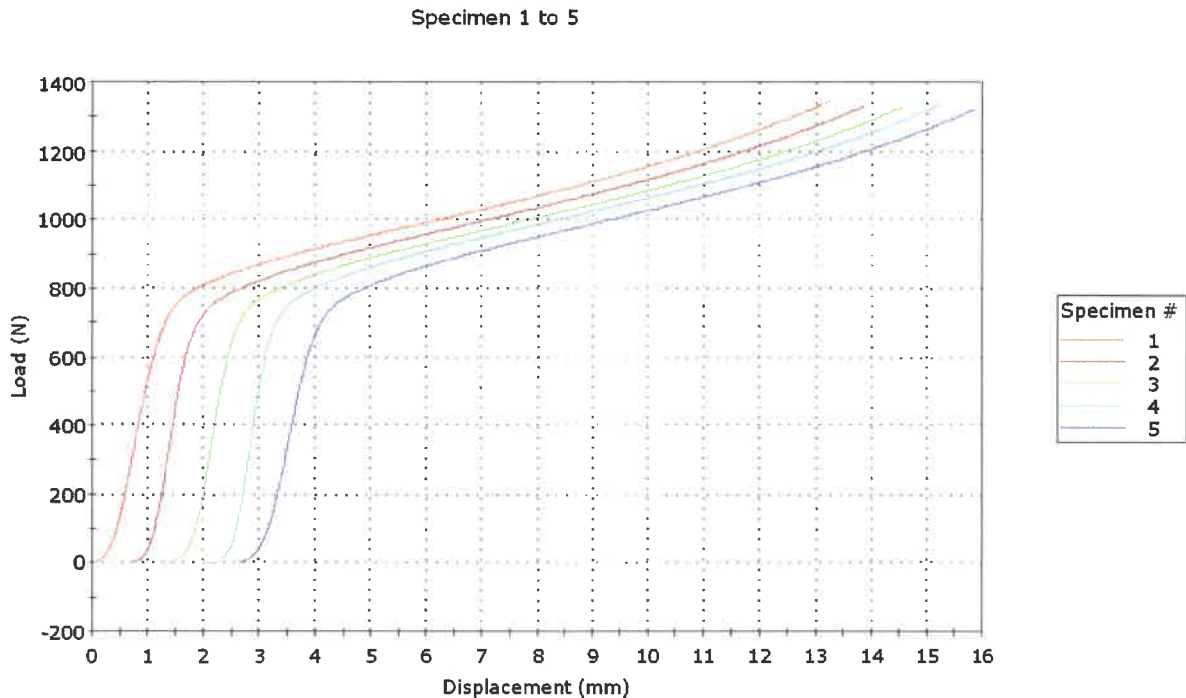
Test conditions: 23° C / 50% RH

Speed: 2.5mm/min

Load frame: 07095

Load cell: 07258

Graph 1



	Compressive strength at 10 % strain (MPa)	Compressive strength at 25 % strain (MPa)	Compressive strength at 50 % strain (MPa)
1	0.145	0.173	0.225
2	0.144	0.172	0.223
3	0.143	0.171	0.223
4	0.144	0.172	0.224
5	0.141	0.170	0.222
Mean	0.144	0.172	0.223
Std. Dev.	0.00	0.00	0.00



# QRT<sup>®</sup>-1 SERIES



**MAX / DELUXE / STANDARD**  
4-POINT SECUREMENT  
WHEELCHAIR RETRACTORS



# QRT<sup>®</sup>-1 SERIES

## The Securement System That Changed Everything

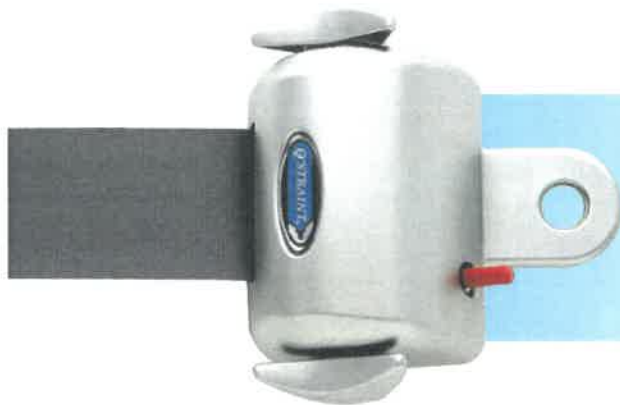
The original 4-point wheelchair securement system, QRT-1 Series retractors defined the way passenger safety devices are designed and tested.

With a range of 3 different options to fit every need and every budget, the QRT-1 Series of retractors offer easy to use, effective 4-Point securement of wheelchairs for virtually any vehicle application.



### QRT MAX

FULLY AUTOMATIC, premium knobless retractor that allows for one-handed operation.



### QRT DELUXE

SELF-LOCKING & SELF-TENSIONING retractor with ergonomic housing and dual tensioning knobs.



### QRT STANDARD

SEMI-AUTOMATIC retractor that meets all industry standards and specifications.





More than 30 years ago, Q'STRAIT introduced the world's first fully integrated 4-Point wheelchair passenger securement system, now an industry standard the world over.

**The QRT line of retractors are the linchpin of that system.**



Every QRT retractor is fully ADA compliant, and meets or exceeds all standards and regulations, including:

- SAE J2249, ISO 10542,
- FMVSS 209, 302, 210, 222
- CMVSS 209
- CSA Z605
- and 30mph/20g crash testing

## Anchorage Options

All QRT-1 Series Retractors are compatible with L-Track, L-Pockets and Slide 'N Click anchorages, or may be directly mounted to vehicle floors, seat legs or barriers.



### L-TRACK / L-POCKETS

For kits that use L-Track or L-Pocket anchorages, QRT Series retractors feature our patented Positive Lock Indicator (PLI) that clearly indicates when the fitting is locked in the anchorage.

### SLIDE 'N CLICK

For kits that include Slide 'N Click anchorages, QRT Series retractors feature a single-bolt SNC assembly and plunger that allows a full 360° rotation, eliminating anchorage alignment guesswork.

## QRT-1 SERIES FEATURES COMPARISON

	MAX	DLX	STD	
<b>Knobless, One-Handed Operation.</b> No knobs to interfere with wheels and footrests.	●			
<b>Dual Tensioning Knobs.</b> Provides additional tensioning if needed.		●		
<b>Single Tensioning Knob.</b> Provides additional tensioning if needed.			●	
<b>Automatic, Self-Locking.</b> Allows easy, one-handed hook-up.	●	●		
<b>Self-Tensioning.</b> Retractors automatically take up 'slack'.	●	●		
<b>Positive Lock Indicator.</b> Patented feature clearly indicates when fitting is locked in anchorage.	●	●	●	
<b>Interchangeable.</b> Eliminates confusion: no right, left, front or rear locations.	●	●	●	
<b>Low Profile &amp; Compact.</b> Elimination of mounting bracket allows retractors to fit under most footrests.	●	●	●	
<b>Accommodates Larger Wheelchairs.</b> Reduced overall length leaves more room for wheelchairs.	●	●		
<b>Ultra-Durable.</b> Hardened steel and coated zinc for maximum corrosion resistance.	●	●	●	
<b>Universal Design.</b> Accommodates virtually all wheelchair designs, including scooters.	●	●	●	
<b>J-Hook.</b> Reduces twisting of belts and ensures proper securement for all wheelchair designs.	●	●	●	
<b>Foot Release Lever.</b> Easy release eliminates the stress of bending down.	●	●	●	



[WWW.QSTRAINT.COM/QRT-1-SERIES](http://WWW.QSTRAINT.COM/QRT-1-SERIES)

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# LIMITED WARRANTY

Q'STRAIT provides limited warranty coverage on Q'STRAIT products (the "Products") as described in this Limited Warranty. For customers in the U.S.: this warranty gives you specific legal rights; you also may have other rights, which vary from state to state. For customers in the European Union: the purchaser may have additional legal rights under applicable national legislation governing the sale of consumer goods, and those rights (if applicable) are not affected by this warranty.

## **COVERED PRODUCTS AND LIMITATIONS:**

**Q'STRAIT's limited warranty coverage applies only to factory defects in materials and workmanship in the Products as follows:**

- **QUANTUM** – 3 years\* or 10,000 cycles.
- **Q'POD, QRT-3 Series, QRT-5 Series** – 5 years\* limited warranty coverage.
- **QRT Max, QRT Deluxe, QLK-150, Q'UBE** – 3 years\* limited warranty coverage.
- **QRT Standard, Q-5000, M-Series, QLK-110, INQLINE, INQLINE Loader** – 2 years\* limited warranty coverage.
- **All other Products** – 1 year limited warranty coverage.

**\*Only valid if product is registered with Q'STRAIT.** Otherwise a 1 year limited warranty applies to all products.

Each of the warranty coverage periods runs from the date the Products are shipped from Q'STRAIT, and applies only to warranted defects that first manifest themselves and are reported to Q'STRAIT within the applicable warranty period. Q'STRAIT retains the right to determine to its reasonable satisfaction whether any claimed defect is covered by this warranty.

**CERTAIN ITEMS ARE EXCLUDED FROM WARRANTY COVERAGE BY Q'STRAIT, AND THIS LIMITED WARRANTY COVERAGE DOES NOT APPLY TO:**

1. Products which are not installed and maintained in accordance with Q'STRAIT's instructions.
2. Products which are subject to misuse, abuse, accident, negligence, or exposure to the elements or chemicals.
3. Products which are altered or not repaired by a Q'STRAIT authorized repair service.
4. Normal wear and tear, and routine maintenance.
5. Products which are not used in applications or in a manner approved by Q'STRAIT.

**ALL STATUTORY OR IMPLIED WARRANTIES (INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), CONDITIONS AND GUARANTIES ARE EXCLUDED AND DISCLAIMED TO THE FULLEST EXTENT ALLOWED BY LAW. If any implied warranties, conditions or guarantees are required under applicable law, they are limited to the minimum duration allowed by law (not longer than the duration of the applicable express limited warranty coverage). For customers in the U.S.: some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.**

## **REMEDIES UNDER THIS LIMITED WARRANTY**

If a defect covered by this warranty occurs, Q'STRAIT (or one of its authorized dealers, as determined by Q'STRAIT) will repair or replace the defective Products, in its sole discretion. This "repair or replacement" remedy is the **exclusive remedy** under this warranty. Q'STRAIT has **no responsibility or liability for any incidental or consequential damages**, such as loss of use, interest or finance charges, the cost of repairs by unauthorized repair services, depreciation, etc., all of which are specifically **excluded and disclaimed** from this warranty. For customers in the U.S.: some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

## **RESPONSIBILITY OF PURCHASER**

1. Any claims under this limited warranty must be made to Q'STRAIT within fifteen (15) days after the defect first arises.

2. The Products must be returned to Q'STRAIT (or its authorized repair facility, as determined by Q'STRAIT) within the warranty period for inspection and warranty service. The expense of disassembly, returning the Products for warranty service, and of returning the Products to the owner and reassembly after any warranty service has been completed, is the responsibility of the owner and will not be reimbursed by Q'STRAIT. Contact Q'STRAIT Customer Service for information on how to return Products.
3. If your Product includes a registration form it must be returned to Q'STRAIT within thirty (30) days after the Products are delivered to the purchaser.

*Q'STRAIT reserves the right to improve its products through changes in design or materials without being obligated to the owners of other Products.*

Q'STRAIT may be contacted at **800-987-9987** or via email at [customersatisfaction@qstraint.com](mailto:customersatisfaction@qstraint.com).

## Vulcan™ Series V12 HD/IP Mobile DVR

### 12-CHANNEL DVR

#### DIMENSIONS

- Height: 3.5 inches
- Width: 8.7 inches
- Depth: 11.6 inches
- Weight: 5.7 pounds

#### TWELVE (12) A/V INPUTS

- 8 channels D1, WD1, 720P, or up to 1080P  
+ 4 channels IP up to 1080P

#### VIDEO OUTPUTS

- 2 channels

#### AUDIO OUTPUTS

- 2 channels

#### CAMERA COMPATIBILITY

- 8 channels D1, WD1, 720P, or up to 1080P (see NTSC)
- 4 channels IP up to 1080P

### STORAGE MEDIA

#### RECORDING MEDIUM

- One (1) 2.5" SATA hard drive and one (1) optional solid-state SD card

#### CAPACITY

- 1TB (standard) up to 2TB (capable) (optional) 64GB SD card up to 512GB

#### RECORDING OPTIONS

- SD card slot for redundant recording

### INTERFACE

#### NETWORK DATA CONNECTION

- One RJ45 x 1 (10/100 M/1000M)

#### EXPANSION

- RS232 x 2, RS485 x 2

#### GPS INTERFACE

- Built-in, compatible with optional GPS antenna

### DRIVER ACTION DETECTION

#### PANIC BUTTON

- The remote status indicator (panic button) can be connected to show DVR power/record status without using a video monitor
- The driver-operated panic button has the following functions:
  - Solid green LED indicates that the unit has power and is recording
  - Event marker (panic button)

#### DRIVER ACTION DETECTION WIRES

- 8 signal wires individually programmable to indicate alarm or event



#### BUILT-IN G-FORCE SENSOR

#### COMPRESSION FORMAT

- Video: H.264
- Audio: ADPCM, G.711A G.711U

### RECORD RESOLUTION

#### NTSC

- 1080P, 720P, WD1(928X480), WHD1(928X240), WCIF(464X240), D1(704x480), HD1(704x240), CIF(352x240)

#### PAL

- 1080P, 720P, WD1(928X576), WHD1(928X288), WCIF(464X288), D1(704X576), HD1(704x288), CIF(352x288)

#### RECORDING OPTIONS

- **Continuous record:** System will record all channels continuously while vehicle is running (factory setting).
- **Alarm record:** System will record when an alarm is triggered.
- **Motion record:** System will record when the cameras detect motion while vehicle is running.
- **Schedule record:** System will boot and record according to user-selectable schedule.

### ELECTRICAL & OPERATING REQUIREMENTS

#### AUTO ON/OFF DETECTION

- ACC detection

#### DELAY OFF SETTING

- User selectable up to 24 hours

#### OPERATING VOLTAGE

- 8~36VDC

#### OPERATING TEMPERATURE

- -14°F (-25°C) ~ +158°F (+70°C);  
-40°F (-40°C) ~ +158°F (+70°C)  
with heater

#### POWER CONSUMPTION

- 0W-105.3W

### POWER SUPPLY

#### INPUT RANGE

- DC 8-36V

#### OUTPUT RANGE

- DC5V/DC12V

#### OUTPUT CURRENT

- 5V@500mA, 12V@500mA

#### BUILT-IN POWER PROTECTION

#### LOW VOLTAGE PROTECTION

- User selectable and programmed at installation

#### HOUSING/CASING

- Removable, shock-mounted
- Vandal-resistant locking front cover
- Shock-resistant: MIL-STD-810F
- Aluminum
- Optional fan with filter, removable for cleaning

#### BUILT-IN WI-FI MODULE

### OPTIONAL COMPONENTS

#### VIRTUAL SYNCHRONIZED MAPPING

- External Virtual Synchronized Mapping™ module with North American maps
- Includes GPSV1 antenna
- Embeds GPS tracking information synchronized with recorded video footage

#### GPS ANTENNA

#### FIREPROOF BOX BACKUP

#### CELLULAR MODEM

Specifications, features and applications of use are subject to change without notice. 4/2017



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# 500

## 500 SERIES



510

BEACONS

LIGHTBARS/  
MINIBARS

SAFETY  
DIRECTOR™

LED DIRECTIONAL  
LIGHTS

LIGHTING  
SYSTEMS

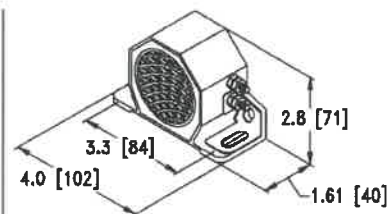
BACK-UP  
ALARMS

CAMERA  
SYSTEMS

## Back-Up Alarm

ECCO's most compact and popular line of back-up alarms, the 500 Series provides a cost-effective warning solution with ECCO quality and reliability. A glass-filled nylon housing with epoxy-encapsulated electronics provide exceptional durability and protection against moisture, dust and vibration.

ECCO's 500 Series Smart Alarm™ measures ambient noise and adjusts sound levels, creating a volume that is safe without being annoying or contributing to noise pollution. Smart Alarms eliminate the need for constant manual adjustment and help prevent intentional alarm disconnection.



### Models

PART NO.	VOLTAGE	dB(A)	AMPS	SAE	WARRANTY
505	12-24	87	0.1	D	SAE J944 e
510	12	97	0.2	C	SAE J944 e
520	12-24	97	0.2	C	SAE J944 e
530	12-24	102	0.2	F	SAE J944 e
580	12-80	87	0.1	D	SAE J944 e
585	12-48	97	0.1	C	SAE J944 e
SA950	12-24	82-102	0.4	F	SAE J944 e SMART ALARM
SA951	12-48	77-97	0.2	F	SAE J944 e SMART ALARM

Models 510, 520 and 505 are AMECA certified to SAE J994

### Alarm Specifications

		CURRENT (NOMINAL)	AVG. POWER (NOMINAL)		CURRENT (NOMINAL)	AVG. POWER (NOMINAL)
SA950	12V	0.65A	4.0W	585	12V	0.19A 1.2W
	24V	0.77A	9.3W		24V	0.21A 2.5W
SA951	12V	0.31A	1.9W		36V	0.22A 4.1W
	24V	0.34A	4.1W		42V	0.23A 4.9W
	36V	0.34A	6.1W		48V	0.23A 5.6W
	42V	0.34A	7.2W	505	12V	0.11A 0.6W
	48V	0.35A	8.5W		24V	0.15A 1.8W
530	12V	0.44A	2.6W	580	12V	0.03A 0.1W
	24V	0.48A	5.8W		24V	0.04A 0.5W
510	12V	0.30A	1.8W		36V	0.04A 0.7W
520	12V	0.30A	1.8W		42V	0.04A 0.8W
	24V	0.36A	4.3W		48V	0.04A 0.8W
					80V	0.04A 1.7W

CONNECTION: 8-32 UNI STUD CONNECTION

RECOMMENDED MOUNTING BOLT: 1/4" GRADE 5 OR BETTER

RECOMMENDED WASHER: 1/4" TYPE A, SERIES N OR W

WEIGHT: 12 oz

### Features and Benefits

- Compact size and universal mounting bracket maximizes location options
- Self grounding
- Sealed in epoxy for protection against dust, moisture, and vibration
- Temperature Range: -40°F to +185°F (-40°C to +85°C)
- 2 Year Warranty

# ECCO®

833 West Diamond Street  
Boise, Idaho 83705

T: 800-635-5900 or 208-395-8000  
F: 800-688-3226 or 208-395-8190  
www.eccolink.com

A DIVISION OF  
**ECCO**  
GROUP



Creative Bus Sales

#### TRAINING ACKNOWLEDGEMENT LETTER

Creative Bus Sales is hereby acknowledgement and understanding of the training responsibilities of a successful bidder outlined in the procurement specification in section 3.44

We look forward to working with the customers to maximize their success with the buses we provide to them by facilitating the training described.



## TRANSIGN

YOUR DESTINATION **BEGINS** HERE

## LED DESTINATOR

The LED Destinator™ Series - perfect for fleets of all types - is available in a variety of sizes and colors to fit your installation and display needs. These versatile and highly adaptive signs offer full integration into Destination, Route, and Next Stop announcement services, always keeping your customers pointed towards their next destination.

