KENWORTH ELECTRIC K SERIES BODY BUILDER SUPPLEMENT MANUAL JANUARY 2023

KENWORTH

A PACCAR COMPANY

SECTION 1 – INTRODUCTION

This manual provides body builders with appropriate information and guidelines useful in the body planning and installation process. This information will be helpful when installing bodies or other associated equipment.

This manual contains appropriate dimensional information, guidelines for mounting bodies, guidelines for modifying frames, electrical wiring information, and other information useful in the body installation process.

The intended primary users of this manual are body builders who install bodies and associated equipment on electric K series Medium Duty vehicles. Dealers who sell and service the vehicle will also find this information useful.

This Body Builder's Manual can be particularly useful when specifying a vehicle, particularly when the body builder is involved in the vehicle definition and ordering process. Early in the process, professional body builders
can often contribute valuable information that reduces the ultimate cost of the body installation.

The DAVIE4 diagnostic tool is recommended for all electric K series built with the push button transmission shifter. The DAVIE tool should be used with all electric K series built with the lever style transmission shifter. Both DAVIE4 and DAVIE3 should be connected to the blue, 16-pin OBD (OnBoard Diagnostic) connector located on the passenger side of the dash. Contact your local Kenworth dealer to utilize the DAVIE tools or order the required hardware and software.

This manual is not a maintenance manual or an operation manual.

For chassis maintenance and repair information consult the PACCAR ServiceNet available in the Service Department of the selling dealer or order a custom shop manual or parts catalog for your vehicle through your local dealer.

For chassis operating information consult the Operator's Manual, included with each vehicle. It can also be ordered from your local dealer.

Contents

SECTION 2 - SAFETY AND COMPLIANCE

We have put several alerting messages in this book. Please read and follow them. They are there for your protection and information. These alerting messages can help you avoid injury to yourself or others and help prevent costly damage to the vehicle.

Key symbols and “signal words” are used to indicate what kind of message is going to follow. Pay special attention to comments prefaced by “WARNING,” “CAUTION,” and “NOTE.” Please do not ignore any of these alerts.

WARNING	When you see this word and symbol, the message that follows is especially vital. It signals a potentially hazardous situation which, if not avoided, could result in death or serious injury. This message will tell you what the hazard is, what can happen if you do not heed the warning, and how to avoid it. Example: **WARNING! Be sure to use a circuit breaker designed to meet liftgate amperage requirements. An in- correctly specified circuit breaker could result in an electrical overload or fire situation. Follow the liftgate installation instructions and use a circuit breaker with the recommended capacity.**
CAUTION	Signals a potentially hazardous situation which, if not avoided, could result in minor or moderate injury or damage to the vehicle. Example: **CAUTION: Never use a torch to make a hole in the rail. Use the appropriate drill bit.**
NOTE	Provides general information. For example, the note could warn you on how to avoid damaging your vehicle or how to drive the vehicle more efficiently. Example: **Note: Be sure to provide maintenance access to the battery**

Please take the time to read these messages when you see them, and remember:

WARNING
Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION
Signals a potentially hazardous situation which, if not avoided, could result in minor or moderate injury or damage to the vehicle.
NOTE
Useful information that is related to the topic being discussed.

FEDERAL MOTOR VEHICLE SAFETY STANDARDS COMPLIANCE

As an Original Equipment Manufacturer (OEM), Kenworth Truck Co. ensures that our products comply with all applicable U.S. or Canadian Federal Motor Vehicle Safety Standards. However, the fact that this vehicle has no fifth wheel and that a Body Builder (Intermediate or Final Stage Manufacturer) will be doing additional modifications means that the vehicle was incomplete when it left the build plant. See next section and Appendix for additional information.

Incomplete Vehicle Certification

An Incomplete Vehicle Document is shipped with the vehicle, certifying that the vehicle is not complete. See Figure **1**.
In addition, affixed to the driver's side door frame or edge is an Incomplete Vehicle Certification label. See Figure 2–2. For further information on Vehicle Certification and Identification, see Appendix "VEHICLE IDENTIFICATION" or owner's manual.