**SOFTWARE AND PROGRAMMING**

Our signs and control modules are pre-programmed and include FREE software. Advanced controllers are available for J1708/J1587 system integration and Hands-Free operation, ensuring the safest and most reliable performance for any fleet.

**STANDARD FEATURES**

- Destination Messages
- Next Stop Announcements
- Public Relations Messaging
- Scrolling/Flashing/Stacked Messages

**AVAILABLE ADVANCED FEATURES INCLUDE:**

- Automated GPS message progression
- Hands-Free operation for safety
- Voice Announcements
- J1708/J1587 integration compatible
- Automatic brightness control
- Basic programming software included (USB)
- Maintenance free- ZERO cost of ownership
- Many OCU options to suit your needs

**BUY AMERICA - MADE IN U.S.A.**

Using the highest quality parts, our LED Destinator™ Signs are proudly made in Detroit, Michigan USA in full compliance with the **Buy America Act**.

**LED DESTINATOR™ WARRANTY INFO**

With a lifetime warranty that outlasts the lifetime of most vehicles (100,000 hours at full brightness), our signs will exceed your expectations in reliability and performance.

**ABOUT TRANSIGN**

Established in 1959, Transign is a leading provider of high-quality signage for the transit industry. We remain committed to providing world-class U.S. based customer service and technical support.

Transign LLC, 281 Collier Rd., Auburn Hills, Michigan 48326  
Toll Free: 855.535.7446 | Main: 248.623.6400 | Fax: 248.623.2930  
[www.transignllc.com](http://www.transignllc.com)

# TRANSIGN

YOUR DESTINATION **BEGINS HERE**

## LED Destinator™ Electronic Signs - Dimensions

Signs	Pixel Count H x W (pixels)	Display H x W (in)	Enclosure H x W x D (in)
<b>LD16160</b>	16 x 160	6 1/2 x 63 1/8	9 1/2 x 64 5/8 x 2 3/8
<b>LD16128</b>	16 x 128	6 1/2 x 50 1/2	9 1/2 x 52 x 2 3/8
<b>LD16112</b>	16 x 112	6 1/2 x 44 1/8	9 1/2 x 45 3/4 x 2 3/8
<b>LD1696</b>	16 x 96	6 1/2 x 37 1/8	9 1/2 x 39 3/8 x 2 3/8
<b>LD1680</b>	16 x 80	6 1/2 x 31 5/8	9 1/2 x 33 x 2 3/8
<b>LD1632</b>	16 x 32	6 1/2 x 12 3/4	9 1/2 x 14 x 2 3/8
<b>LD12112</b>	12 x 112	4 7/8 x 44 1/8	8 x 45 3/4 x 2 3/8
<b>LD1280</b>	12 x 80	4 7/8 x 31 5/8	8 x 33 1/8 x 2 3/8
<b>LD1232</b>	12 x 32	4 3/4 x 12 3/4	8 x 14 x 2 3/8
<b>LD896</b>	8 x 96	3 1/4 x 37 1/8	6 3/8 x 39 3/8 x 2 3/8
<b>LD864</b>	8 x 64	3 1/4 x 25 1/4	6 3/8 x 26 3/4 x 2 3/8

Be sure to check out our other great products!



**Stop Request Signs**

- Flush, ceiling or surface mount
- Any font/color combination
- Back-lit by efficient LED's



**Interior Passenger Information Sign**

- Easy to install
- ADA compliant
- LED's rated at 100K hours



**Roller Curtain Signs**

- High-res logos & graphics
- Perfect for large fleets
- Virtually maintenance free
- Reliable, efficient LED backlight
- Available in 12 and 24 VDC
- Up to 120 destinations



**Run Number Box**

- Metal or plastic frame
- Available in 2, 3, or 4 digits
- Easy to read 4" lettering
- Spring loaded return
- Reliable, efficient LED backlight
- Virtually maintenance free



**LED Run Number Box**

- Steel enclosure
- ADA compliant
- Reliable LED's
- Multiple colors
- Automatic brightness
- 12 and 24 VDC

**Join Our Mailing List**

[www.transignllc.com/subscribe](http://www.transignllc.com/subscribe)

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 Toll Free: 855.535.7446 | Main: 248.623.6400 | Fax: 248.623.2930  
[www.transignllc.com](http://www.transignllc.com)

Est. 1959



# **Limited Warranty and Owners Information**

**GLAVAL BUS LIMITED WARRANTY  
AND CUSTOMER INFORMATION**

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## GLAVAL BUS Commitment

We are committed to supplying you with a bus that has been designed and manufactured using quality materials and the finest workmanship available to our industry.

We focus on providing the highest standards of quality control over every component that goes into your bus to ensure maximum safety and reliability. Due to our commitment and focus we are able to provide you with one of the longest warranties in the industry.

## About this Booklet

This booklet explains in detail the warranty coverage for your bus. This booklet also explains **Owner Assistance** information and information regarding alternative **Dispute Resolution**.

Please note that other warranty coverage's are provided by the chassis and/or other component manufacturers. Review the other manufacturers' warranty manuals for their particular warranty coverage. Refer to **Other Warranties That May Apply**.

We ask that you keep this booklet in your bus for reference and to be available to any repair facility that is providing warranty service. We also ask that you pass this manual on to any future owners.

## Warranty Registration Notice

As an Owner your Warranty Registration Start Form must be completed, signed and mailed to GLAVAL BUS. If you do not remember signing the warranty card during the initial delivery please contact your dealer.

The warranty registration helps ensure that we can find you in the event that either GLAVAL BUS or a Component Manufacturer needs to contact you. We must have the company name, owner's name, street address, city, state/province, zip/postal code and telephone number.

This signed form **must** be returned to GLAVAL BUS Warranty Department **before** the GLAVAL BUS Limited Warranty will be in affect.

Note: The GLAVAL BUS Limited Warranty is one of the many express warranties that accompany your bus and are included within your packet of information. Please review the information to be sure you are properly registered with the manufacturers of the chassis and other components. Refer to **Other Warranties That May Apply**.

## Warranty Start Date

For a new bus the Warranty Start Date for the GLAVAL BUS Limited Warranty is the day you take delivery of your new bus.

For a GLAVAL BUS Demo the Warranty Start Date for the GLAVAL BUS Limited Warranty is the day you take delivery. However, the Manufacturers' warranties for other components will run from the original in service date for the bus.

For a GLAVAL BUS Dealer Demo the Warranty Start Date for the GLAVAL BUS Limited Warranty is the day the Dealer put the bus into service.

## Who Warrants the Bus

Each new bus body is warranted by the manufacturer and installer of the body: GLAVAL BUS, Division of Forest River, Inc., hereinafter referred to as GLAVAL BUS, 914 County Road 1 North, Elkhart, Indiana; and is administered by the GLAVAL BUS Customer Service Department, Elkhart, Indiana 46514.

## Who Is Covered

GLAVAL BUS, the warrantor, extends this limited warranty to the original and any subsequent owners of the bus during the WARRANTY PERIOD.

## What Is Covered

GLAVAL BUS warrants that each new bus body will be free from defects in any materials or workmanship supplied or performed by GLAVAL BUS that occur under normal use within the applicable warranty period and subject to certain limitations and exclusions as specified in this limited warranty.

Refer to items under **Other Warranties That May Apply, Exclusions and Limitations** and **Limits of Warranty**.

Replacement parts provided under the terms of the warranty will whenever possible, match original equipment. When necessary, GLAVAL BUS will substitute parts of comparable function and value. Defective items may be replaced with new, remanufactured, reconditioned or repaired components.

# Warranty Period

The **GLAVAL BUS Limited Warranty** is for a period of five (5) years from the date of first delivery or 100,000 miles, whichever occurs first, **except** for other coverage's listed under this paragraph and items listed under **Other Warranties That May Apply, Exclusions and Limitations and Limits of Warranty**.

**Paint and/or Tape application**, if performed by GLAVAL BUS, is warranted to be free of substantial defects in workmanship and materials provided by GLAVAL BUS for **1 year (12 months)** from date of first delivery.

**Exterior Body parts** are warranted against rust-through due to improper application or assembly for two (2) years from date of first delivery, regardless of mileage.

# Other Warranties That May Apply

The bus's engine, chassis, drive train, suspension system, battery, and other chassis components are covered by a separate warranty offered by the chassis manufacturer and are administered by the chassis manufacturer's authorized dealers. The tire manufacturer separately warrants tires.

Other components throughout the bus may also be covered by separate warranties from the component manufacturer(s) and administered by the manufacturer(s) and/or their authorized dealers.

If you do not understand the different warranty cards and registrations supplied with your bus please contact your dealer for assistance.

**Examples of the other manufacturer warranties.** These are subject to change per the manufacturer and there may be others.

Elec. Components Limited Warranty	1 year	Unlimited mileage
Alternators Limited Warranty	1 year	Unlimited mileage
Air Conditioning Limited Warranty	2 year	Unlimited mileage
Heater(s) Limited Warranty	2 year	Unlimited mileage
Electric Door Limited Warranty	1 year	Unlimited mileage
Wheelchair lift		
Braun Limited Warranty	3 year	Unlimited mileage
Ricon Limited Warranty	5 year	Unlimited mileage
Wheelchair tie down	90 days	Unlimited mileage

## What Is Not Covered

As stated previously, GLAVAL BUS does not warrant the base vehicle engine, chassis, drive train, suspension system, battery, and other chassis components. These components are covered by a separate warranty offered by the chassis manufacturer and administered by the chassis manufacturer's authorized dealers. The tire manufacturer separately warrants tires.

GLAVAL BUS does not cover any accessory covered by a separate warranty offered and administered by the component manufacturer. Examples of these are listed in **"Other Warranties That May Apply."**

All items are subject to the terms set forth under **"Exclusions and Limitations"** and **"Limits of Warranty."**

## Exclusions and Limitations

**The GLAVAL BUS Limited Warranty specifically does not extend to the following:**

### **Components that have been Altered, Modified or Substituted**

Components or systems which have been modified, altered, substituted or repaired by unauthorized personnel without the written authorization of GLAVAL BUS.

Contact GLAVAL BUS Customer Service before you make any changes to your bus.

### **Damages resulting from Overloading**

Damages that may occur as the result of overloading or uneven weight distribution, including damages to the chassis, frame, and other parts or components, will not be covered and can invalidate portions of the GLAVAL BUS Limited Warranty.

**Note:** To avoid damage when loading make sure the weight is evenly distributed throughout the unit.

### **Deterioration from Normal Wear and Tear**

Deterioration from normal wear and tear is not covered including, but not limited to, wear and tear to the interior seating, flooring, facing of fabrics, carpeting or windows and exterior body panels, lights, trim, mirrors and other accessories.



## **Maintenance and Consumable Items**

The GLAVAL BUS Limited Warranty does not cover parts and/or consumables needed to maintain the bus including, but not limited to, light bulbs, fuses, wiper blades, batteries, etc.

## **Damages Caused by Lack of Maintenance**

Damages caused by failure to perform regular and reasonable preventive maintenance are not covered including, but not limited to,

- Failure to maintain the paint and/or finishes which can result in rust or corrosion.
- Failure to maintain and flush the underbody to remove salt and other road chemicals which can result in rust or corrosion.
- Failure to yearly inspect undercoating and to replace gouged or missing areas which can result in rust or corrosion.
- Failure to yearly inspect and repair exterior caulk and sealant resulting in leaks.

## **Damages resulting from Accidents, Abuse or Misuse**

Your warranty does not cover damages caused by driver, other people in or around the bus and/or road situations including, but not limited to,

- Accidents, collisions or objects striking the bus (including power washers)
- Negligence
- Theft, vandalism
- Customer applied chemicals or accidental spills.
- Misuse (driving over curbs, etc) or otherwise using the bus in a manner other than its intended purpose.

## **Damages caused by the Environment**

Damages or surface corrosion caused by the environment, exposure to road chemicals or exposure to the elements are not covered including, but not limited to,

- Acid rain, air borne fallout, road salt or other road condition chemicals.
- Tree sap, bird and bee droppings, tree damage
- Natural disasters, flood, fire or explosion, lightning, hail, freezing conditions, or windstorms
- Acts of war or riot

## **Damages caused by Road Hazard**

Road hazard damage is not covered. It may be necessary for the owner to check and adjust the chassis alignment due to rough road conditions, or hitting curbs, pots holes, etc.

The need for a front suspension alignment is maintenance and not covered under the GLAVAL BUS Limited Warranty.

Stones or rocks and other items hitting into glass and/or the body causing cosmetic damage and/or surface corrosion are not covered.

## **Other Expenses**

GLAVAL BUS does not cover the costs of loss of vehicle use, rental vehicle, interim transportation, storage, payment for loss of time or pay, lost revenue or profits, lodging, meals, transporting of the bus to an appropriate Warranty Service Location for service, travel costs, downtime, or any other incidental or consequential damages or expenses or inconvenience incurred while your bus is out of service due to warranty repair work.

## **LIMITS OF WARRANTY**

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF ANY KIND WHETHER WRITTEN, ORAL, OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IT CANNOT BE AMENDED BY ANY DEALERSHIP, SALESPERSON OR AGENT. THE SOLE OBLIGATION OF GLAVAL BUS UNDER THIS WARRANTY SHALL BE TO REPAIR OR REPLACE AT THE DISCRETION OF GLAVAL BUS, ANY DEFECTIVE COMPONENT OR PART.

## **PURCHASER'S EXCLUSIVE REMEDY**

THIS WARRANTY SHALL BE THE OWNER'S SOLE AND EXCLUSIVE REMEDY AGAINST GLAVAL BUS, WHETHER IN CONTRACT, UNDER STATUTE (INCLUDING STATUTORY PROVISIONS AS TO CONDITIONS AS TO QUALITY OR FITNESS FOR ANY PARTICULAR PURPOSE OF GOODS SUPPLIED PURSUANT TO THE CONTRACT OF SALE), WARRANTY, TORT, STRICT LIABILITY OR ANY OTHER LEGAL THEORY.

## **LIMITATION OF LIABILITY**

THE LIABILITY OF GLAVAL BUS UNDER THIS WARRANTY IS LIMITED TO THE COST TO REPAIR OR REPLACE, IN THE SOLE DISCRETION OF GLAVAL BUS, THE DEFECTIVE COMPONENT OR PART, WHICH IN NO EVENT SHALL EXCEED THE FAIR MARKET VALUE OF THE BUS AT THE TIME THE DEFECT IS DISCOVERED. IN NO EVENT SHALL GLAVAL BUS BE LIABLE ON A CLAIM OF ANY KIND FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO INJURIES TO PERSONS OR DAMAGE TO PROPERTY, LOSS OF PROFITS OR ANTICIPATED PROFITS, OR ANY LOSS OF VEHICLE USE, RESULTING FROM THE OWNERSHIP OR USE OF THE BUS.

## **DISPUTE RESOLUTION**

Should you be unable to resolve a disagreement with your dealer regarding your right to pursue warranty coverage for a needed repair, contact the GLAVAL BUS Customer Service Manager (see address on page 8). If a dispute about warranty service arises between GLAVAL BUS and you, the owner, the disagreement will be resolved in accordance with the customary procedures of the American Arbitration Association relating to commercial transactions, or the dispute will be submitted to a panel of three (3) arbitrators for decision. The panel will be made up of one member appointed by GLAVAL BUS, one member appointed by the complainant/owner, and one member from the arbitrators group mentioned above. Any and all legal remedies shall be available to the owner after pursuing this informal dispute resolution if a ruling is entered against GLAVAL BUS and GLAVAL BUS fails to abide the ruling. The expenses of the arbitration will be paid by the party against whom the arbitrator(s) rule.

## **FEDERAL COMPLIANCE**

THE TERMS OF THE WARRANTOR'S UNDERTAKING EXPRESSED IN THIS LIMITED WARRANTY ARE DRAFTED TO COMPLY WITH THE MAGNUSEN MOSS WARRANTY LEGISLATION, P.L. 93-637 OF 1974, AND OTHER APPLICABLE LAW. ANY WARRANTY PROVISIONS PROMULGATED BY THE FEDERAL TRADE COMMISSION PURSUANT TO RULES OR ANY OTHER LAW RELATIVE THERETO ARE EXPRESSLY INCORPORATED HEREIN. TO THE EXTENT ANY PROVISIONS OF THIS LIMITED WARRANTY ARE INCONSISTENT WITH STATE LAWS, ONLY THOSE PARTS INCONSISTENT ARE VOID.

## Who Performs Warranty Service

You need to be aware that not all dealers and/or repair facilities are equipped to understand a bus body and/or features.

To obtain warranty service, contact or visit the dealership where you originally purchased your vehicle. Your dealer should be able to meet your service needs or can refer you to another GLAVAL BUS warranty service facility. If you need assistance in locating a servicing dealer and/or repair facility contact GLAVAL BUS Customer Service Department listed below.

## Who Pays For Warranty Repairs

When you have warranty work performed by a GLAVAL BUS dealer or a GLAVAL BUS repair facility you will not be charged for the repairs.

Your claim must be made within 30 days of the discovery of the defect. Based on the determination of GLAVAL BUS, and subject to the terms of the warranty, the warranty repair work will be authorized by GLAVAL BUS.

If you prefer a non GLAVAL BUS service facility, or a GLAVAL BUS service center is not available, you may be required to initially pay for the repairs.

**Please Note:** In the case that you need to stop at or rely on a non GLAVAL BUS repair facility, **before** the repair is started, have the facility call GLAVAL BUS for assistance and authorization. Unauthorized repairs amount could alter your reimbursement.

Once the job is complete send a copy of the paid repair order either by mail or fax along with the authorization number for reimbursement. See below for contact information.

## Owner Assistance

Should you ever encounter a problem or issue that is not resolved to your satisfaction with either your dealer or repair facility please contact GLAVAL BUS Customer Service.

Please have available the Vehicle Identification Number or the GLAVAL BUS Unit number when calling and/or include with any written correspondence.

GLAVAL BUS Customer Service  
914 County Road #1 North· Elkhart, IN 46514  
Phone: 1-800-445-2825 or 574-262-2212 • Fax: 574-264-9036

If we can not resolve the issue to your satisfaction please follow the steps outlined under **Dispute Resolution** on page 7.



## OPTRONICS® LED LIFETIME LIMITED WARRANTY



Optronics LED lighting products are warranted for the lifetime of original purchaser from defects in workmanship and/or materials only. Optronics will replace the product to the original purchaser or refund the purchase price if the product fails because of defect due to workmanship and/or materials. This limited lifetime warranty covers every and all diodes within each unit. Connector failure is covered by our three year limited warranty. The LED Lifetime Warranty does not apply to severe applications such as construction or off-road use and does not cover damage resulting from accident, misuse, or abuse. If warrantor is unable to provide replacement and repair is not commercially practicable or cannot be timely made, then warrantor will refund the purchase price. This offer does not constitute in any way a product guarantee and Optronics does not assume any obligations beyond replacement of the product. This warranty is not transferable and applies to the original installation of the product.