NOTE: These documents list the U.S. or Canadian Federal Motor Vehicle Safety Standard regulations that the vehicle complied with when it left the build plant. You should be aware that if you add, modify, or alter any of the components or systems covered by these regulations, it is your responsibility as the Intermediate or Final Stage Manufacturer to ensure that the complete vehicle is in compliance with the particular regulations upon completion of the modifications.

INCOMPLETE VEHICLE DOCUMENT	DOCUMENTO DE VEHÍCULO INCOMPLETO	DOCUMENT DE VÉHICULE INCOMPLET
MANUFACTURED BY KENWORTH MEXICANA S.A. DE C.V. APDO POSTAL NO. 3-739 KILÓMETRO 10.5 CARRETERA A SAN LUIS MEXICALI, BAJA CALIFORNIA	FABRICADO POR KENWORTH MEXICANA S.A. DE C.V. APDO POSTAL NO. 3-739 KILÓMETRO 10.5 CARRETERA A SAN LUIS MEXICALI, BAJA CALIFORNIA	CONSTRUIT PAR KENWORTH MEXICANA S.A. DE C.V. APDO POSTAL NO. 3-739 KILÓMETRO 10.5 CARRETERA A SAN LUIS MEXICALI, BAJA CALIFORNIA

Fecha de fabricación de vehículo incompleto: **Date de production du vehicule incomplet :** **Date of incomplete vehicle manufacture:** _____	**Número de Identification:** **Numéro d' identification :** **Identification number:** _____
Peso bruto nom. del. veh (GVWR): **PNBV :** **GVWR:** _____	**Peso bruto nom. por eje 1.° intermedio (GAWR):** **PNBE 1er intermédiaire :** **GAWR** **1st intermediate:** _____
Peso bruto nom. por eje delantero (GAWR): **PNBE avant :** **GAWR front:** _____	**Peso bruto nom. por eje 2.° intermedio (GAWR):** **PNBE 2ième intermédiaire :** **GAWR** **2nd intermediate:** _____
Peso bruto nom. por eje trasero (GAWR): **PNBE arrière :** **GAWR rear:** _____	

Este vehículo ha sido designado para ser: (marque uno) **Ce véhicule a été conçu pour être un : (cochez une case)** **This vehicle designed to be a: (check one)**	☐	**Camión** **Camion** **Truck**	☐	**Tractocamión** **Porteur-remorqueur** **Truck Tractor**

ESTOS PESOS DE VEHÍCULOS SE APLICAN SI NO SE EFECTÚAN ALTERACIONES AL CHASIS, SUSPENSIÓN, EJES, LLANTAS, MAZAS, RINES O RUEDAS, ESTE VEHÍCULO PUEDE SER TERMINADO COMO CAMIÓN O COMO TRACTOCAMIÓN (VEA ADENTRO LAS RESTRICCIONES INDICADAS EN LOS PÁRRAFOS 108, 105 Y 121).
DE ACUERDO A LOS REQUISITOS DE LA LEY FEDERAL, EL FABRICANTE DE LA ETAPA FINAL QUE COMPLETE ESTE VEHÍCULO DEBE LLENAR Y ADHERIR LA ETIQUETA DE CERTIFI-CACIÓN A ESTE VEHÍCULO. EL FABRICANTE DE LA ETAPA DEBE REGISTRAR Y CONSERVAR ESTE NÚMERO DE SERIE DEL VEHÍCULO. EL FABRICANTE Y EL NÚMERO DE SERIE

Figure 1 Beginning portion of the Incomplete vehicle document

*Figure **2 Locations of Information Labels - Driver's***

*Figure 3 Detail image of Figure **2** item A*

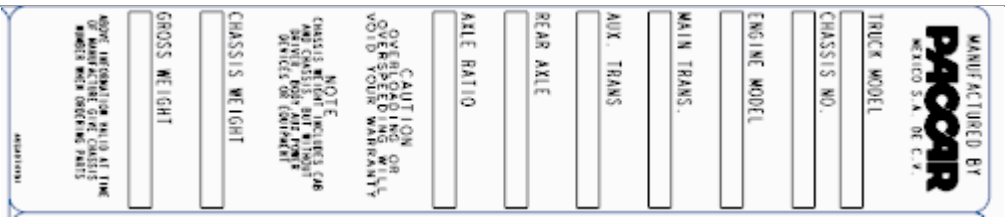


*Figure 4 Detailed image of Figure **2** Item B*

As the Intermediate or Final Stage Manufacturer, you should retain the Incomplete Vehicle Document for your records. In addition, you should record and retain the manufacturer and serial number of the tires on the vehicle. Upon completion of the vehicle (installation of the body and any other modifications), you should affix your certification label to the vehicle as required by Federal law. This tag identifies you as the "Intermediate or Final Stage Manufacturer" and certifies that the vehicle complies with Federal Motor Vehicle Safety Standards. (See Figure 2 - Figure 4.) Be advised that regulations affecting the intermediate and final stage manufacturer may change without notice. Ensure you are referencing the most updated copy of the regulation during the certification and documentation processes.

In part, if the final stage manufacturer can complete and certify the vehicle within the instruction in the incomplete vehicle document (IVD) the certification label would need a statement that reads, "This vehicle has been completed in accordance with the prior manufacturers IVD where applicable. This vehicle conforms to all applicable Federal Motor Vehicle Safety Standards [and Bumper and Theft Prevention Standards if applicable] in effect in (month, year)."
However, if the vehicle cannot be completed and certified with in the guidance provided in the IVD, the final stage manufacturer must ensure the vehicle conforms to all applicable Federal Motor Vehicle Safety Standards (FMVSS). The final stage manufactures certification label would need a statement that reads, "This vehicle conforms to all applicable Federal Motor Vehicle Safety Standards [and Bumper and Theft Prevention Standards if applicable] in effect in (month, year).
Please refer to e-CFR Title 49: Transportation Part 567 Certification for details related to this regulation.

For Canadian final stage manufacturers see:
http://www.gazette.gc.ca/index-eng.html and http://www.tc.gc.ca/eng/acts-regulations/menu.htm for the regulations.

Motor Vehicle Safety Regulations C.R.C, c. 1038, Section 6.1 – Vehicles Manufactured in Stages

Or contact: Transport Canada
Tower C, Place de Ville, 330 Sparks Street
Ottawa, Ontario K1A0N5
TTY: 1-888-675-6863

SECTION 3 – DIMENSIONS

Frame Height

Top of frame is the sum of the tires (SLR), the suspension, and the frame.

Model	K370E	K270E
Frame	10 ¼ inches	10 ¼ inches
Front Suspension		
Rating	12K	10K
Unladen	8.1″	8.1″
Laden	5.9″	5.9″
Rear Suspension		
HAS 210/230	12K	10K
Unladen	8.5″	8.5″
Laden	8.3″	8.3″
79Kb 21,000 lbs.		
Unladen	9.18″	9.18″
Laden	6.75″	6.75″

Tires	Rim Diameter		K370 E (SLR)	K270 E (SLR)	GVWR (Gross Vehicle Weight Rating)
245/70R	19.5	G	N/A	15.5″	26,720
265/70R	19.5	G	N/A	15.9″	30,990
255/70R	22.5	H	N/A	17.2″	31,300
275/70R	22.5	J	17.6″	17.6″	39,580
295/75R	22.5	G	18.8″	18.8″	35,050
11R	22.5	G	19.5	19.5″	35,710

TURNING RADIUS

Approximate turning radius specifications for the KE series are listed (by wheelbase) in the following tables. Tables 3-2 Turning Radius and 3-3 Cab Tilt Height information for chassis with standard components. Optional components may give different results.