## INCANDESCENT 3-YEAR LIMITED WARRANTY

Optronics' incandescent 12-volt lighting products are warranted for a period of three years from defects in workmanship and/or materials only. Optronics will replace the product to the original purchaser or refund the purchase price if the product fails because of defect due to workmanship and/or materials within the limited warranty period from the date or lot code printed on the product. If warrantor is unable to provide replacement and repair is not commercially practicable or cannot be timely made, then warrantor will refund the purchase price. This offer does not constitute in any way a product guarantee and Optronics does not assume any obligations beyond replacement of the product. This warranty is not transferable and applies to the original installation of the product.

## OPTI-BRITE™/MILLENNIUM SERIES™ LIMITED WARRANTY

Opti-Brite and Millennium Series LED Lights are warranted against leakage and failure to the original retail purchaser for 3 full years (applies only to failed components). Millennium Series chrome-plated bezels are warranted against defects in workmanship for one (1) full year from the original retail purchase date. These warranties do not cover any damage resulting from road hazards, accident, abuse, misuse, corrosive environment, improper installation or other mishandling. Damage includes breakage, wear and tear on the lens, severing of the wiring and/or modification or alteration to any part of the unit. Optronics assumes no responsibility for the cost of installation or removal of any products. Any alteration or modification of the light or the wiring will void the warranty.

## CONSPICUITY TAPE LIMITED WARRANTY

Optronics' conspicuity tape products are warranted for a period of seven years from defects in workmanship and/or materials and adhesion failure only. Optronics will replace the product to the original purchaser or refund the purchase price if the product fails within the limited warranty period from the date or lot code printed on the product. If warrantor is unable to provide replacement and repair is not commercially practicable or cannot be timely made, then warrantor will refund the purchase price. This offer does not constitute in any way a product guarantee and Optronics does not assume any obligations beyond replacement of the product. This warranty is not transferable and applies to the original installation of the product.

## PRODUCT REPLACEMENT PROCEDURES

To be eligible for Limited Warranty consideration, please contact your local authorized distributor/dealer or Optronics' customer service. Optronics' authorized distributor/dealer has full authority to issue an upfront warranty replacement/credit. If the product is found to be out of warranty at a later date, Optronics' customer service will rebill the customer for the replacement/credit. Customer service will determine if the failed product requires a return to Optronics. If return is required, a RETURN GOODS AUTHORIZATION NUMBER (RGA) will be issued.

THESE WARRANTIES DO NOT COVER DAMAGE RESULTING FROM ACCIDENT, MISUSE, OR ABUSE. CONSEQUENTIAL DAMAGES ARE EXCLUDED UNDER THIS WARRANTY AND ANY IMPLIED WARRANTY, EXCEPT FOR PERSONAL INJURY. THIS WARRANTY IS OFFERED IN LIEU OF ALL OTHER WARRANTIES. HOWEVER, MODIFICATION, LIMITATIONS OR EXCLUSIONS ON IMPLIED WARRANTIES MAY BE UNENFORCEABLE IN SOME STATES. THIS WARRANTY GIVES YOU SPECIFIC



### OKLAHOMA

401 South 41st Street East  
Muskogee OK 74403  
Warranty Contact – Leslie Cook  
Phone – 800-364-5483 ext. 228  
Fax – 918-683-9517



### INDIANA

3535 Corrie Drive  
Goshen, IN 46526  
Warranty Contact – Kate Wine  
Phone – 800-826-5483 ext. 119  
Fax – 574-389-0041

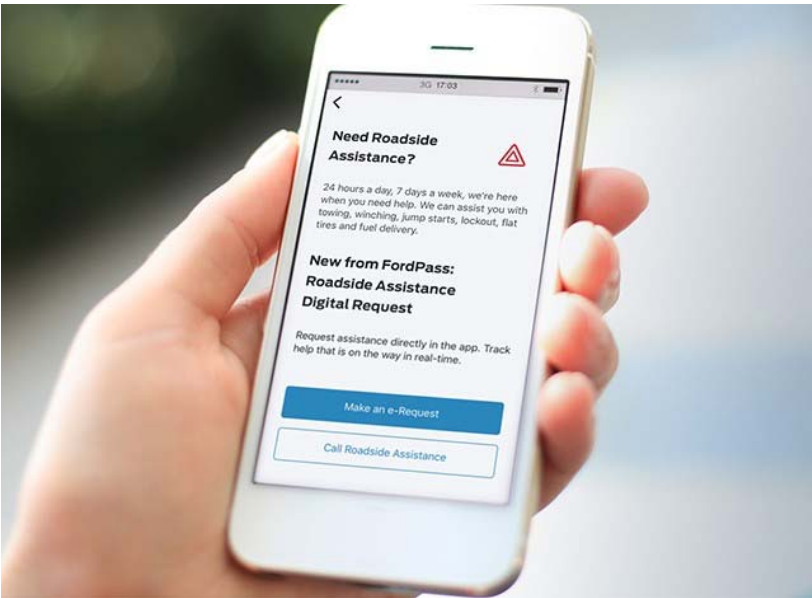
# 2020 Transit

2020 Transit > **Specs**

## Warranties

### 24-HOUR ROADSIDE ASSISTANCE<sup>(1)</sup>

- Owners can call the toll-free number (1-800-241-3673) 24 hours a day
- Customers can also use their FordPass<sup>(2)</sup> app:
  - Tap the red Hazard icon at the top of the screen
  - Tap the Make an e-Request button
  - Follow the prompts, which allow owners to identify the type of service they need
  - Owners can follow real-time progress of their request on the FordPass map
- Services available include flat tire change, towing to the nearest Ford dealership, fuel delivery, jump start and lockout assistance
- The FordPass app also offers a link to Accident Assistance under Vehicle Details/Vehicle Support
  - Accident Assistance includes information on what to do in an accident and about collision repairs
  - It also provides a collision shop locator that identifies the nearest Ford Certified Collision Center



### POWERTRAIN LIMITED WARRANTY

- Powertrain Limited Warranty for Ford vehicles is 5 years or 60,000 miles, whichever comes first
- That's an additional 2 years/24,000 miles of coverage beyond the bumper-to-bumper coverage for components such as the engine, transmission and front- or rear-wheel-drive parts

(1) Roadside Assistance is included for certain owners and available to everyone for a per-service fee.

(2) FordPass, compatible with select smartphone platforms, is available via a download. Message and data rates may apply.

### NEW VEHICLE LIMITED WARRANTIES

- 3-year/36,000-mile bumper-to-bumper; no deductible
- 5-year/60,000-mile Powertrain Limited Warranty
- 5-year/unlimited-mileage Corrosion Perforation (aluminum panels don't require perforation)
- 5-year/60,000-mile Safety Restraint Warranty

**NOTE:** See [www.motorcraftservice.com](http://www.motorcraftservice.com) for a link to a printable PDF of the Warranty Guide.

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# **Limited Warranty and Owners Information**

# **GLAVAL BUS LIMITED WARRANTY AND CUSTOMER INFORMATION**

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## GLAVAL BUS Commitment

We are committed to supplying you with a bus that has been designed and manufactured using quality materials and the finest workmanship available to our industry.

We focus on providing the highest standards of quality control over every component that goes into your bus to ensure maximum safety and reliability. Due to our commitment and focus we are able to provide you with one of the longest warranties in the industry.

## About this Booklet

This booklet explains in detail the warranty coverage for your bus. This booklet also explains **Owner Assistance** information and information regarding alternative **Dispute Resolution**.

Please note that other warranty coverage's are provided by the chassis and/or other component manufacturers. Review the other manufacturers' warranty manuals for their particular warranty coverage. Refer to **Other Warranties That May Apply**.

We ask that you keep this booklet in your bus for reference and to be available to any repair facility that is providing warranty service. We also ask that you pass this manual on to any future owners.

## Warranty Registration Notice

As an Owner your Warranty Registration Start Form must be completed, signed and mailed to GLAVAL BUS. If you do not remember signing the warranty card during the initial delivery please contact your dealer.

The warranty registration helps ensure that we can find you in the event that either GLAVAL BUS or a Component Manufacturer needs to contact you. We must have the company name, owner's name, street address, city, state/province, zip/postal code and telephone number.

This signed form **must** be returned to GLAVAL BUS Warranty Department **before** the GLAVAL BUS Limited Warranty will be in affect.

Note: The GLAVAL BUS Limited Warranty is one of the many express warranties that accompany your bus and are included within your packet of information. Please review the information to be sure you are properly registered with the manufacturers of the chassis and other components. Refer to **Other Warranties That May Apply**.

## Warranty Start Date

For a new bus the Warranty Start Date for the GLAVAL BUS Limited Warranty is the day you take delivery of your new bus.

For a GLAVAL BUS Demo the Warranty Start Date for the GLAVAL BUS Limited Warranty is the day you take delivery. However, the Manufacturers' warranties for other components will run from the original in service date for the bus.

For a GLAVAL BUS Dealer Demo the Warranty Start Date for the GLAVAL BUS Limited Warranty is the day the Dealer put the bus into service.

## Who Warrants the Bus

Each new bus body is warranted by the manufacturer and installer of the body: GLAVAL BUS, Division of Forest River, Inc., hereinafter referred to as GLAVAL BUS, 914 County Road 1 North, Elkhart, Indiana; and is administered by the GLAVAL BUS Customer Service Department, Elkhart, Indiana 46514.

## Who Is Covered

GLAVAL BUS, the warrantor, extends this limited warranty to the original and any subsequent owners of the bus during the WARRANTY PERIOD.

## What Is Covered

GLAVAL BUS warrants that each new bus body will be free from defects in any materials or workmanship supplied or performed by GLAVAL BUS that occur under normal use within the applicable warranty period and subject to certain limitations and exclusions as specified in this limited warranty.

Refer to items under **Other Warranties That May Apply, Exclusions and Limitations** and **Limits of Warranty**.

Replacement parts provided under the terms of the warranty will whenever possible, match original equipment. When necessary, GLAVAL BUS will substitute parts of comparable function and value. Defective items may be replaced with new, remanufactured, reconditioned or repaired components.

# Warranty Period

The **GLAVAL BUS Limited Warranty** is for a period of five (5) years from the date of first delivery or 100,000 miles, whichever occurs first, **except** for other coverage's listed under this paragraph and items listed under **Other Warranties That May Apply, Exclusions and Limitations and Limits of Warranty**.

**Paint and/or Tape application**, if performed by GLAVAL BUS, is warranted to be free of substantial defects in workmanship and materials provided by GLAVAL BUS for **1 year (12 months)** from date of first delivery.

**Exterior Body parts** are warranted against rust-through due to improper application or assembly for two (2) years from date of first delivery, regardless of mileage.

# Other Warranties That May Apply

The bus's engine, chassis, drive train, suspension system, battery, and other chassis components are covered by a separate warranty offered by the chassis manufacturer and are administered by the chassis manufacturer's authorized dealers. The tire manufacturer separately warrants tires.

Other components throughout the bus may also be covered by separate warranties from the component manufacturer(s) and administered by the manufacturer(s) and/or their authorized dealers.

If you do not understand the different warranty cards and registrations supplied with your bus please contact your dealer for assistance.

**Examples of the other manufacturer warranties.** These are subject to change per the manufacturer and there may be others.

Elec. Components Limited Warranty	1 year	Unlimited mileage
Alternators Limited Warranty	1 year	Unlimited mileage
Air Conditioning Limited Warranty	2 year	Unlimited mileage
Heater(s) Limited Warranty	2 year	Unlimited mileage
Electric Door Limited Warranty	1 year	Unlimited mileage
Wheelchair lift		
Braun Limited Warranty	3 year	Unlimited mileage
Ricon Limited Warranty	5 year	Unlimited mileage
Wheelchair tie down	90 days	Unlimited mileage

## What Is Not Covered

As stated previously, GLAVAL BUS does not warrant the base vehicle engine, chassis, drive train, suspension system, battery, and other chassis components. These components are covered by a separate warranty offered by the chassis manufacturer and administered by the chassis manufacturer's authorized dealers. The tire manufacturer separately warrants tires.

GLAVAL BUS does not cover any accessory covered by a separate warranty offered and administered by the component manufacturer. Examples of these are listed in **"Other Warranties That May Apply."**

All items are subject to the terms set forth under **"Exclusions and Limitations"** and **"Limits of Warranty."**

## Exclusions and Limitations

**The GLAVAL BUS Limited Warranty specifically does not extend to the following:**

### **Components that have been Altered, Modified or Substituted**

Components or systems which have been modified, altered, substituted or repaired by unauthorized personnel without the written authorization of GLAVAL BUS.

Contact GLAVAL BUS Customer Service before you make any changes to your bus.

### **Damages resulting from Overloading**

Damages that may occur as the result of overloading or uneven weight distribution, including damages to the chassis, frame, and other parts or components, will not be covered and can invalidate portions of the GLAVAL BUS Limited Warranty.

**Note:** To avoid damage when loading make sure the weight is evenly distributed throughout the unit.

### **Deterioration from Normal Wear and Tear**

Deterioration from normal wear and tear is not covered including, but not limited to, wear and tear to the interior seating, flooring, facing of fabrics, carpeting or windows and exterior body panels, lights, trim, mirrors and other accessories.

## **Maintenance and Consumable Items**

The GLAVAL BUS Limited Warranty does not cover parts and/or consumables needed to maintain the bus including, but not limited to, light bulbs, fuses, wiper blades, batteries, etc.

## **Damages Caused by Lack of Maintenance**

Damages caused by failure to perform regular and reasonable preventive maintenance are not covered including, but not limited to,

- Failure to maintain the paint and/or finishes which can result in rust or corrosion.
- Failure to maintain and flush the underbody to remove salt and other road chemicals which can result in rust or corrosion.
- Failure to yearly inspect undercoating and to replace gouged or missing areas which can result in rust or corrosion.
- Failure to yearly inspect and repair exterior caulk and sealant resulting in leaks.

## **Damages resulting from Accidents, Abuse or Misuse**

Your warranty does not cover damages caused by driver, other people in or around the bus and/or road situations including, but not limited to,

- Accidents, collisions or objects striking the bus (including power washers)
- Negligence
- Theft, vandalism
- Customer applied chemicals or accidental spills.
- Misuse (driving over curbs, etc) or otherwise using the bus in a manner other than its intended purpose.

## **Damages caused by the Environment**

Damages or surface corrosion caused by the environment, exposure to road chemicals or exposure to the elements are not covered including, but not limited to,

- Acid rain, air borne fallout, road salt or other road condition chemicals.
- Tree sap, bird and bee droppings, tree damage
- Natural disasters, flood, fire or explosion, lightning, hail, freezing conditions, or windstorms
- Acts of war or riot

## **Damages caused by Road Hazard**

Road hazard damage is not covered. It may be necessary for the owner to check and adjust the chassis alignment due to rough road conditions, or hitting curbs, pots holes, etc.

The need for a front suspension alignment is maintenance and not covered under the GLAVAL BUS Limited Warranty.

Stones or rocks and other items hitting into glass and/or the body causing cosmetic damage and/or surface corrosion are not covered.

## **Other Expenses**

GLAVAL BUS does not cover the costs of loss of vehicle use, rental vehicle, interim transportation, storage, payment for loss of time or pay, lost revenue or profits, lodging, meals, transporting of the bus to an appropriate Warranty Service Location for service, travel costs, downtime, or any other incidental or consequential damages or expenses or inconvenience incurred while your bus is out of service due to warranty repair work.

## **LIMITS OF WARRANTY**

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF ANY KIND WHETHER WRITTEN, ORAL, OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IT CANNOT BE AMENDED BY ANY DEALERSHIP, SALESPERSON OR AGENT. THE SOLE OBLIGATION OF GLAVAL BUS UNDER THIS WARRANTY SHALL BE TO REPAIR OR REPLACE AT THE DISCRETION OF GLAVAL BUS, ANY DEFECTIVE COMPONENT OR PART.

## **PURCHASER'S EXCLUSIVE REMEDY**

THIS WARRANTY SHALL BE THE OWNER'S SOLE AND EXCLUSIVE REMEDY AGAINST GLAVAL BUS, WHETHER IN CONTRACT, UNDER STATUTE (INCLUDING STATUTORY PROVISIONS AS TO CONDITIONS AS TO QUALITY OR FITNESS FOR ANY PARTICULAR PURPOSE OF GOODS SUPPLIED PURSUANT TO THE CONTRACT OF SALE), WARRANTY, TORT, STRICT LIABILITY OR ANY OTHER LEGAL THEORY.

## **LIMITATION OF LIABILITY**

THE LIABILITY OF GLAVAL BUS UNDER THIS WARRANTY IS LIMITED TO THE COST TO REPAIR OR REPLACE, IN THE SOLE DISCRETION OF GLAVAL BUS, THE DEFECTIVE COMPONENT OR PART, WHICH IN NO EVENT SHALL EXCEED THE FAIR MARKET VALUE OF THE BUS AT THE TIME THE DEFECT IS DISCOVERED. IN NO EVENT SHALL GLAVAL BUS BE LIABLE ON A CLAIM OF ANY KIND FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO INJURIES TO PERSONS OR DAMAGE TO PROPERTY, LOSS OF PROFITS OR ANTICIPATED PROFITS, OR ANY LOSS OF VEHICLE USE, RESULTING FROM THE OWNERSHIP OR USE OF THE BUS.

## **DISPUTE RESOLUTION**

Should you be unable to resolve a disagreement with your dealer regarding your right to pursue warranty coverage for a needed repair, contact the GLAVAL BUS Customer Service Manager (see address on page 8). If a dispute about warranty service arises between GLAVAL BUS and you, the owner, the disagreement will be resolved in accordance with the customary procedures of the American Arbitration Association relating to commercial transactions, or the dispute will be submitted to a panel of three (3) arbitrators for decision. The panel will be made up of one member appointed by GLAVAL BUS, one member appointed by the complainant/owner, and one member from the arbitrators group mentioned above. Any and all legal remedies shall be available to the owner after pursuing this informal dispute resolution if a ruling is entered against GLAVAL BUS and GLAVAL BUS fails to abide the ruling. The expenses of the arbitration will be paid by the party against whom the arbitrator(s) rule.

## **FEDERAL COMPLIANCE**

THE TERMS OF THE WARRANTOR'S UNDERTAKING EXPRESSED IN THIS LIMITED WARRANTY ARE DRAFTED TO COMPLY WITH THE MAGNUSEN MOSS WARRANTY LEGISLATION, P.L. 93-637 OF 1974, AND OTHER APPLICABLE LAW. ANY WARRANTY PROVISIONS PROMULGATED BY THE FEDERAL TRADE COMMISSION PURSUANT TO RULES OR ANY OTHER LAW RELATIVE THERETO ARE EXPRESSLY INCORPORATED HEREIN. TO THE EXTENT ANY PROVISIONS OF THIS LIMITED WARRANTY ARE INCONSISTENT WITH STATE LAWS, ONLY THOSE PARTS INCONSISTENT ARE VOID.

## Who Performs Warranty Service

You need to be aware that not all dealers and/or repair facilities are equipped to understand a bus body and/or features.

To obtain warranty service, contact or visit the dealership where you originally purchased your vehicle. Your dealer should be able to meet your service needs or can refer you to another GLAVAL BUS warranty service facility. If you need assistance in locating a servicing dealer and/or repair facility contact GLAVAL BUS Customer Service Department listed below.

## Who Pays For Warranty Repairs

When you have warranty work performed by a GLAVAL BUS dealer or a GLAVAL BUS repair facility you will not be charged for the repairs.

Your claim must be made within 30 days of the discovery of the defect. Based on the determination of GLAVAL BUS, and subject to the terms of the warranty, the warranty repair work will be authorized by GLAVAL BUS.