	Rear Axles	Wheelbase Range	Curb to Curb Est. Radius Est.	Wall to Wall Radius Est.
Model		Inch	ft	ft
K series	Single	206	26	32
		218	27	33
		274	34	39

CAB TILT

Model K series with 19.5” tires

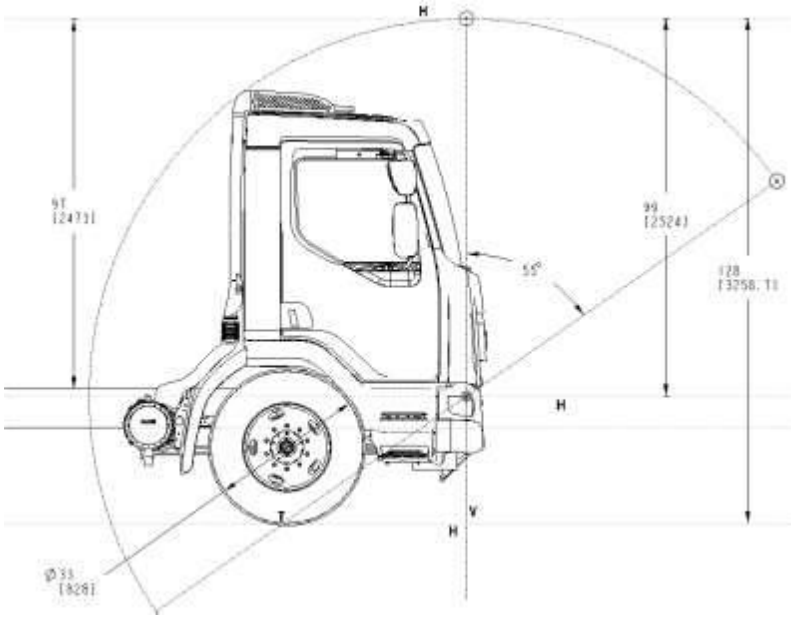


Figure 5 K series W/19.5 Tires Cab Tilt Height and Pivot location Measurement 128”

Table 1 Cab Tilt Height

CAB Tilt	Highest point inches
K series W/19.5 Tires	128
K Series W/22.5 Tires	132

Model K series with 22.5” tires

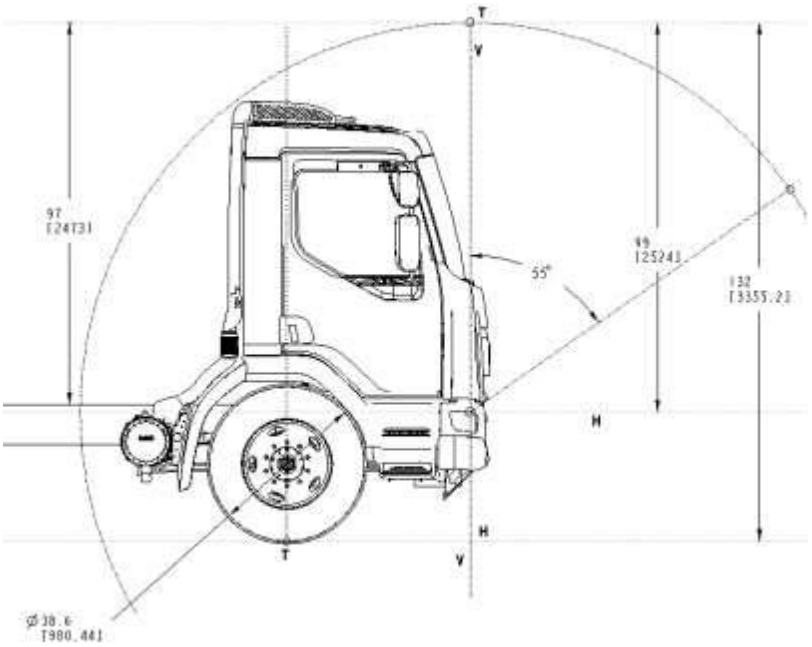


Figure 6 K series W/22.5 Tires Cab Tilt Height and Pivot location Measurement 132”

Table 2 Cab Pivot location

Behind CAB	Pivot location
Above FOF (Front of Frame)	1-3/4”
WL	8-1/4”
CTR-CTR	38-1/2”

OVERALL DIMENSIONS

This section includes drawings of the base K series, which includes detail drawings show views of each component of the vehicle. They illustrate important measurements critical to designing bodies of all types. See the “Contents” at the beginning of the manual to locate the drawing you need.

Side View – K series

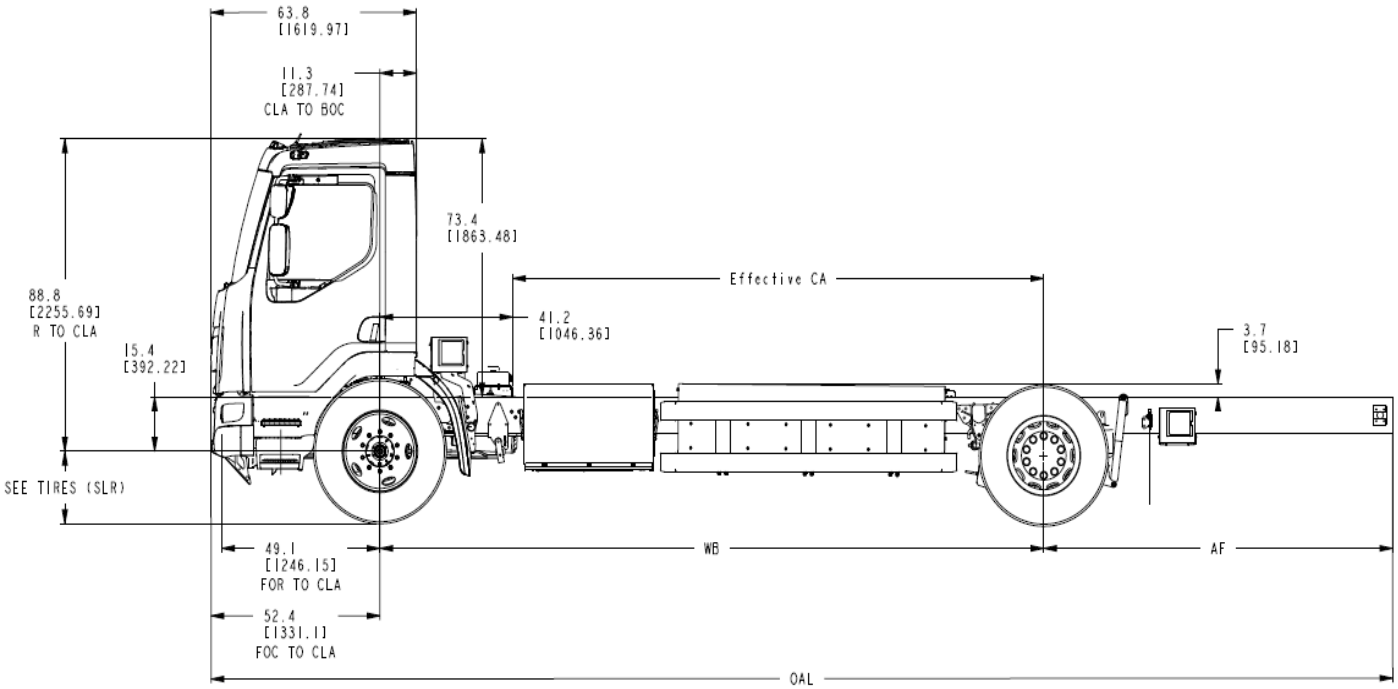


Figure 7 Side View —K series BEV (Battery Electric Vehicle) Laden Height and Length Measurement