If you prefer a non GLAVAL BUS service facility, or a GLAVAL BUS service center is not available, you may be required to initially pay for the repairs.

**Please Note:** In the case that you need to stop at or rely on a non GLAVAL BUS repair facility, **before** the repair is started, have the facility call GLAVAL BUS for assistance and authorization. Unauthorized repairs amount could alter your reimbursement.

Once the job is complete send a copy of the paid repair order either by mail or fax along with the authorization number for reimbursement. See below for contact information.

## Owner Assistance

Should you ever encounter a problem or issue that is not resolved to your satisfaction with either your dealer or repair facility please contact GLAVAL BUS Customer Service.

Please have available the Vehicle Identification Number or the GLAVAL BUS Unit number when calling and/or include with any written correspondence.

GLAVAL BUS Customer Service  
914 County Road #1 North· Elkhart, IN 46514  
Phone: 1-800-445-2825 or 574-262-2212 • Fax: 574-264-9036

If we can not resolve the issue to your satisfaction please follow the steps outlined under **Dispute Resolution** on page 7.





## OPTRONICS® LED LIFETIME LIMITED WARRANTY



Optronics LED lighting products are warranted for the lifetime of original purchaser from defects in workmanship and/or materials only. Optronics will replace the product to the original purchaser or refund the purchase price if the product fails because of defect due to workmanship and/or materials. This limited lifetime warranty covers every and all diodes within each unit. Connector failure is covered by our three year limited warranty. The LED Lifetime Warranty does not apply to severe applications such as construction or off-road use and does not cover damage resulting from accident, misuse, or abuse. If warrantor is unable to provide replacement and repair is not commercially practicable or cannot be timely made, then warrantor will refund the purchase price. This offer does not constitute in any way a product guarantee and Optronics does not assume any obligations beyond replacement of the product. This warranty is not transferable and applies to the original installation of the product.

## INCANDESCENT 3-YEAR LIMITED WARRANTY

Optronics' incandescent 12-volt lighting products are warranted for a period of three years from defects in workmanship and/or materials only. Optronics will replace the product to the original purchaser or refund the purchase price if the product fails because of defect due to workmanship and/or materials within the limited warranty period from the date or lot code printed on the product. If warrantor is unable to provide replacement and repair is not commercially practicable or cannot be timely made, then warrantor will refund the purchase price. This offer does not constitute in any way a product guarantee and Optronics does not assume any obligations beyond replacement of the product. This warranty is not transferable and applies to the original installation of the product.

## OPTI-BRITE™/MILLENNIUM SERIES™ LIMITED WARRANTY

Opti-Brite and Millennium Series LED Lights are warranted against leakage and failure to the original retail purchaser for 3 full years (applies only to failed components). Millennium Series chrome-plated bezels are warranted against defects in workmanship for one (1) full year from the original retail purchase date. These warranties do not cover any damage resulting from road hazards, accident, abuse, misuse, corrosive environment, improper installation or other mishandling. Damage includes breakage, wear and tear on the lens, severing of the wiring and/or modification or alteration to any part of the unit. Optronics assumes no responsibility for the cost of installation or removal of any products. Any alteration or modification of the light or the wiring will void the warranty.

## CONSPICUITY TAPE LIMITED WARRANTY

Optronics' conspicuity tape products are warranted for a period of seven years from defects in workmanship and/or materials and adhesion failure only. Optronics will replace the product to the original purchaser or refund the purchase price if the product fails within the limited warranty period from the date or lot code printed on the product. If warrantor is unable to provide replacement and repair is not commercially practicable or cannot be timely made, then warrantor will refund the purchase price. This offer does not constitute in any way a product guarantee and Optronics does not assume any obligations beyond replacement of the product. This warranty is not transferable and applies to the original installation of the product.

## PRODUCT REPLACEMENT PROCEDURES

To be eligible for Limited Warranty consideration, please contact your local authorized distributor/dealer or Optronics' customer service. Optronics' authorized distributor/dealer has full authority to issue an upfront warranty replacement/credit. If the product is found to be out of warranty at a later date, Optronics' customer service will rebill the customer for the replacement/credit. Customer service will determine if the failed product requires a return to Optronics. If return is required, a RETURN GOODS AUTHORIZATION NUMBER (RGA) will be issued.

THESE WARRANTIES DO NOT COVER DAMAGE RESULTING FROM ACCIDENT, MISUSE, OR ABUSE. CONSEQUENTIAL DAMAGES ARE EXCLUDED UNDER THIS WARRANTY AND ANY IMPLIED WARRANTY, EXCEPT FOR PERSONAL INJURY. THIS WARRANTY IS OFFERED IN LIEU OF ALL OTHER WARRANTIES. HOWEVER, MODIFICATION, LIMITATIONS OR EXCLUSIONS ON IMPLIED WARRANTIES MAY BE UNENFORCEABLE IN SOME STATES. THIS WARRANTY GIVES YOU SPECIFIC



### OKLAHOMA

401 South 41st Street East  
Muskogee OK 74403  
Warranty Contact – Leslie Cook  
Phone – 800-364-5483 ext. 228  
Fax – 918-683-9517



### INDIANA

3535 Corrie Drive  
Goshen, IN 46526  
Warranty Contact – Kate Wine  
Phone – 800-826-5483 ext. 119  
Fax – 574-389-0041



## Creative Bus Sales

### WARRANTY INFORMATION DOCUMENT: WEST VIRGINIA CRFQ 0805 PTR20000003

The warranty details below are for informational purposes. All warranty claims or request for assistance should be directed to [warranty@creativebussales.com](mailto:warranty@creativebussales.com). This allows Creative Bus Sales warranty department to assist the end user with identifying if the issue is a body manufacturer warranty issues or an OEM chassis warranty issue.

The list below is intended to be comprehensive, not specific to any individual order. If there is an component on your bus that is not listed below, please reach out to me directly for assistance.

Glaval Bus Body warranty-1 year 12,000 mile bumper to bumper  
-5 year 100,000 mile structural

Ford Chassis warranty- 3 year 36,000 mile bumper to bumper  
-5 year 60,000 mile powertrain

Supplier	Component/Function	Warranty Terms
ACC	AirConditioning	2 year unlimited
Intermotive	Interlocks-Fast Idle	1 year 12,000 mile
Jensen	PA System	1 year 12,000 mile
Transign	Destination Signs	1 year 12,000 mile
Roscoe	Ext. Mirrors/BU camera	1 year 12,000 mile
Q Straint	Wheelchair restraints	2 years
Braun	Wheelchair lift	1 year 12,000 mile
	Safety Equipment	90 days
Freedman	All seat components	1 year 12,000 mile
GerFlor	Floor Covering	1 year 12,000 mile
Transpec	Roof Hatch	1 year 12,000 mile
	Back up alarm	1 year 12,000
Intermotive	Engine Monitor	1 year 12,000 mile
Angel Trax	Camera systems	1 year 12,000 mile

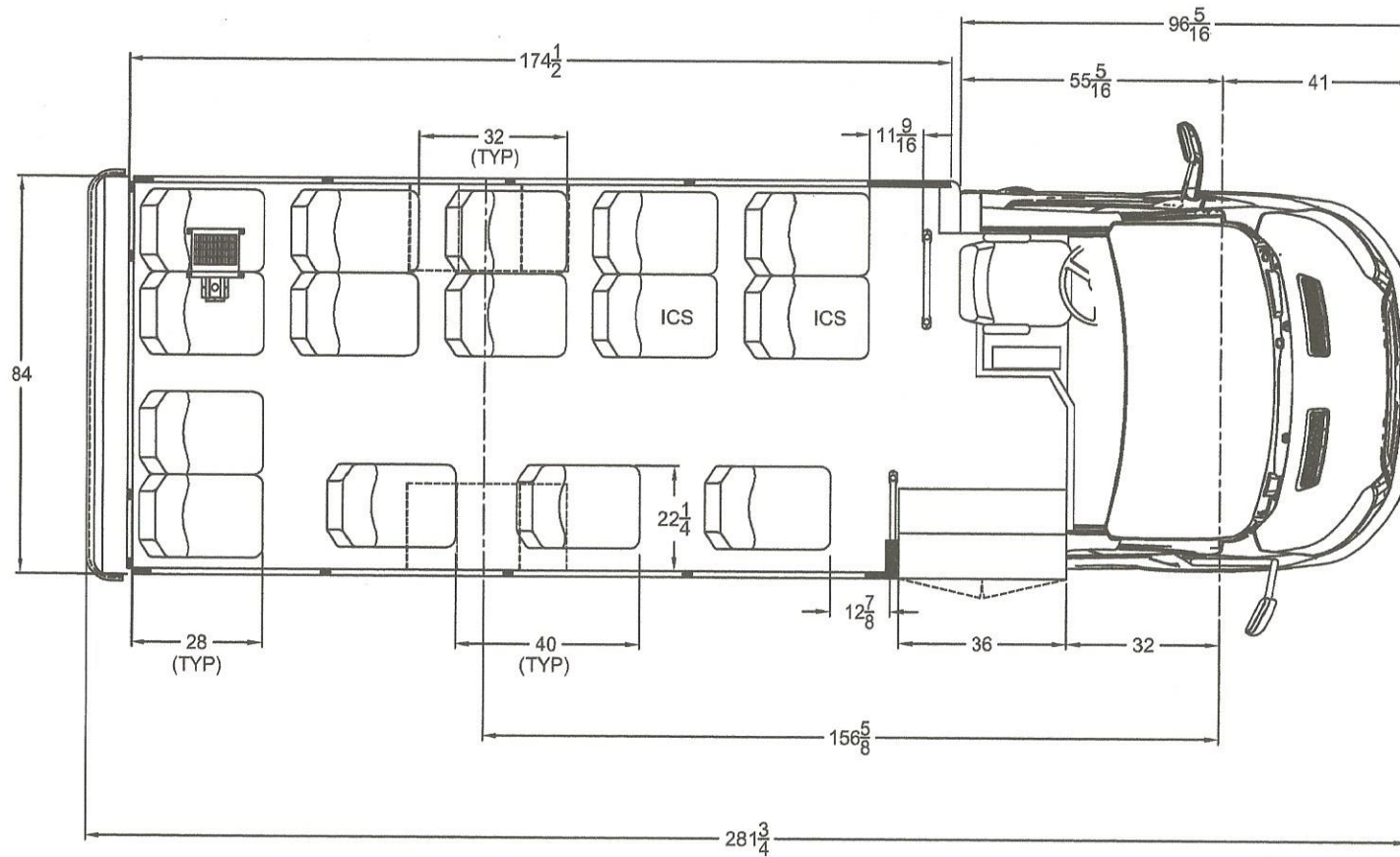
Again, please direct all service/warranty related questions to:

[Warranty@creativebussales.com](mailto:Warranty@creativebussales.com)

Thank you,

Matt Mashuda  
Transit/Government Sales Representative  
Creative Bus Sales  
[mattm@creativebussales.com](mailto:mattm@creativebussales.com)  
(412) 992-0184

- CLASS A -



NOTE: SHOWN WITH MID HI FREEDMAN SEATS  
 COMMUTE TRANSIT 10,360 GVWR  
 THIS FLOOR PLAN IS FOR ILLUSTRATION PURPOSES ONLY.  
 A WEIGHT ANALYSIS HAS NOT YET BEEN PERFORMED.  
 FINAL APPROVAL WITH A WEIGHT ANALYSIS IS REQUIRED UPON RECEIPT OF A  
 COMPLETED ORDER WITH ALL OPTIONS SHOWN.  
 OPTIONAL EQUIPMENT MAY BE SHOWN.  
 THE SALES ORDER PLACED DICTATES ACTUAL OPTION CONTENT.

### DEALER APPROVAL

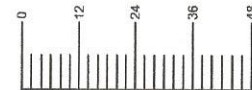
☐ APPROVED

### CUSTOMER SIGNATURE

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REV.	DESCRIPTION OF CHANGE	BY	CHK	DATE	ECN No.
LET.					

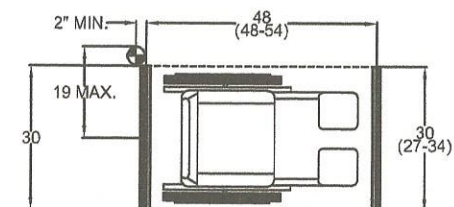
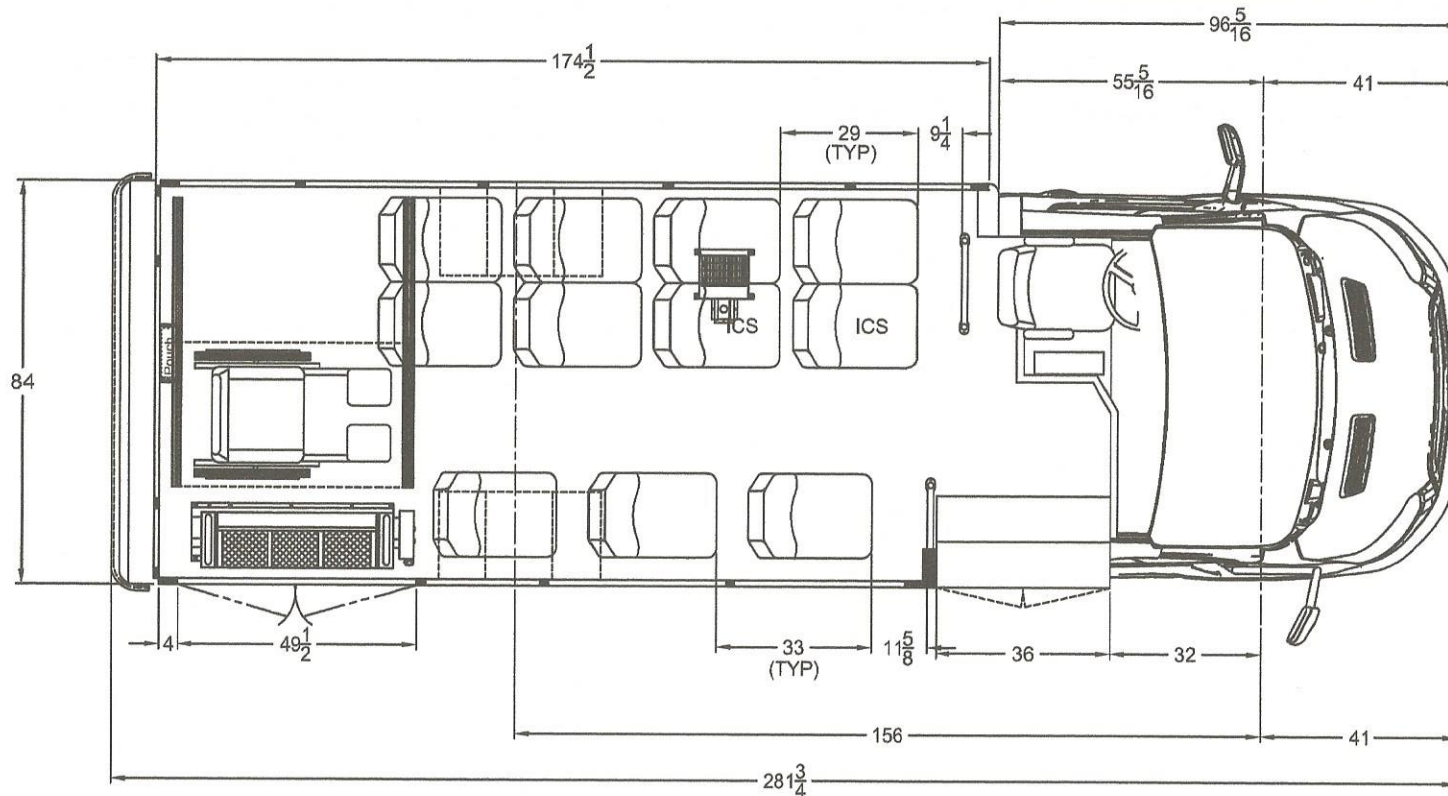
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IN INCHES



TOLERANCE UNLESS OTHERWISE SPECIFIED		GLAVAL BUS Buses for the new millennium	
WOOD	OTHER	DATE: 06/07/18	TITLE: 15 PASS 156 WB MODEL 22 COMMUTE TRANSIT
+ 1/8"	+ 1/16"	NAME: TAS	
+ 1°	+ 1/2°	DWG. No.	15 PASS 156 174-3 USA



# CLASS B - CLASS E - CLASS H - CLASS K - CLASS N



NOTE: SHOWN WITH MID HI FREEDMAN SEATS  
 COMMUTE 10,360 GVWR  
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 FINAL APPROVAL WITH A WEIGHT ANALYSIS IS REQUIRED UPON RECEIPT OF A  
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 OPTIONAL EQUIPMENT MAY BE SHOWN.  
 THE SALES ORDER PLACED DICTATES ACTUAL OPTION CONTENT.

## DEALER APPROVAL

☐ APPROVED

CUSTOMER SIGNATURE

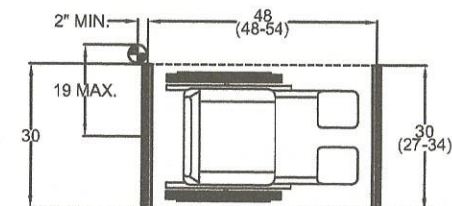
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REV.	DESCRIPTION OF CHANGE	BY	CHK	DATE	ECN No.