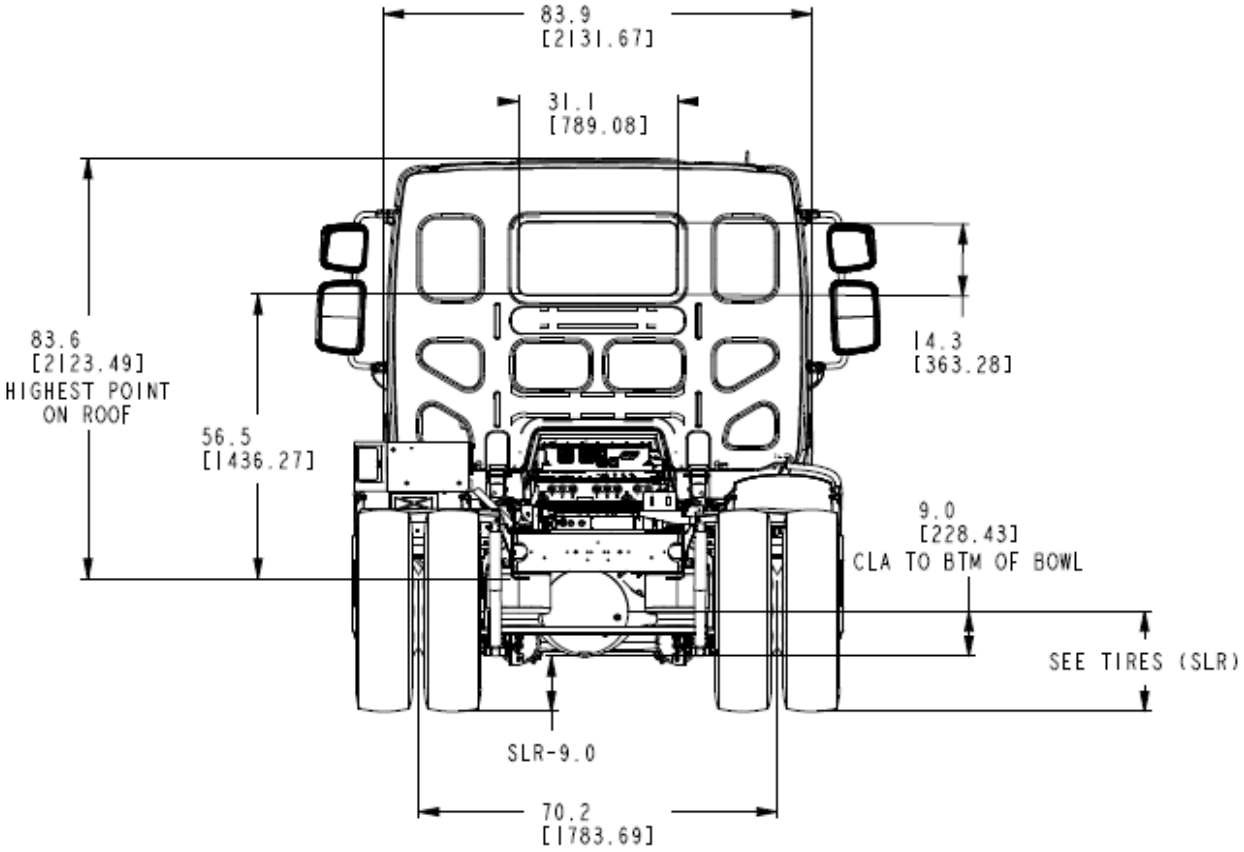


Figure 8 K series Laden Rear View: Width and Ground Clearance Measurements: inches (mm).

Figure 9 Cab Floor: Side View, Left Side w/ 19.5 Tires

Position	Unladen	Laden
	In	In
A FUEL SUPPORT STEP	10.5	7.5
B FIRST STEP	16.6	13.2
C SECOND STEP	27.2	23.8
D CAB FLOOR	38.6	35.2