SCALE  
IN INCHES



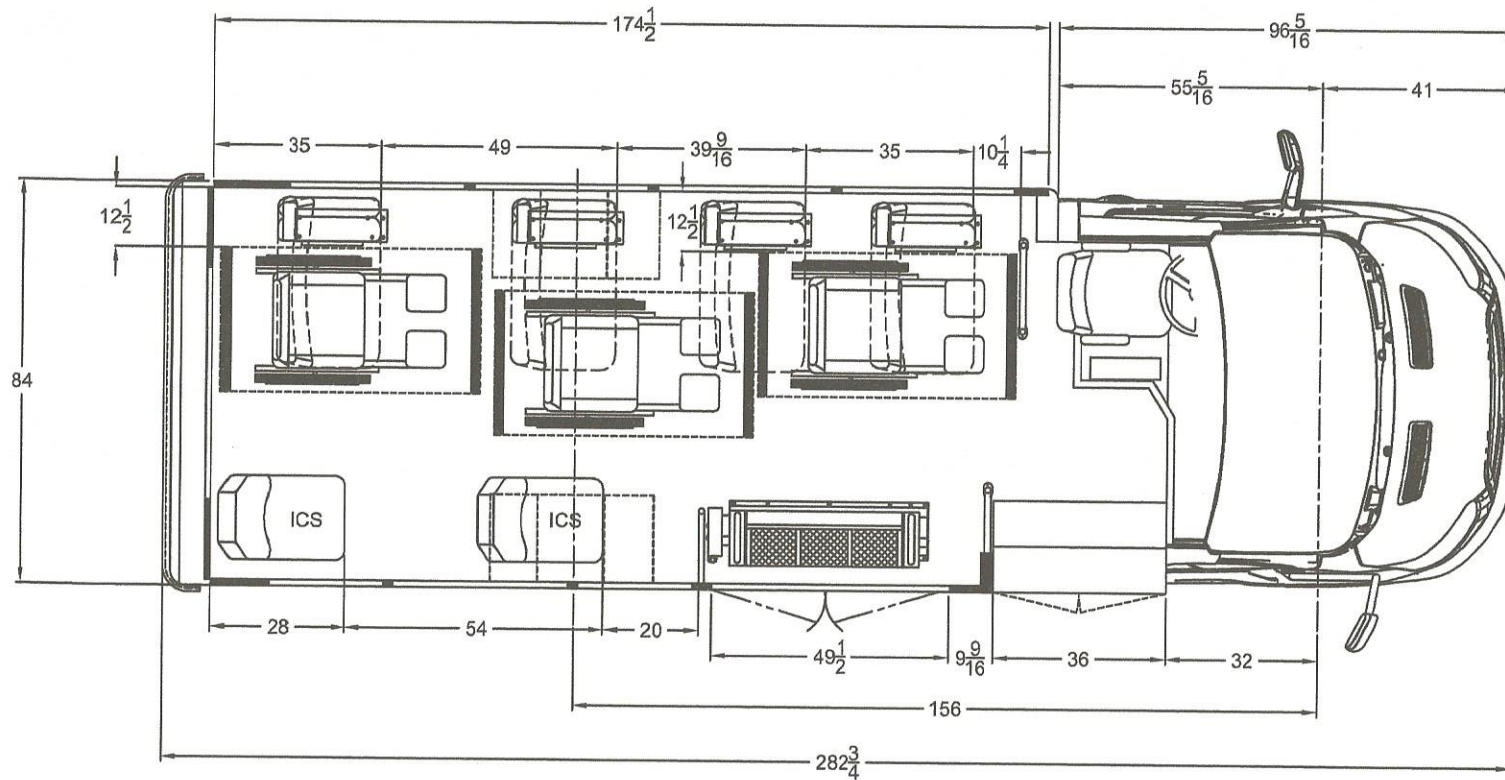
TOLERANCE UNLESS OTHERWISE SPECIFIED		GLAVAL BUS Buses for the new millennium	
WOOD	OTHER	DATE: 11/12/18	TITLE:
± 1/8"	± 1/16"	NAME: JOT	11 2 WC 156 WB MODEL 22 TRANSIT
± 1°	± 1/2°	DWG. No.	11 2 WC 156 WB 174 BDY GLAVAL



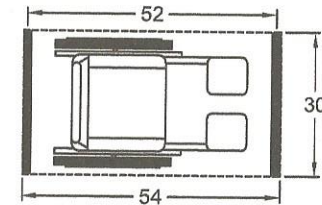
TOLERANCE UNLESS OTHERWISE SPECIFIED		 Buses for the new millennium	
WOOD	OTHER	DATE: 11/12/18	TITLE:
± 1/8"	± 1/16"	NAME: TAS	11 2 WC 156 WB MODEL 22 TRANSIT
± 1°	± 1/2°	DWG. No.	11 2 WC 156 WB 174 BDY GLAVAL



CLASS D - CLASS G - CLASS J - CLASS M - CLASS P



NOTE: SHOWN WITH MID HI FREEDMAN SEATS  
COMMUTE TRANSIT 10,360 GVWR  
THIS FLOOR PLAN IS FOR ILLUSTRATION PURPOSES ONLY.  
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FINAL APPROVAL WITH A WEIGHT ANALYSIS IS REQUIRED UPON RECEIPT OF A  
COMPLETED ORDER WITH ALL OPTIONS SHOWN.  
OPTIONAL EQUIPMENT MAY BE SHOWN.  
THE SALES ORDER PLACED DICTATES ACTUAL OPTION CONTENT.



DEALER APPROVAL

☐ APPROVED

CUSTOMER SIGNATURE

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REV.	DESCRIPTION OF CHANGE	BY	CHK	DATE	ECN No.
LET.					

SCALE  
IN INCHES



**GLAVAL BUS**  
Buses for the new millennium

DATE: 07/21/20 TITLE: 2 3 WC 156 WB TRANSIT  
NAME: TAS COMMUTE TRANSIT  
DWG. No. 2 3 WC 4 DB FOLDS 156 174 USA

TOLERANCE UNLESS  
OTHERWISE SPECIFIED

WOOD	OTHER
$\pm 1/8"$	$\pm 1/16"$
$\pm 1"$	$\pm 1/2"$

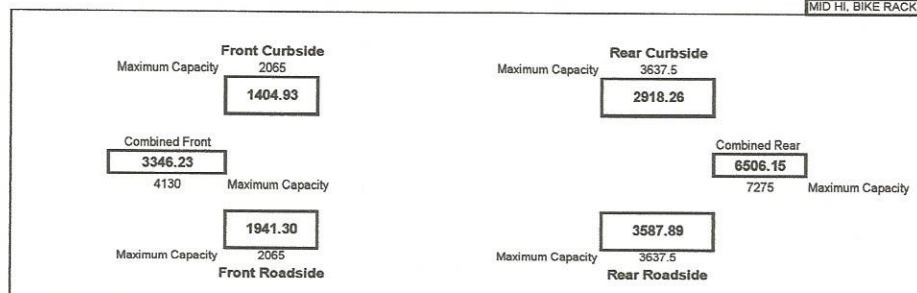
CLASS A

### WEIGHT ANALYSIS

7/21/2020 15 PASS 156 174-3 EST USA

[illegible]

94376B	
MID HI, BIKE RACK	



Chassis GVWR is 10,360 pounds



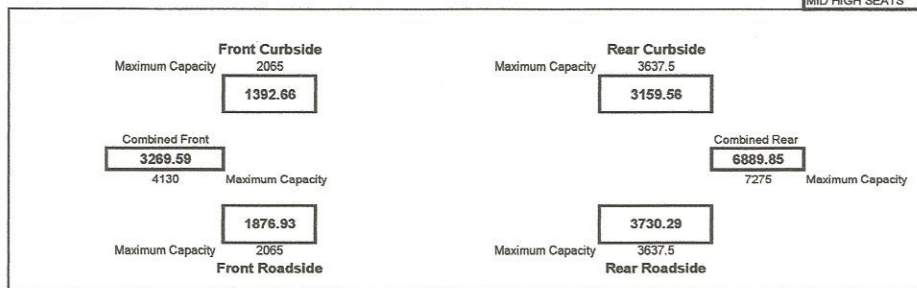
CLASSES B, E, H, K, N

### WEIGHT ANALYSIS

7/21/2020 11 1 WC 1 DBL FOLD 156 WB 174 BDY EST USA

			INPUT AREAS=						FUEL LOAD ADJ. DATA (F.L.A.)			
			VEHICLE DESCRIPTION:		CHASSIS		UNIT #		MODEL:		FUEL TYPE:	
			11 1 WC 1 DBL FOLD 158 WB 174 BD		TRANSIT				TRANSIT		GAS	
			WHEELBASE		PER IN. VALUE CALC.				FUEL AMT.		WGTF OF FUEL	
			156		0.64				0.13		152.5	
			AXLE CAPACITIES				2904		FUEL TANK CENTER		DEALER	
			FRONT		REAR		TOTAL					
			4130		7275		10360		4650		2109	
							2541					
			LEFT (ROADSIDE)					RIGHT (CURBSIDE)				
			DISTANCE (IN.)		WEIGHT (LBS.)		% REAR AXLE		FRONT		REAR	
			44		150		28.21%		107.69		42.31	
			MID HI DB		122		-55		-11.99		-43.19	
			MID HI DB		162		-55		103.85%		2.12	
			SGL FLIP		227		-32		145.51%		14.56	
									0.00%		0.00	
									0.00%		0.00	
									94		182	
									127		182	
									160		182	
									227		200	
											0.00%	
											60.26%	
											81.41%	
											102.56%	
											145.51%	
											14.56	
											-46.56	
											0.00%	
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47685B	
MID HIGH SEATS	



Chassis GVWR is 10,360 pounds

CLASSES C, F, I, L, O

WEIGHT ANALYSIS

7/21/2020 11 2 WC 156 WB 174 8DY EST USA

		INPUT AREAS=				FUEL LOAD ADJ. DATA (F.L.A.)					
		VEHICLE DESCRIPTION:		CHASSIS		MODEL:		FUEL TYPE:		FUEL CAP.	
		11 2 WC 156 WB 174 8DY EST USA		TRANSIT		TRANSIT		GAS		25	
		WHEELBASE		PER IN. VALUE CALC.		AXLE WEIGHTS		FUEL AMT.		WGTF OF FUEL	
		156		0.64		LEFT FRONT RIGHT FRONT		0.13		152.5	
AXLE CAPACITIES				2904		1598 1306		FUEL TANK CENTER		DEALER	
FRONT		REAR		TOTAL		LEFT REAR RIGHT REAR		78			
4130		7275		10360		2109 2541					
LEFT (ROADSIDE)						RIGHT (CURBSIDE)					
		DISTANCE (IN.)	WEIGHT (LBS.)	% REAR AXLE	FRONT	REAR	DISTANCE (IN.)	WEIGHT (LBS.)	% REAR AXLE	FRONT	REAR
DRIVER		44	150	28.21%	107.69	42.31	94	-32	60.26%	-12.72	-19.28
MID HI DB		122	-55	78.21%	-11.99	-43.01	127	-32	81.41%	-5.95	-26.05
MID HI DB		162	-55	33.85%	2.12	-57.12	160	-32	102.56%	0.82	-32.82
SGL FLIP		227	-32	145.51%	14.56	-46.56	227	-32	145.51%	14.56	-46.56
				0.00%	0.00	0.00			0.00%	0.00	0.00
				0.00%	0.00	0.00	94	182	60.26%	72.33	109.67
MID HI DB		85	355	54.49%	161.57	193.43	127	182	81.41%	33.83	148.17
MID HI DB		114	355	73.08%	95.58	259.42	160	182	102.56%	-4.67	186.57
MID HI DB		143	355	91.67%	29.58	325.42	194	200	124.36%	-49.72	249.72
MID HI DB		172	355	110.26%	-36.41	391.41	156		0.00%	0.00	0.00
W/C		194	200	124.36%	-48.72	248.72	194	28	100.00%	0.00	28.00
				0.00%	0.00	0.00	156	0	100.00%	0.00	0.00
5/8 MARINE		156	28	100.00%	0.00	28.00	235	-7.5	150.64%	3.80	-11.30
MORYDE		156	0	100.00%	0.00	0.00			0.00%	0.00	0.00
ROMEO RIM BUMPER		235	-7.5	150.64%	3.80	-11.30			0.00%	0.00	0.00
				0.00%	0.00	0.00			0.00%	0.00	0.00
				0.00%	0.00	0.00			0.00%	0.00	0.00
				0.00%	0.00	0.00			0.00%	0.00	0.00
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				0.00%	0.00	0.00			0.00%	0.00	0.00
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CLASSES D, G, J, M, P

WEIGHT ANALYSIS  
7/21/2020 2 3 WC 4 DB FOLDS 156 174 EST USA

INPUT AREAS=				FUEL LOAD ADJ. DATA (F.L.A.)			
VEHICLE DESCRIPTION:				FUEL CAP.			
2 3 WC 4 DB FOLDS 156 174 EST US				FUEL WGT PER GAL			
TRANSIT				25			
WHEELBASE				6.1			
PER IN. VALUE CALC.				FUEL AMT.			
156				WGT OF FUEL			
0.54				FUEL ADJ. AMT.			
AXLE CAPACITIES				FUEL TANK CENTER			
3196				DEALER			
FRONT				78			
4130							
REAR							
TOTAL							
7275							
4612							
2117							
2495							
LEFT (ROADSIDE)				RIGHT (CURBSIDE)			
DISTANCE (IN.)				WEIGHT (LBS.)			
WEIGHT (LBS.)				% REAR AXLE			
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WEIGHT (LBS.)				% REAR AXLE			
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REAR				DISTANCE (IN.)			
DISTANCE (IN.)				WEIGHT (LBS.)			
WEIGHT (LBS.)				% REAR AXLE			
% REAR AXLE				FRONT			
FRONT				REAR			
REAR				DISTANCE (IN.)			

## Product Description

- For Solvent, UV, and Latex Inkjet printing

## Product Features

- Pressure-activated adhesive for easy sliding, tacking, snap-up and repositioning
- Excellent hiding power; flexible; conforms to compound curves, corrugations and rivets
- Many finished graphic constructions can be stretched up to 130% (i.e., a 10 inch [25 cm] piece of film can stretch to 13 inches [33 cm]) without primer or relief cuts and maintain lift resistance; see "Stretchability" on page 6
- Removable with heat
- IJ180mC-10UR:** Expected Performance Life of 8 years (unwarranted period for unprinted film with no graphic protection, applied to a flat, vertical, outdoor surface)
- All others:** Expected Performance Life of 10 years (unwarranted period for unprinted film with no graphic protection, applied to a flat, vertical, outdoor surface)

### Quick Links

[3M Graphics Warranties](#)  
[Technical Information Selector](#)  
[Safety Data Sheets \(SDS\)](#)  
[Flammability](#)  
[Videos](#)

Some of these links lead to web-based resources that are not product-specific.

Product Name	Description	Features
3M™ Controltac™ Graphic Film IJ180-10	<ul style="list-style-type: none"> <li>2-mil, white, vinyl film with a luster finish</li> </ul>	<ul style="list-style-type: none"> <li>The original film is optimal for trailer &amp; box truck graphics</li> </ul>
3M™ Controltac™ Graphic Film w/Comply™ Adhesive IJ180C-10	<ul style="list-style-type: none"> <li>2-mil, white, vinyl film with a luster finish</li> </ul>	<ul style="list-style-type: none"> <li>The original film is optimal for trailer &amp; box truck graphics using Comply™ Adhesive air release channels for fast, easy, bubble-free installations</li> </ul>
3M™ Controltac™ Graphic Film w/Comply™ Adhesive v3 IJ180Cv3-10	<ul style="list-style-type: none"> <li>2-mil, white, vinyl film with a luster finish</li> </ul>	<ul style="list-style-type: none"> <li>The industry go-to film is optimal for trailer &amp; box truck graphics using Comply™ v3 Adhesive non-visible air release channels for fast, easy, bubble-free installations</li> </ul>
3M™ Print Wrap Film IJ180mC-10	<ul style="list-style-type: none"> <li>2-mil, white, vinyl film with a luster finish</li> </ul>	<ul style="list-style-type: none"> <li>The industry's go-to film is fine tuned for wraps using Comply™ Adhesive with micro technology non-visible air release channels for fast, easy, bubble-free installations</li> </ul>
3M™ Print Wrap Film IJ180mC-114 "Transparent"	<ul style="list-style-type: none"> <li>2-mil, clear, vinyl film with a luster finish</li> </ul>	<ul style="list-style-type: none"> <li>Printable clear wrap film with micro technology non-visible air release channels for fast, easy, bubble-free installations</li> </ul>
3M™ Print Wrap Film IJ180mC-120 "Metallic"	<ul style="list-style-type: none"> <li>2-mil, metallic silver, vinyl film with a luster finish</li> </ul>	<ul style="list-style-type: none"> <li>Printable metallic wrap film with micro technology non-visible air release channels for fast, easy, bubble-free installations</li> </ul>
3M™ Print Wrap Film IJ180mC-10UR	<ul style="list-style-type: none"> <li>2-mil, white, vinyl film with a luster finish with Ultra-Removable adhesive.</li> </ul>	<ul style="list-style-type: none"> <li>Ultra-Removable adhesive. Shorter term option. Fast, clean removal without heat or chemicals.</li> </ul>

## Recommended Types of Graphics and End Uses

- Wraps for vehicles, straight trucks, semi-trucks and semi-trailers; emblems or striping
  - Horizontal vehicle wraps when protected with 3M overlaminates 8528, 8548G, 8549L, or 8900
- Walls, indoor and outdoor graphics and signs, including point-of-purchase and displays
- Watercraft graphics (above the static water line only)
- Bus graphics
- Small format original equipment manufacturer's (OEM) decorative and identification graphics, cautionary and safety labeling
- IJ180mC-114 can be used for 2 way emblems on windows (excluding buses or other vehicles).

### IMPORTANT NOTE

For all stainless steel applications, see [IJ180mC-10SLS product bulletin](#).

For all low-surface energy applications, see [IJ180mC-10LSE product bulletin](#).

When constructed and used as described in this Bulletin, these types of graphics and end uses may be warranted by the 3M™ MCS™ Warranty or the 3M Performance Guarantee. Please read the entire Bulletin for details.



# 3M™ Controltac™ Graphic Film

## 3M™ Print Wrap Film

### Recommended Compatible Products

See [3Mgraphics.com/warranties](http://3Mgraphics.com/warranties) for a complete list of compatible products that are approved by 3M for use with the base film covered in this Bulletin and used for the creation of a graphic that may be eligible for the 3M™ MCS™ Warranty or 3M Performance Guarantee.

### OEM Inkjet Inks and Printers for the 3M Performance Guarantee

See the [3M Performance Guarantee Matrix](#) for a complete list of compatible OEM Inkjet Inks and Printers that are approved by 3M for use with the base film covered in the Bulletin and used for the creation of a graphic that may be eligible for the 3M Performance Guarantee.

### Graphic Protection

- [3M™ Scotchcal™ Gloss Overlaminate 8518](#)
- [3M™ Scotchcal™ Luster Overlaminate 8519](#)
- [3M™ Scotchcal™ Matte Overlaminate 8520](#)
- [3M™ Scotchcal™ Gloss Overlaminate 8528](#) *with horizontal vehicle warranty*
- [3M™ Envision™ Gloss Wrap Overlaminate 8548G](#) *with horizontal vehicle warranty*
- [3M™ Envision™ Luster Wrap Overlaminate 8549L](#) *with horizontal vehicle warranty*
- [3M™ Scotchcal™ Ultra Matte Overlaminate 8915](#)
- [3M™ Screen Print Gloss Clear 1920DR](#)
- [3M™ Screen Print UV Gloss Clear 9740i](#)
- [3M™ Piezo Inkjet Protective Clear 8530](#)
- [3M™ Wrap Overlaminate Series 8900](#)
- [3M™ Décor Overlaminate 8600](#)

### Application Tapes

See [3M Instruction Bulletin AT-1](#) to determine what application tape is recommend for your film or finished graphic.

### Other Products

- [3M™ Edge Sealer 3950](#)
- [3M™ Edge Sealer Tape 8914](#)
- [3M™ Vehicle Channel Applicator Tool VCAT-2](#)
- [3M™ Roller S \(small hard roller\)](#)
- [3M™ Roller L \(large hard roller\)](#)
- [3M™ Scotchgard™ Paint Protection Film SGH6](#)

### Certificate of 3M™ MCS™ Warranty

Graphic manufacturers who produce digitally printed graphics made with all 3M Graphics Products, including 3M Ink purchased through a qualified 3M Distributor or 3M Printing Partner, may register to be recognized with a Certificate of 3M™ MCS™ Warranty. Only graphic manufacturers having a current Certificate of 3M™ MCS™ Warranty are eligible to extend this warranty to their customers.

**NOTE:** For non-digitally printed Finished Graphics, check your eligibility for the 3M™ MCS™ Warranty by viewing the Warranty Period found within the Product Bulletin or using the warranty selector at [www.3mgraphics.com/warranties](http://www.3mgraphics.com/warranties).

# 3M™ Controltac™ Graphic Film

## 3M™ Print Wrap Film

### Characteristics

These are typical values for unprocessed product. Processing may change the values.

### Physical Characteristics

Characteristic	Value
<b>Material</b>	Cast vinyl
<b>Film Color</b>	<b>Film IJ180, IJ180C, IJ180Cv3, IJ180mC-10, IJ180mC-10UR:</b> White, opaque <b>IJ180mC-120:</b> Silver <b>IJ180mC-114:</b> Clear
<b>Thickness</b>	<b>Without adhesive:</b> 2 mil (0.05 mm) <b>With adhesive:</b> 3–4 mil (0.08–0.10 mm)
<b>Adhesive</b>	<b>Film IJ180:</b> Pressure-activated (slide, tack, snap-up, reposition) <b>Films IJ180C, IJ180Cv3; IJ180mC (all versions):</b> Pressure-activated (slide, tack, snap-up, reposition) with air release channels
<b>Adhesive Color</b>	<b>Film IJ180, IJ180C, IJ180Cv3, IJ180mC-10, IJ180mC-10UR:</b> Gray <b>IJ180mC-120:</b> Silver <b>IJ180mC-114:</b> Clear
<b>Liner</b>	Polyethylene-coated paper
<b>Adhesion, Typical 24 hours after application</b>	<b>ABS:</b> 4–5 pounds/inch (0.72–0.89 kg/cm) <b>Acrylic enamel:</b> 3–4 pounds/inch (0.54–0.72 kg/cm) <b>Aluminum, anodized:</b> 7–8 pounds/inch (1.26–1.43 kg/cm) <b>Aluminum, etched:</b> 5–6 pounds/inch (0.89–1.08 kg/cm) <b>Chrome:</b> 4–5 pounds/inch (0.72–0.89 kg/cm) <b>Fruehauf pre-painted panels:</b> 3–5 pounds/inch (0.54–0.89 kg/cm)
<b>Tensile Strength</b>	5 pounds/inch at 73 °F (0.9kg/cm at 23 °C)
<b>Chemical Resistance</b>	Resists mild alkalis, mild acids, and salt Excellent resistance to water ( <i>does not include immersion</i> ) Resists occasional fuel spills
<b>Flammability</b>	ASTM E84 reports: <a href="#">IJ180</a> , <a href="#">IJ180C</a> , and <a href="#">IJ180Cv3</a> or go to the On-line Product Catalog at <a href="#">3M.com/graphics</a> All other test reports: call 1-800-328-3908

### Application Characteristics

Characteristic	Value
<b>Finished Graphic Application Recommendation</b>	Surface type: flat, with and without rivets, simple curves, compound curves, and corrugations Substrate type: ABS resins, aluminum, chrome, glass, fiberglass reinforced plastics, paint (check adhesion to powder-coated or water-based paints), fiberglass with gel coat Application method: Dry Application temperature: air and substrate <ul style="list-style-type: none"> <li>Flat without rivets: 40–100 °F (4–38 °C)</li> <li>Curves or corrugations with rivets: 50–100 °F (10–38 °C)</li> <li>Compound curves and/or watercraft: 60–90 °F (16–32 °C)</li> </ul>
<b>Applied Shrinkage</b>	0.015 inches (0.4 mm)
<b>Temperature Range After Application</b>	-65 to +225 °F (-60 to +107 °C) (not for extended periods of time at the extremes)
<b>Graphic Removal</b>	Removable with heat from most substrates within the Warranty Period at 50 °F (10 °C) minimum (air and substrate). 3M makes no claims as to the ease or speed of removal. <b>IJ180mC-10UR</b> is ultra-removable, and does not need heat to remove. See <a href="#">3M Instruction Bulletin 6.5</a> for removal techniques.

## Warranty Information

### Warranty Coverage Overview

The warranty coverage for eligible graphics is based on the user both reading and following all applicable and current 3M Graphics Product and Instruction Bulletins. The warranty period for eligible graphics is as stated in the 3M Graphics Warranties Matrices at the time that the film was purchased. Information found at [3MGraphics.com/warranties](https://www.3MGraphics.com/warranties) includes:

- [3M Graphics Warranties Bulletin](#)
  - This bulletin contains information on limitations and exceptions, and warranty period reductions for 3M Graphics Warranties. The warranty period may be reduced and stipulations may apply for certain constructions, applications, and graphic exposures as covered in this Bulletin.
- [3M Graphics Warranties Selector](#)
  - Use this selector to search for your vertical warranty period by product type, ink type, film name, and/or ink/printer platform.
- [U.S. Desert Southwest Region Map](#)
  - Use this map of hot, arid desert areas to determine if you are subject to reduced warranted durabilities.

The warranties set forth in this Bulletin are made in lieu of all other express or implied warranties, including any implied warranty of merchantability, fitness for a particular purpose, or arising out of a course of dealing, custom, or usage of trade.

### 3M Basic Product Warranty

3M Graphics Products are warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in its applicable 3M Graphics Product Bulletin and as further set forth in the [3M Graphics Warranties Bulletin](#).

### Limited Remedy

The limited remedy applicable to each warranty is addressed in the 3M Graphics Warranties Bulletin found at [3MGraphics.com/warranties](https://www.3MGraphics.com/warranties).

### Limitation of Liability

Except where prohibited by law, 3M SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE TO PURCHASER OR USER FOR ANY DIRECT (EXCEPT FOR THE LIMITED REMEDY PROVIDED IN THE 3M GRAPHICS WARRANTIES BULLETIN), INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LABOR, NON-3M MATERIAL CHARGES, LOSS OF PROFITS, REVENUE, BUSINESS, OPPORTUNITY, OR GOODWILL) RESULTING FROM OR IN ANY WAY RELATED TO 3M'S GRAPHICS PRODUCTS, SERVICES, or THIS BULLETIN. This limitation of liability applies regardless of the legal or equitable theory under which such losses or damages are sought.

### Warranty Period Matrices

See the 3M Graphics Warranties Matrices at [3MGraphics.com/warranties](https://www.3MGraphics.com/warranties), for vertical warranty period information specific to your film.

### Warranty Period Matrices - Smooth, Interior Walls

**Table A.** Warranty Period (in years) for Finished Graphics Applied to Smooth, Indoor Walls Not Exposed to the Elements or in Direct Sunlight. See the 3M™ MCS™ Graphics Warranties Matrices at [3MGraphics.com/warranties](https://www.3M.com/graphics/warranties) for full list of compatible inks.

Film	Overlaminates	Inks		
		UV Inkjet Inks	Solvent Inkjet Inks	Latex Inkjet Inks
IJ180mC-10	8520; 8550M; 8600; 8915;	8	8	8

#### IMPORTANT NOTE

**This warranty period does not include removability.**

#### IMPORTANT NOTE

Warranty Period table above applies to the listed overlaminates used in conjunction with the films listed in the table and applicable Inkjet inks on smooth, indoor wall applications not exposed to the elements and not located in direct sunlight.

The Adhesion Test Kit must be used to test adhesion characteristics of smooth indoor walls before application in order to be eligible for the 3M™ MCS™ Warranty. See [3M Instruction Bulletin 5.37](#) for full details.

The 3M Smooth Interior Wall Installation Checklist (located at the end of this Bulletin) must be completed in order for the finished graphic to be eligible for the 3M™ MCS™ Warranty.

### Additional Limitations

See the 3M Graphics Warranties Bulletin at [3MGraphics.com/warranties](https://www.3M.com/graphics/warranties), for terms, additional limitations of your warranty, if any, information on reduced warranties for different exposures, and limitations of liability.

### Factors that Affect Graphic Performance Life

The actual performance life of a graphic is affected by:

- the combinations of graphics materials used.
- complete ink drying or curing.
- selection, condition and preparation of the substrate.
- surface texture.
- application methods.
- angle and direction of sun exposure.
- environmental conditions.
- cleaning or maintenance methods.

### Graphics Manufacturing

Before using any equipment, always read the manufacturer's instructions for safe operation.

### Inkjet Printing

Always read and follow the ink manufacturer's written instructions on usage.



# 3M™ Controltac™ Graphic Film

## 3M™ Print Wrap Film

### Total Ink Coverage

The maximum recommended total ink coverage for this film is:

- **270%** when printed with all approved 3M solvent inkjet inks.
- **280%** when printed with all approved 3M UV inkjet inks.
- **280%** when printed with all approved 3M latex inkjet inks.
- **250%** when printed on the Mimaki JV5 Series printer with HS ink series ([3M Performance Guarantee](#)).

Do not exceed the recommended total ink coverage for the ink series used on this product. Having too high a total physical ink amount on the product results in media characteristic changes, incomplete drying, overlamine lifting, and/or poor graphic performance. For additional details about total ink coverage, refer to the 3M Product and Instruction Bulletin for 3M inks or the [3M Performance Guarantee Matrix](#) for OEM inks.

### Completely Dry Graphics

#### **IMPORTANT NOTE**

Incomplete drying or curing can result in graphic failure including curling, increased shrinkage and adhesion failure, which are not covered under any 3M Graphic Warranty.

See the ink's 3M Product and Instruction Bulletin for more details.

### Cutting

See [3M Instruction Bulletin 4.1](#) for Sheeting, Scoring and Film Cutting details.

### Graphic Protection

Graphic protection may improve the appearance, performance and durability of the graphic. Click on the graphic protection options listed in Product Bulletin or see the [3M Graphics Market Product Catalog](#), for more information.

#### **IMPORTANT NOTE**

During installation, scratches may occur on films without graphic protection.

### Application Tapes

There are two types of application tapes. See [3M Instruction Bulletin AT-1](#) to determine what application tape is recommended for your film or finished graphic.

#### Premasking Tape

Increases stiffness during application while preventing stretching and damage. Use when little or no liner is exposed. See [3M Instruction Bulletin 4.3](#) for complete details.

#### Prespacing Tape

Holds cut and weeded letters or graphics in place during application and after removing the film liner, while preventing stretching and damage. Use when large amounts of liner are exposed. See [3M Instruction Bulletin 4.3](#) for complete details.

## Application and Installation

In addition to other 3M Bulletins specified in this document, the following Bulletins provide details that you may need to successfully apply a graphic.

- [3M Instruction Bulletin 2.1](#) Design of graphics.
- [3M Instruction Bulletin 4.22](#) Lamination Basics for Inkjet Printed Graphics.
- [3M Instruction Bulletin 5.36](#) Application Techniques for Automobiles, Vans and Buses. Complete the 3M Pre-Installation Inspection Record found in this Instruction Bulletin prior to manufacturing or applying a graphic to an automobile, van, or bus.
- [3M Instruction Bulletin 5.4](#) Application, Fleet Trucks.
- [3M Instruction Bulletin 5.42](#) Application, Special Considerations for Watercraft. Complete the 3M Pre-Installation Inspection Record found in this Instruction Bulletin prior to manufacturing or applying a graphic to a watercraft.
- [3M Instruction Bulletin 5.5](#) Application, General Procedures for Interior and Exterior Dry Application.
- [3M Product and Instruction Bulletin V-Tools](#) 3M™ Vehicle Channel Applicator Tools.

### IMPORTANT NOTE

UV inkjet inks may crack if too much heat is used during graphic application to complex curves and deep contours as well as around rivets. When using heat during application, make sure the film surface temperature does not exceed 212° F (100° C). For best results, always do a test application of a printed graphic to determine how much heat can be used without damaging the image.

### IMPORTANT NOTE

3M recommends using additional heat in the post-application process for vehicle graphics. During this process, 3M only recommends using a heat gun to make sure the film surface temperature reaches a minimum of 200° F (93° C) and does not exceed 225° F (107° C).

### IMPORTANT NOTE

IJ180mC-120 may exhibit a directional characteristic in its appearance. For the best overall appearance, do not alternate between lengthwise and widthwise graphic panels.

## Pressure-activated Adhesive

The pressure activated adhesive on this film offers:

- smooth sliding into position on a substrate;
- fast finger tacking to check position; and
- easy snap-up and repositioning when you need it.

The snap-up and reposition feature is lost:

- when firm pressure with a squeegee or other application tool is applied.
- at application temperatures above 100° F (38° C) even if only light finger pressure was used for tacking.
- if any part of the film is removed from the original liner and reapplied to the same or another liner.
- solvent from inkjet ink has not completely dried or cured, which affects both slideability and snap-up.

### Working with Air Release Channels

Air release channels are a characteristic of films with Comply™ adhesive that allow trapped air to exit through the edges of the graphic.

- The channels will be damaged and effective air removal affected if you remove and attempt to change liners or reapply the same liner.
- For the best results, always work from the center out to the edges of the graphic to allow trapped air to exit through the air release channels. If the channels are closed off by firm pressure and air is trapped, use an air release tool to aid in removing air bubbles. See [3M Instruction Bulletin 5.4](#) for details.
- The mC channels have slightly different characteristics than the other Comply™ channels like Cv3 and C. Working with mC channels may need a more consistent, firm pressure with overlapping strokes compared with other patterns.

### Video

Click [here](#) to see how 3M's Comply™ adhesive technology works.

Click [here](#) to see a demonstration of film application and bubble removal.

### Stretchability

Many finished graphic constructions can be stretched without primer or relief cuts and maintain lift resistance.

- For Automobiles, Vans and Buses, see [3M Instruction Bulletin 5.36](#) for details and exceptions.
- For Straight trucks, semi-trucks and semi-trailers, see [3M Instruction Bulletin 5.4](#) for details and exceptions.

### 3M™ Tape Primer 94

3M recommends that where the film will be stretched, particularly on the edges of the film, use primer to maximize a graphic's bond to its substrate.

### Maintenance and Cleaning

Use a cleaner designed for general housekeeping such as the Scotch-Brite™ Easy Eraser or Simple Green® and then rinse with clear water. The cleaner must be wet, non-abrasive, without solvents, and have a pH value between 3 and 11 (neither strongly acidic nor strongly alkaline). See [3M Instruction Bulletin 6.5](#) for details.

### Removal

Removal may require heat. The ease and rate of removal depends on a number of factors. See [3M Instruction Bulletin 6.5](#) for details.

### Shelf Life, Storage and Shipping

#### Shelf Life

The shelf life is never more than 3 years from the date of manufacture on the original box.

If you process the film, the shelf life is changed to 1 year from the processing date, but not later than the 3 year maximum from the manufacturing date.

#### Storage Conditions

- 40° to 100 °F (4° to 38 °C)
- Out of sunlight
- Clean, dry area
- Original container
- Bring the film to room temperature before use

#### Shipping Finished Graphics

Flat, or rolled printed side out on 6 inch (15 cm) or larger core. This helps prevent the application tape, if used, from popping off.

# 3M™ Controltac™ Graphic Film

## 3M™ Print Wrap Film

### Health and Safety

#### CAUTION

When handling any chemical products, read the manufacturer's container labels and the Safety Data Sheets (SDS) for important health, safety and environmental information. To obtain SDS sheets for 3M products go to [3M.com/SDS](https://www.3m.com/SDS), or by mail or in case of an emergency, call 1-800-364-3577 or 1-651-737-6501.

When using any equipment, always follow the manufacturer's instructions for safe operation.

#### Commercial Solutions

3M Center, Building 220-12E-04  
St. Paul, MN 55144

1-800-328-3908  
[3M.com/Graphics](https://www.3m.com/Graphics)

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Revision U, March 2020 Please recycle.



## Product Description






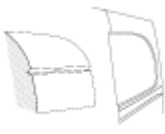
- Multi-layer cast adhesive backed film for solid color vehicle detailing, decoration and full wraps
- This film utilizes 3M™ Controltac™ and 3M™ Comply™ technology  
Controltac™ minimizes the initial contact area of the adhesive for easy sliding, tacking, snap-up and repositioning.  
Comply™ technology allows air to exit through air release channels to the edge of the graphic.
- 60 inch (1.52 m) rolls—allowing almost any section of the vehicle to be wrapped without seams
- Use the film right out-of-the-box with or without graphic protection
- Expected Performance Life (unwarranted period for film with no graphic protection, applied to a flat, vertical, outdoor surface):
  - All colors and textures: 8 years

Important Notice: All 3M™ Wrap Film Series 2080 gloss films have a clear protective film layer to prevent scratching; this protective film layer can be left on the gloss film surface for the entire installation and must be removed before post-heating. See 3M FAQ 2080 for more details.

## Recommended types of graphic and use

- Solid color vehicle detailing
- Standard vehicle graphics, detailing and decoration, multiple layers of graphics
- Commercial vehicle and fleet graphics, emblems or striping
- Watercraft graphics (above the static water line only)

### Surface types

flat	rivets	simple curves	compound curves	corrugations	deep channels and recesses
✓	✓	✓	✓	✓	✓
					

## Product Line

Product name	Description	Features
3M™ Wrap Film 2080-X	X = color code, opaque. Various colors and surfaces.	Controltac™ and Comply™

## Graphic Protection

Use [3M™ Wrap Overlaminate Series 8900](#) to enhance the appearance of 3M™ Wrap Film Series 2080.

## Physical Properties

The values displayed are the results of illustrative lab test measures made according to the indicated external norm and shall not be considered as a commitment from 3M

Value	Characteristic
Material	Cast vinyl
Color	See colors of <a href="#">3M™ Wrap Film 2080</a> Note: The opacity of these films vary and should be considered when installing.
Thickness Values apply to 2080-M12; designs vary slightly in thickness ISO 534	Film without adhesive: 3.5 ± 0.4 mil (0,09 ± 0,01 mm) Film with adhesive: 4.5 ± 0.6 mil (0,11 ± 0,015 mm)
Adhesive	Acrylic, pressure-activated (slideable, repositionable), with air release channels
Adhesive appearance	Grey or clear, depending on film color Note: Grey adhesive color may be darker or lighter depending on the film color.
Adhesion	Aluminum etched 5.6 ± 1.1 lbf/in (25 ± 5 N /25 mm)
Indicative values FTM 1, 24 h 23°C/50%RH	Paint 3.4 ± 1.1 lbf/in (15 ± 5 N /25 mm)
Applied shrinkage FTM 14	< 15 mils (0,4 mm)
Liner	Polyethylene-coated paper
Application method	Dry only
Substrate types	Aluminum, chrome, glass, ABS, paint**, fiberglass with gel coat  The application of film onto glass can cause glass break by uneven heat absorption through sun exposure. 3M does not accept liability for glass breakage.  ** Check adhesion to powder-coated or water-based paints.
Application temperature	60 – 90 °F (16 – 32 °C)  3M recommends application at +65 °F to 73 °F (+18°C to +23 °C) for optimum ease of application.
Temperature range after application	-65 to +225 °F (-53 to +107 °C)  (not for extended periods of time at the extremes)
Chemical Resistance	<ul style="list-style-type: none"> <li>• Resists mild alkalis, mild acids, and salt</li> <li>• Excellent resistance to water (does not include immersion)</li> <li>• Resists occasional fuel spills</li> </ul>
Flammability	Flammability standards are different from country to country. Ask your local 3M contact for details, please. All available test reports: call 1-800-328-3908

**Product Lifecycle**

3M™ Wrap Film Series 2080-X		1	2	3	4	5	
Installation Characteristics	Challenging/High Skill						Easy/Low Skill
24-hour adhesion	Low						High
Long term adhesion	Low						High
Removability	Not Designed for Easy Removal						Designed for Easy Removal

**Warranty Information****3M Basic Product Warranty**

3M Graphics Products are warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in its applicable 3M Graphics Product Bulletin and as further set forth in the 3M Graphics Warranties Bulletin.

**3M™ Performance Guarantee and MCS™ Warranty**

3M provides a guarantee/warranty on a finished applied graphic within the framework of 3M™ Performance Guarantee and/or 3M™ MCS™ warranty programs.