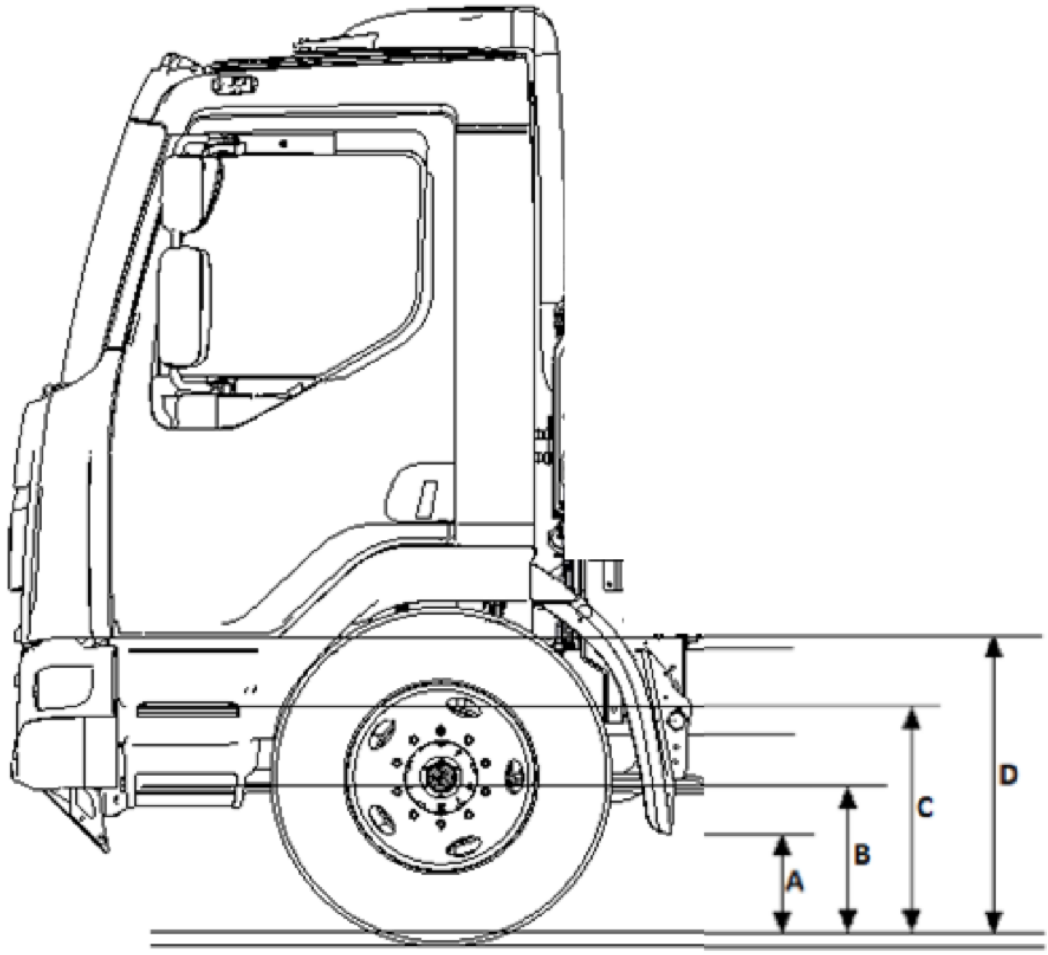


Figure 10 Floor: Side View, Left Side w/ 22.5 Tires

Position	Unladen In	Laden In
A FUEL SUPPORT	15.8	14.3
B FIRST STEP	18.4	16.9
C SECOND STEP	32.7	31.2
D CAB FLOOR	41.4	39.9

SECTION 4 – FRAME LAYOUTS BODY MOUNTING

INTRODUCTION

This section has been designed to provide guidelines to aid in body mounting. This is not intended as a complete guide, but as general information. Body mounting strategies are unique to each body type and each body builder must determine the appropriate method. Please note, an alignment adjustment is required after body installation. Front alignment and rear alignment must be performed prior to putting the vehicle into service.

Please contact your local Kenworth dealer if more information is desired

Visual Index

Symbol	Description
	**Battery Box**
	**Battery Electric Vehicle Battery**
	**BEV Chiller**
	**BEV Charging Port**

FRAME RAILS

Frame rail information is provided per rail.