Follow the link for a complete list of compatible products that are approved by 3M for use with the base film covered in this Bulletin and used for the creation of a graphic that may be eligible for the 3M™ MCS™ Warranty or 3M Performance Guarantee.

**Limited Remedy****Unsuitable End Uses**

3M recommended product end uses are listed in each 3M graphics product bulletin. End uses not listed in the applicable 3M Graphics Product Bulletins are typically not eligible for 3M Graphics Warranties. For non-recommended and/or non-warranted end uses or applications, users must test and approve the end uses or applications, assume any associated risks, and acknowledge that 3M has no liability for such end uses or applications. Please contact your 3M representative with any questions about graphic applications, end uses, and warranties.

**Limitation of liability**

Except where prohibited by law, 3M SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE TO PURCHASER OR USER FOR ANY DIRECT (EXCEPT FOR THE LIMITED REMEDY PROVIDED IN THE 3M GRAPHICS WARRANTIES BULLETIN), INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LABOR, NON-3M MATERIAL CHARGES, LOSS OF PROFITS, REVENUE, BUSINESS, OPPORTUNITY, OR GOODWILL) RESULTING FROM OR IN ANY WAY RELATED TO 3M'S GRAPHICS PRODUCTS, SERVICES, or THIS BULLETIN. This limitation of liability applies regardless of the legal or equitable theory under which such losses or damages are sought.

3M Commercial Solutions products are not tested against automotive manufacturer specifications!

## Graphic Manufacturing

### Vehicle wrapping

Textured, metallic, pearl, and color flip films may have a directional characteristic in their appearance. For the best overall appearance, do not alternate between lengthwise and widthwise graphic panels.

Film colors vary from lot-to-lot. For consistent looking color use the same lot number of film for an entire vehicle.

To maximize a graphic's bond to the substrate 3M recommends to use 3M™ Tape Primer 94 in areas that will be partly stretched, particularly on the edges of the film.

Important Note: Consult air quality regulations before using 3M™ Tape Primer 94.

### Sheeting, Scoring and Film Cutting

See 3M Instruction Bulletin 4.1 for Sheeting, Scoring and Film Cutting details

Important Note: The thickness and texture of this film makes it more difficult to cut and weed cleanly. Use clean, sharp, properly aligned blades. The user must assume with responsibility of the outcome, so always test and approve before cutting a large job.

### Application Tapes

See instruction bulletin 'AT-1' for information about selection and use of suitable application tapes for this product, please.

## Application and Installation

In addition to other 3M Bulletins specified in this document, the following Bulletins and Videos provide details that you may need to successfully apply a graphic.

See 3M Instruction Bulletin 5.36 for application techniques for automobiles, vans and buses.

See 3M Instruction Bulletin 5.4 for application: fleet trucks.

See 3M Instruction Bulletin 5.45 for application techniques for railcars.

See 3M Instruction Bulletin 5.42 for application and special considerations for watercrafts.

See 3M Instruction Bulletin 5.46 for application on substrate with recesses

See 3M Instruction Bulletin 5.5 for general procedures for interior and exterior dry application.

3M FAQ 2080

## Maintenance, Cleaning and Removal

Use a cleaner designed for high-quality painted surfaces. The cleaner must be wet, non-abrasive, without solvents, and have a pH value between 3 and 11 (neither strongly acidic nor strongly alkaline).

These films can be removed with the aid of heat.

See 3M Instruction Bulletin 6.5 for information about storage, handling, maintenance and removal of films and sheetings.



## Factors that Affect Graphic Performance Life

The actual performance life of a graphic is affected by:

- selection, condition and preparation of the substrate.
- surface texture.
- application methods.
- angle and direction of sun exposure.
- environmental conditions.
- cleaning or maintenance methods.

## Shelf Life, Storage and Shipping

The shelf life as defined below remains an indicative and maximum data, subject to many external and non-controllable factors. It may never be interpreted as warranty.

The shelf life is never more than 3 years from the date of manufacture on the original box. If you process the film, the shelf life is changed to 1 year from the processing date, but not later than the 3-year maximum from the manufacturing date.

Storage conditions: +40°F to 100°F (+4°C to +38°C), out of sunlight, original container in clean and dry area.

Bring the film to room temperature before use.

Shipping finished graphics: Flat, or rolled printed side out on 6 inch (15 cm) or larger core.

## Health and Safety

When handling any chemical products, read the manufacturer's container labels and the Safety Data Sheets (SDS) for important health, safety and environmental information.

[Follow the link to obtain SDS sheets for 3M products on 3M.com/SDS.](https://www.3m.com/SDS)

**IMPORTANT!** When using any equipment, always follow the manufacturer's instructions for safe operation.

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### **3M Commercial Solutions**

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Building 220 12E-04  
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Phone 1-888-328-3908  
Web 3M.com/Graphics

### **3M Canada**

PO Box 5757  
London, ON N6A 4T1  
1-800-265-1840  
Fax 519-452-6245

### **3M México S.A. de C.V.**

Av. Santa Fe No. 55  
Col. Santa Fe, Del. Alvaro Obregón  
México D.F. 01210  
General 5255-5270-0400  
Fax 5255-5270-2277

### **3M Puerto Rico, Inc.**

350 Chardon Avenue  
Suite 1100  
San Juan, PR 00918  
General 787-620-3000  
Fax 787-620-3018

## Series 7125

### Product Description

- 2-mil, cast vinyl film

### Product Features

- Pressure-sensitive, non-removable adhesive
- Same color on both sides
- The blue paper liner on 7125-10 and 7125-20 provides easier visibility when weeding; other film colors have a white paper liner
- Superior cutting as small as 0.375 inch (0.95 cm) and weeding
- Ideal for prespaced and electronically cut, screen printed or used in narrow width thermal transfer printing systems
- Expected Performance Life of 8 years (unwarranted period for unprinted film with no graphic protection, applied to a flat, vertical, outdoor surface)

#### Quick Links

[3M Graphics Warranties](#)  
[Technical Information Selector](#)  
[Safety Data Sheets \(SDS\)](#)  
[Flammability](#)  
[Videos](#)

Some of these links lead to web-based resources that are not product-specific.

### Recommended Types of Graphics and End Uses

See [3M.com/graphicswarranties](http://3M.com/graphicswarranties) for a complete list of compatible products that are approved by 3M for use with the base film covered in this Bulletin and used for the creation of a graphic that may be eligible for the 3M™ MCS™ Warranty.

- Prespaced and electronically cut graphics
- Commercial and industrial graphic applications, including emblems, vehicle graphics, labels, striping, general signage, and two-way window markings
- Thermal transfer printed graphics

### Recommended Compatible Products

See [3M.com/graphicswarranties](http://3M.com/graphicswarranties) for a complete list of compatible products that are approved by 3M for use with the base film covered in this Bulletin and used for the creation of a graphic that may be eligible for the 3M™ MCS™ Warranty or 3M Performance Guarantee.

#### Screen Printing Inks for 3M™ MCS™ Warranty

- [3M™ Screen Printing Ink Series 1900 \(Solvent\)](#), line color only
- [3M™ Screen Printing UV Ink Series 9800](#), line color and four color

### Graphic Protection

- [3M™ Scotchcal™ Gloss Overlamine 8518](#)
- [3M™ Scotchcal™ Luster Overlamine 8519](#)
- [3M™ Scotchcal™ Matte Overlamine 8520](#)
- [3M™ Scotchcal™ Gloss Overlamine 8528](#)
- [3M™ Envision™ Gloss Wrap Overlamine 8548G](#)
- [3M™ Envision™ Luster Wrap Overlamine 8549L](#)
- [3M™ Envision™ Matte Wrap Overlamine 8550M](#)
- [3M™ Anti-Graffiti Gloss Overlamine 8588G](#)
- [3M™ Anti-Graffiti Matte Overlamine 8590M](#)
- [3M™ Scotchgard™ Graphic and Surface Protection Film 8991](#)
- [3M™ Scotchgard™ Graphic and Surface Protection Film 8993](#)
- [3M™ Screen Print Gloss Clear 1920DR](#)
- [3M™ Screen Print UV Gloss Clear 9800CL](#)
- [3M™ Screen Print Matte Clear 9730i](#)
- [3M™ Screen Print UV Gloss Clear 9740i](#)



## Application Tapes

See [3M Instruction Bulletin AT-1](#) to determine what application tape is recommended for the film or finished graphic.

## Other Products

- [3M™ Edge Sealer 3950](#)
- [3M™ Edge Sealer Tape 8914](#)

## Certificate of 3M™ MCS™ Warranty

Graphic manufacturers who produce digitally printed graphics made with all 3M Graphics Products, including 3M Ink purchased through a qualified 3M Distributor or 3M Printing Partner, may register to be recognized with a Certificate of 3M™ MCS™ Warranty. Only graphic manufacturers having a current Certificate of 3M™ MCS™ Warranty are eligible to extend this warranty to their customers.

**NOTE:** For non-digitally printed Finished Graphics, check your eligibility for the 3M™ MCS™ Warranty by viewing the Warranty Period found within the Product Bulletin or using the warranty selector at [www.3m.com/graphicswarranties](http://www.3m.com/graphicswarranties).

## Characteristics

These are typical values for unprocessed product. Processing may change the values.

### Physical Characteristics

Characteristic	Value
<b>Material</b>	Vinyl
<b>Film Color</b>	Opaque, see Colors
<b>Thickness</b>	<b>Without adhesive:</b> 2 mil (0.05 mm) <b>With adhesive:</b> 2.5 – 3.5 mils (0.063 – 0.09 mm)
<b>Adhesive</b>	Pressure-sensitive
<b>Adhesive Color</b>	Clear
<b>Liner</b>	<b>Films 7125-10, 7125-20:</b> Blue kraft paper <b>All other colors:</b> White kraft paper
<b>Adhesion, Typical 24 hours after application</b>	<b>ABS:</b> 4 pounds/inch (0.7 kg/cm) <b>Acrylic:</b> 4 pounds/inch (0.7 kg/cm) <b>Acrylic enamel:</b> 4 pounds/inch (0.7 kg/cm) <b>Fruehauf pre-painted panels:</b> 4 pounds/inch (0.7 kg/cm) <b>Polycarbonate:</b> 4 pounds/inch (0.7 kg/cm) <b>Urethane paints:</b> 4 pounds/inch (0.7 kg/cm) <b>Aluminum, alodine:</b> 8 pounds/inch (1.4 kg/cm) <b>Chrome:</b> 5 pounds/inch (0.9 kg/cm) <b>Polypropylene:</b> 3 pounds/inch (0.5 kg/cm)
<b>Tensile Strength</b>	5 pounds/inch at 73 °F (0.9 kg/cm at 23 °C)
<b>Chemical Resistance</b>	Resists mild alkalis, mild acids, and salt Excellent resistance to water (does not include immersion)
<b>Flammability</b>	ASTM E84 test report: <a href="#">click here</a> or go to the On-line Catalog at 3Mgraphics.com All available test reports: call 1-800-328-3908

## Application Characteristics

Characteristic	Value
<b>Finished Graphic Application Recommendation</b>	<b>Surface type:</b> Flat, with and without rivets, simple curves, moderate compound curves <b>Application method:</b> Wet or dry <b>Application temperature (air and substrate):</b> Flat surfaces with and without rivets: 50–100 °F (10–38 °C)
<b>Temperature Range After Application</b>	-40 to +225 °F (-40 to +107 °C) (not for extended periods of time at the extremes)
<b>Graphic Removal</b>	Not removable

## Colors

Solid Colors			Metallic and Transparent
10 White	53 Cardinal Red	101 Nimbus Gray	120 Satin Aluminum
11 Pearl Gray	54 Light Orange	103 Magenta	131 Satin Gold
12 Black	56 Dark Green	105 Harvest Gold	201 Slate
13 Tomato Red	57 Olympic Blue	107 Light Blue	211 Charcoal
14 Bright Orange	58 Burgundy	117 Persian Blue	217 Dark Blue
15 Bright Yellow	59 Putty	121 Light Gray	227 Bright Blue
16 Khaki Green	61 Mid Gray	127 Boat Blue	229 Copper
17 Vivid Blue	63 Geranium	136 Lime Green	239 Chocolate Brown
19 Deep Mahogany Brown	64 Apricot	151 Traffic Gray	241 Gold
20 Matte White	65 Light Lemon Yellow	177 Shadow Blue	243 Steampunk Red
22 Matte Black	66 Forest Green	186 Bright Green	247 Petroleum Blue
23 Deep Red	69 Duranodic	187 Wedgewood Blue	249 Champagne
24 Terra Cotta	74 Red Orange	196 Apple Green	114 Transparent
25 Sunflower	77 Peacock Blue	197 Light Navy	
27 Indigo (Navy)	78 Plum	263 Perfect Match Red	
29 Russet Brown	81 Stone Gray	273 Process Magenta	
31 Medium Gray	86 Robin Egg Blue	276 Bottle Green	
37 Sapphire Blue	89 Sandstone	293 Atomic Red	
38 Royal Purple	90 Antique White	307 Dark Aqua	
39 Tan	91 Dove Gray	357 Bermuda Blue	
41 Dark Gray	93 Imperial Red	397 Dark Blue	
46 Kelly Green	96 Teal		
47 Intense Blue	97 Soft Blue		
48 Purple	98 Dark Violet		
49 Beige	99 Fawn		

## Warranty Information

### Warranty Coverage Overview

The warranty coverage for eligible graphics is based on the user both reading and following all applicable and current 3M Graphics Product and Instruction Bulletins. The warranty period for eligible graphics is as stated in the 3M Graphics Warranties Matrices at the time that the film was purchased. Information found at [3M.com/graphicswarranties](https://www.3m.com/graphicswarranties) includes:

- [3M Graphics Warranties Bulletin](#)
  - This bulletin contains information on limitations and exceptions, and warranty period reductions for 3M Graphics Warranties. The warranty period may be reduced and stipulations may apply for certain constructions, applications, and graphic exposures as covered in this Bulletin.
- [3M Graphics Warranties Selector](#)
  - Use this selector to search for your vertical warranty period by product type, ink type, film name, and/or ink/prINTER platform.
- [U.S. Desert Southwest Region Map](#)
  - Use this map of hot, arid desert areas to determine if you are subject to reduced warranted durabilities.

The warranties set forth in this Bulletin are made in lieu of all other express or implied warranties, including any implied warranty of merchantability, fitness for a particular purpose, or arising out of a course of dealing, custom, or usage of trade.

#### IMPORTANT NOTE

Screen printed vehicle graphics require a liquid clear coat in order to be eligible for the 3M™ MCS™ Warranty. Liquid clear coats such as 9730i may haze, which is not covered by the 3M™ MCS™ Warranty.

### 3M Basic Product Warranty

3M Graphics Products are warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in its applicable 3M Graphics Product Bulletin and as further set forth in the [3M Graphics Warranties Bulletin](#).

### Limited Remedy

The limited remedy applicable to each warranty is addressed in the 3M Graphics Warranties Bulletin found at [3M.com/graphicswarranties](https://www.3m.com/graphicswarranties).

### Limitation of Liability

Except where prohibited by law, 3M SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE TO PURCHASER OR USER FOR ANY DIRECT (EXCEPT FOR THE LIMITED REMEDY PROVIDED IN THE 3M GRAPHICS WARRANTIES BULLETIN), INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LABOR, NON-3M MATERIAL CHARGES, LOSS OF PROFITS, REVENUE, BUSINESS, OPPORTUNITY, OR GOODWILL) RESULTING FROM OR IN ANY WAY RELATED TO 3M'S GRAPHICS PRODUCTS, SERVICES, or THIS BULLETIN. This limitation of liability applies regardless of the legal or equitable theory under which such losses or damages are sought.

### Warranty Period Matrices

See the 3M Graphics Warranties Matrices at [3M.com/graphicswarranties](https://www.3m.com/graphicswarranties), for vertical warranty period information specific to your film.

### Additional Limitations

See the 3M Graphics Warranties Bulletin at [3MGraphics.com/warranties](https://www.3m.com/graphicswarranties), for terms, additional limitations of your warranty, if any, and limitations of liability.

## Factors that Affect Graphic Performance Life

The actual performance life of a graphic is affected by:

- the combinations of graphics materials used.
- complete ink drying or curing.
- selection, condition and preparation of the substrate.
- surface texture.
- application methods.
- angle and direction of sun exposure.
- environmental conditions.
- cleaning or maintenance methods.

## Graphics Manufacturing



### CAUTION

Before using any equipment, always read the manufacturer's instructions for safe operation.

## Screen Printing

Formulations and processing conditions can affect ink durability. Refer to the Product and Instruction Bulletins for your ink for limitations and proper usage.

## Thermal Transfer Printing

Formulations and processing conditions can affect ink durability. Refer to the 3M Product and Instruction Bulletins for your ink limitations and proper usage.

This film can be imaged with narrow-width thermal transfer printing systems. Refer to the equipment manufacturer's literature for details.

## Cutting

See [3M Instruction Bulletin 4.1](#) for Sheeting, Scoring and Film Cutting details.

## Weeding

The excess film should be weeded (removed) as soon after cutting as practical. This is to minimize the effect of possible adhesive flow 24 or more hours after cutting.

## Graphic Protection

Graphic protection may improve the appearance, performance and durability of the graphic. Click on the graphic protection options listed in Product Bulletin or see the [3M Graphics Market Product Catalog](#), for more information.



### IMPORTANT NOTE

During installation, scratches may occur on films without graphic protection.

## Application Tapes

There are two types of application tapes. See [3M Instruction Bulletin AT-1](#) to determine what application tape is recommended for the film or finished graphic.

### Premasking Tape

Increases stiffness during application while preventing stretching and damage. Use when little or no liner is exposed. See [3M Instruction Bulletin 4.3](#) for complete details.

## Prespacing Tape

Holds cut and weeded letters or graphics in place during application and after removing the film liner, while preventing stretching and damage. Use when large amounts of liner are exposed. See [3M Instruction Bulletin 4.3](#) for complete details.

## Application and Installation

In addition to other 3M Bulletins specified in this document, the following Bulletins provide details that you may need to successfully apply a graphic.

- [3M Instruction Bulletin 2.1](#) Design of graphics.
- [3M Instruction Bulletin 3.11](#). Screen Printing, 3M™ Screen Printing Ink Series 1900 four color and Screen Print Clear VIO402.
- [3M Instruction Bulletin 3.12](#). Screen Printing, 3M™ Screen Printing Ink Series 1900 Line Color and Screen Print Clear VIO402.
- [3M Instruction Bulletin 3.20](#). Screen Printing, 3M™ Screen Printing UV Ink Series 9800 for Line Color Only.
- [3M Instruction Bulletin 3.21](#). Screen Printing, 3M™ Screen Printing UV Ink Series 9800 for Four Color Only.
- [3M Instruction Bulletin 5.7](#) Application, Wet Method for Translucent, Inkjet, Screen Printed and Cut Graphics

## Stretchability

Many finished graphic constructions can be stretched without primer or relief cuts and maintain lift resistance.

- For Straight trucks, semi-trucks and semi-trailers, see [3M Instruction Bulletin 5.4](#) for details and exceptions.

## 3M™ Tape Primer 94 and Adhesion Promoter 111

3M recommends that where the film will be stretched, use primer to maximize a graphic's bond to its substrate.

## Maintenance and Cleaning

Use a cleaner designed for high-quality painted surfaces. The cleaner must be wet, non-abrasive, without solvents, and have a pH value between 3 and 11 (neither strongly acidic nor strongly alkaline). See [3M Instruction Bulletin 6.5](#) for details.

## Removal

Not removable. 3M makes no claims as to the ease or speed of removal. This product may not remove similarly to other products in the same category. See [3M Instruction Bulletin 6.5](#) for details.

## Shelf Life, Storage and Shipping

### Shelf Life

The shelf life is **never more than 3 years** from the date of manufacture on the original box.

If you process the film, the shelf life is changed to **1 year** from the processing date, but not later than the 3 year maximum from the manufacturing date.

### Storage Conditions

- 40° to 100 °F (4° to 38 °C)
- Out of sunlight
- Clean, dry area
- Original container
- Bring the film to room temperature before use

### Shipping Finished Graphics

Flat, or rolled printed side out on 6 inch (15 cm) or larger core. This helps prevent the application tape, if used, from popping off.

## Health and Safety

### CAUTION

When handling any chemical products, read the manufacturers' container labels and the Safety Data Sheets (SDS) for important health, safety and environmental information. To obtain SDS sheets for 3M products go to [3M.com/SDS](https://www.3m.com/SDS), or by mail or in case of an emergency, call 1-800-364-3577 or 1-651-737-6501.

When using any equipment, always follow the manufacturer's instructions for safe operation.

#### Commercial Solutions

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St. Paul, MN 55144

1-800-328-3908  
[3M.com/Graphics](https://www.3m.com/Graphics)

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Revision M, December 2019 Please recycle.





## 8548G Gloss Wrap Overlamine 8549L Luster Wrap Overlamine 8550M Matte Wrap Overlamine

### Quick Links

[3M Graphics Warranties](#)  
[Technical Information Selector](#)  
[Safety Data Sheets \(SDS\)](#)  
[Flammability \(ASTM E84 Reports\)](#)  
[Videos](#)

Some of these links lead to web-based resources that are not product-specific.

## Product Description

- Suitable for application surfaces that are flat, flat with rivets, corrugated, simple curves, compound curves, or deep channels and concave surfaces.
- Gloss, Luster and Matte high performance non-PVC
- Excellent conformability and lifting resistance
- Good scratch resistance
- Excellent UV protection
- Long term vertical durability
- Horizontal warranty
- Expected performance life of 9 years (unwarranted period applied to a flat, vertical, outdoor surface)

## Recommended Types of Graphics and End Uses

- **8548G/8549L/8550M:** For inkjet printed films
  - [3M™ Controltac™ Graphic Film with Comply™ v3 Adhesive IJ180Cv3](#)
  - [3M™ Controltac™ Graphic Film with Comply™ Adhesive IJ180C](#)
  - [3M™ Controltac™ Graphic Film IJ180-10](#)
  - [3M™ Print Wrap Film IJ180mC-10/IJ180mC-114/IJ180mC-120](#)
  - [3M™ Envision™ Print Wrap Film LX480mC](#)
  - [3M™ Envision™ Print Wrap Film SV480mC](#)
  - [3M™ Controltac™ Wrap Film with Comply™ v3 Adhesive IJ380Cv3](#)
  - [3M™ Scotchcal™ Graphic Film with Comply™ v3 Adhesive IJ170Cv3](#)
  - [3M™ Print Wrap Film IJ175Cv3](#)
  - [3M™ Scotchlite™ Print Wrap Film 780mC-10R](#)
- Fleet
- Vehicle Wraps
- Watercraft
- Transit
- Labels
- Thermoformable
- Signage
- Awning
- Smooth Walls/Textured Walls and Surfaces
  - 8550M is an excellent rough wall material that helps reduce gloss banding that can form when using other rough wall films.
- Windows and Glass

## Characteristics

These are typical values for unprocessed product. Processing may change the values.

## Performance Characteristics

Characteristic	Value
Material	Non-PVC
Cast or non-Cast	N/A
Thickness	2 mils
Gloss	<b>8548G:</b> Gloss <b>8549L:</b> Luster <b>8550M:</b> Matte
Liner	<b>8548G:</b> Polyester <b>8549L/8550M:</b> Kraft paper
Lamination Temperature	50 to 100 °F (10 to +38 °C)
In Use Temperature Range	-65 to +200 °F (-54 to +93°C)
Chemical Resistance	<ul style="list-style-type: none"><li>• Resists mild alkalis, mild acids, and salt</li><li>• Excellent resistance to water (<i>does not include immersion</i>)</li><li>• Resists occasional fuel spills</li><li>• <b>Does not resist IPA</b></li></ul>
Flammability	ASTM E84 reports: <a href="#">8548G</a> , 8550M or go to the On-line Product Catalog at <a href="#">3M.com/graphics</a> All other test reports: call 1-800-328-3908

## Warranty Information

All 3M graphic protection products are covered by the 3M Basic Product Warranty.

A warranty period may be offered based on the graphic construction and application details. Always refer to the 3M Product Bulletin for the 3M base film or flexible substrate you are using to determine if the graphic protection product you want to use is recommended and what, if any warranty period is offered.

### IMPORTANT NOTE

Warranty information including limitations and exceptions and warranty periods for this product can be found at [3MGraphics.com/warranties](#).

## Warranty Coverage Overview

The warranty coverage for eligible graphics is based on the user both reading and following all applicable and current 3M Graphics Product and Instruction Bulletins. The warranty period for eligible graphics is as stated in the 3M Graphics Warranties Matrices at the time that the film was purchased. Information found at [3M.com/graphicswarranties](#) includes:

- [3M Graphics Warranties Bulletin](#)
  - This bulletin contains information on limitations and exceptions, and warranty period reductions for 3M Graphics Warranties. The warranty period may be reduced and stipulations may apply for certain constructions, applications, and graphic exposures as covered in this Bulletin.
- [3M Graphics Warranties Selector](#)
  - Use this selector to search for your vertical warranty period by product type, ink type, film name, and/or ink/prINTER platform.
- [U.S. Desert Southwest Region Map](#)
  - Use this map of hot, arid desert areas to determine if you are subject to reduced warranted durabilities.

The warranties set forth in this Bulletin are made in lieu of all other express or implied warranties, including any implied warranty of merchantability, fitness for a particular purpose, or arising out of a course of dealing, custom, or usage of trade.

## 3M Basic Product Warranty

3M Graphics Products are warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in its applicable 3M Graphics Product Bulletin and as further set forth in the [3M Graphics Warranties Bulletin](#).

## Limited Remedy

The limited remedy applicable to each warranty is addressed in the 3M Graphics Warranties Bulletin found at [3M.com/graphicswarranties](#).

## Limitation of Liability

Except to the extent prohibited by law, 3M SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE TO PURCHASER OR USER FOR ANY DIRECT (EXCEPT FOR THE LIMITED REMEDY PROVIDED HEREIN), INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LABOR, NON-3M MATERIAL CHARGES, LOSS OF PROFITS, REVENUE, BUSINESS, OPPORTUNITY, OR GOODWILL) RESULTING FROM OR IN ANY WAY RELATED TO 3M'S GRAPHICS PRODUCTS, SERVICES, OR THIS BULLETIN. This limitation of liability applies regardless of the legal or equitable theory under which such losses or damages are sought.

## Warranty Period Matrices

See the 3M Graphics Warranties Matrices at [3M.com/graphicswarranties](#), for vertical warranty period information specific to your film.

## Additional Limitations

See the 3M Graphics Warranties Bulletin at [3MGraphics.com/warranties](#), for terms, additional limitations of your warranty, if any, information on reduced warranties for different exposures, and limitations of liability.

## Health and Safety

### CAUTION

When handling any chemical products, read the manufacturers' container labels and the Safety Data Sheets (SDS) for important health, safety and environmental information. To obtain SDS sheets for 3M products go to [3M.com/SDS](#), or by mail or in case of an emergency, call 1-800-364-3577 or 1-651-737-6501.

When using any equipment, always follow the manufacturer's instructions for safe operation.

## Factors that Affect Graphic Performance Life

The actual performance life of a graphic is affected by:

- the combinations of graphics materials used.
- complete ink drying or curing.
- selection, condition and preparation of the substrate.
- surface texture.
- application methods.
- angle and direction of sun exposure.
- environmental conditions.
- cleaning or maintenance methods.

## Graphics Manufacturing

### CAUTION

Before using any equipment, always read the manufacturer's instructions for safe operation.

### Completely Dry Graphics

### IMPORTANT NOTE

Incomplete drying or curing can result in graphic failure including curling, increased shrinkage and adhesion failure, which are not covered under any 3M Graphic Warranty.

See the ink's 3M Product and Instruction Bulletin for more details.

## Application Tapes

There are two types of application tapes. See [3M Instruction Bulletin AT-1](#) to determine what application tape is recommended for your film or finished graphic.

### Premasking Tape

Increases stiffness during application while preventing stretching and damage. Use when little or no liner is exposed. See [3M Instruction Bulletin 4.3](#) for complete details.

### Prespacing Tape

Holds cut and weeded letters or graphics in place during application and after removing the film liner, while preventing stretching and damage. Use when large amounts of liner are exposed. See [3M Instruction Bulletin 4.3](#) for complete details.

## Application and Installation

In addition to other 3M Bulletins specified in this document, the following Bulletins provide details that you may need to successfully apply a graphic.

- [3M Instruction Bulletin 4.22](#) Lamination Basics for Inkjet Printed Graphics

## Maintenance and Cleaning

Use a cleaner designed for high-quality painted surfaces. The cleaner must be wet, non-abrasive, without solvents, and have a pH value between 3 and 11 (neither strongly acidic nor strongly alkaline). See [3M Instruction Bulletin 6.5](#) for details.

### IMPORTANT NOTE

It is not recommended to use Isopropyl alcohol on the Products specified in this document. Use a detergent, such as Simple Green™, and water to clean.

## Shelf Life, Storage and Shipping

### Shelf Life

The shelf life is **never more than 3 years** from the date of manufacture on the original box.

If you process the film, the shelf life is changed to **1 year** from the processing date, but not later than the 3 year maximum from the manufacturing date.

### Storage Conditions

- 40° to 100 °F (4° to 38 °C)
- Out of sunlight
- Clean, dry area
- Original container
- Bring the film to room temperature before use

### Shipping Finished Graphics

Flat, or rolled printed side out on 6 inch (15 cm) or larger core. This helps prevent the application tape, if used, from popping off.

### Commercial Solutions

3M Center, Building 220-12E-04  
St. Paul, MN 55144

1-800-328-3908  
[3M.com/Graphics](http://3M.com/Graphics)

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Revision B, May 2018 Please recycle.



# GLAVAL COMMUTE

## STYLE, VERSATILITY AND VALUE

Experience better fuel mileage than ever before with the all new Commute. Built on the Ford Transit chassis and available in both gas and diesel engines, this narrow-body powerhouse will fit into any fleet with ease. The Commute offers a sleek, narrow profile that can still fit up to five wheelchair positions. Check out the multiple floorplans and numerous upgrade options available to make your Commute

unique. The wide entry door and deep entry steps, along with a wide aisle and plenty of headroom, make the Commute the most spacious shuttle bus in its class. When looking for the economical choice without sacrificing options and comfort, the Commute delivers every time. Let Glaval introduce you to the stylish and affordable, narrow-body Commute.



 **Glaval Bus**  
A Division Of Forest River, Inc.



# GLAVAL COMMUTE

## Standard Exterior Feature Highlights

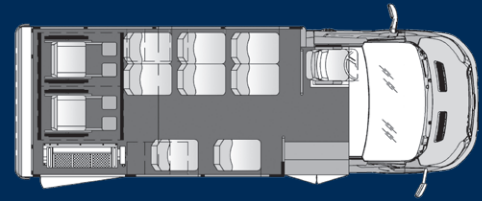
- Fully welded corrosion-preventative coated aluminized steel cage construction with laminated sidewall structure meeting all applicable FMVSS requirements
- "Starview" drivers visibility window in front of entry door
- Electric actuated passenger entry door with full length glass
- 36" wide x 36" high upper double T-Slider tempered safety glass windows with climate control tint
- Black powder coated steel rear bumper
- Rear mud flaps
- Molded wheel flares with no exposed fasteners
- Pre-painted white galvanized steel sidewalls and skirts
- Fiberglass front and rear caps
- One-piece seamless FRP (fiberglass reinforced plastic) roof
- Breakaway rearview mirrors with built-in convex
- Sealed LED stop, tail, and turn signal lights with reverse lights
- Exterior LED front and rear marker lights

## Standard Interior Feature Highlights

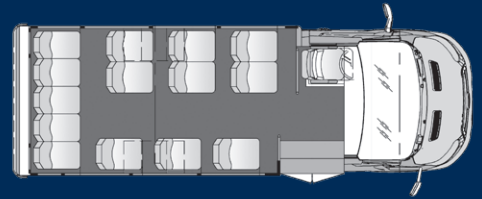
- 81" interior width
- 76" interior floor to ceiling height with standard floor
- Floor and wall seat track for flexible seating
- Black slip resistant Gerflor floor covering
- 5/8" marine tech plywood flooring
- Coved flooring to bottom of seat track
- Gray padded vinyl or cloth interior
- White step nosing at passenger door
- 1.25" left hand vertical passenger assist rail at entry door
- LED entry door step well lights
- LED driver and passenger area lighting
- FlexTech Electrical System
- Backup camera system with 7" monitor/rearview mirror combo
- Non-retractable seat belts

## Popular Option Highlights

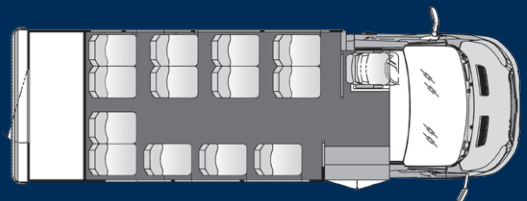
- Stainless steel wheel inserts
- Luggage storage areas (overhead luggage racks with reading lights, interior luggage racks, rear storage area)
- Rear emergency door with window(s)
- Passenger area rear heat and air conditioning
- Passenger grab rails
- Audio and video systems
- Mid back or high back seating
- ADA and FMVSS compliant wheel chair lifts and securement systems
- Fiberglass side walls and skirts



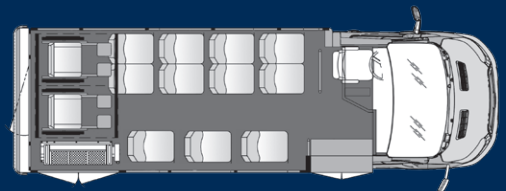
8 Passenger 2 Wheelchair Plus Driver



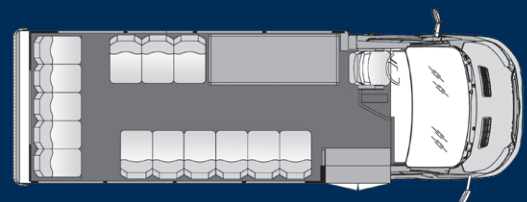
14 Passenger Plus Driver



13 Passenger Plus Rear Luggage Plus Driver



11 Passenger 2 Wheelchair Plus Driver



14 Passenger Plus Interior Luggage Plus Driver



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2367 Century Drive • Goshen, IN 46528 • Lit. No. GLB -03/050719  
1.800.348.7440 • [www.glavalbus.com](http://www.glavalbus.com)

## DEALER INFO

Exhibit A - Pricing Page				
156" Wheelbase Transit Van Dual Rear Wheel (DRW) narrow Body Cutaway Vehicle				
CLASS	ITEM DESCRIPTION	UNIT PRICE PER VEHICLE	ESTIMATED QUANTITY	EXTENDED PRICE
A	Vehicle Non-Accessible / Paratransit Package	\$ 43,914.00	5	\$ 219,570.00
B	Vehicle with One Wheelchair (WC) Positions/ Paratransit Package	\$ 51,844.00	5	\$ 259,220.00
C	Vehicle with Two Wheelchair (WC) Position / Paratransit Package	\$ 53,024.00	5	\$ 265,120.00
D	Vehicle/ Front Lift / 3 WC Positions	\$ 54,799.00	5	\$ 273,995.00
E	Vehicle/ One Wheelchair (WC)/ Fixed Route Packag	\$ 58,864.00	5	\$ 294,320.00
F	Vehicle/Two WC / Fixed Route Package	\$ 58,379.00	5	\$ 291,895.00
G	Vehicle/ Front Lift / Three Wheelchair Positions/ Fixed Route Package	\$ 60,479.00	5	\$ 302,395.00
H	Vehicle/ One WC Position / Fixed Route Package / Full Bus Paint	\$ 62,264.00	5	\$ 311,320.00
I	Vehicle / 2 WC Positions / Fixed Route Package / Full Bus Paint	\$ 62,879.00	5	\$ 314,395.00
J	Vehicle /Front Lift / Three WC Positions/ Full Bus Paint	\$ 64,839.00	5	\$ 324,195.00
K	Vehicle/One WC/Fixed Route Package/ Three Quarter Body Paint with Expanded Graphics Vehicle Skirt PaintinG	\$ 62,954.00	5	\$ 314,770.00
L	Vehicle/Two WC/Fixed Route Package/ Three Quarter Body Paint with Expanded Graphics Vehicle Skirt Painting	\$ 63,879.00	5	\$ 319,395.00
M	Vehicle/Front Lift / Three WC/Fixed Route Package/ Three Quarter Body Paint with Expanded Graphics	\$ 65,839.00	5	\$ 329,195.00
N	Vehicle/One WC/Fixed Route Package/ Vehicle Skirt Painting	\$ 58,514.00	5	\$ 292,570.00
O	Vehicle / Two WC Position/ Fixed Route Package / Vehicle Skirt PaintinG	\$ 59,049.00	5	\$ 295,245.00
P	Vehicle /Front Lift / Fixed Route Package / Vehicle Skirt PaintinG	\$ 61,089.00	5	\$ 305,445.00
				\$ -
A1	Option to add Bus Driver Safety Barrie	\$ 300.00	5	\$ 1,500.00
TOTAL BID AMOUNT				\$ 4,714,545.00
	*Please note these are only estimated quantities and do not reflect any guarantee of purchase.			
	*The DPT may purchase more or less as needed.			
	*Please do not alter pricing page.			





## Transit References

### Capital Area Rural Transportation System

David Marsh- GM  
2010 East 6<sup>th</sup> Street  
Austin, TX 78702  
512-481-1011  
Dave@ridecarts.com

### Houston Metro

Michael Southwell- Procurement  
1900 Main Street  
Houston, TX 77208  
713-739-4803  
Michael.Soothwell@ridemetro.org

### Capital Metro

Andrew Murphy- Equipment Specialist  
2910 East 5<sup>th</sup> Street  
Austin, TX 78702  
512-389-7566  
Andrew.murphy@capmetro.org

### Valley Metro- RPTA

Dave Hyink  
Fleet Manager  
480-924-6653 x 243  
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101 North First Ave Suite 1100  
Phoenix, AZ 85003

### WY- DOT

Rob Rodriguez  
Transit Program Specialist  
307-777-4181  
robert.rodriguez1@wyo.gov  
5300 Bishop Blvd.  
Cheyenne, WY 82009

### Med Valet Corporation

Larry Cranmer  
3535 NW 58<sup>th</sup> Street #920  
Oklahoma City, OK 73112  
405-848-7275  
larry@medvalet.biz