Table 3 Single Frame Rails

				Per Rail		Per Pair of Rail
Rail Height (in.)	**Flange Width**	**Web Thickness**	**Section Modulus ($In.^3$)**	**RBM (in.-lbs.)**	**Weight (lbs./in.)**	**Weight (lbs./in.)**
9-7/8	3-1/2″	1/4″	10.5	1,250,000	1.06	2.12
10-5/8	3-1/2″	5/16″	14.8	1,776,000	1.44	2.88
10-3/4	3-1/2″	3/8″	17.8	2,134,000	1.74	3.48
10-11/16	3-1/2″	1/2″	22.4	2,691,000	2.265	4.53
11-5/8	3-7/8″	3/8″	21.4	2,572,000	1.9	3.8

Table 4 Inserted Frame Rails

			Per Rail		Per Pair of Rail
Main Rail Height (in.)	**Insert size**	**Combined Section Modulus ($In.^3$)**	**RBM (in.-lbs.)**	**Weight (lbs./in.)**	**Weight (lbs./in.)**

10-5/8	9-7/8″	23.7	2,844,000	2.48	4.96
10-3/4	9-7/8″	26.58	3,190,000	2.75	5.5
11-5/8	10-3/4″	37.93	4,551,000	3.64	7.28

Table 5 Double Inserted Frame Rails

				Per Rail		Per Pair of Rail
Main Rail Height (in.)	**First Insert size**	**Second Insert Size**	**Combined Section Modulus (In.^{3})**	**RBM (in.-lbs.)**	**Weight (lbs./in.)**	**Weight (lbs./in.)**
11-5/8	10-3/4″	9-7/8″	46.07	5,528,000	4.7	9.4

CRITICAL CLEARANCES

REAR TIRES AND CAB

CAUTION: Insufficient clearance between rear tires and body structure could cause damage to the body during suspension movement.

Normal suspension movement could cause contact between the tires and the body. To prevent this, mount the body so that the minimum clearance between the top of the tire and the bottom of the body is 8 inches (203 mm). This should be measured with the body empty. See Figure **11**.

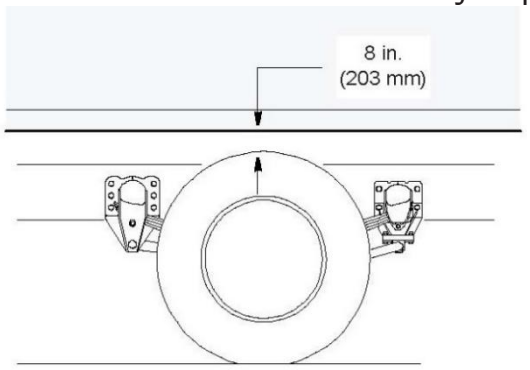


Figure 11 Minimum Clearance between Top of Rear Tires and Body Structure Overhang

CAUTION: Maintain adequate clearance between back of cab and the front (leading edge) of mounted body. It is recommended leading edge of the body be mounted 4 in. behind the cab. See Figure 12 Minimum Back of Cab Clearance.

NOTE:

Be sure to provide maintenance access to the battery box and fuel tank fill neck.

Figure 12 Minimum Back of Cab Clearance

CAUTION: Always install a spacer between the body subframe and the top flange of the frame rail. Installation of a spacer between the body subframe and the top flange of the frame rail will help prevent premature wear of the components due to chafing or corrosion.

WARNING! When mounting a body to the chassis, DO NOT drill holes in the upper or lower flange of the frame rail. If the frame rail flanges are modified or damaged, the rail could fail prematurely and cause an accident. Mount the body using body mounting brackets or U–bolts.

FRAME SILL

If the body is mounted to the frame with brackets, we recommend a frame sill spacer made from a strip of rubber or plastic (delrin or nylon). These materials will not undergo large dimensional changes during periods of high or low humidity. The strip will be less likely to fall out during extreme relative motion between body and chassis. See Figure **13**.

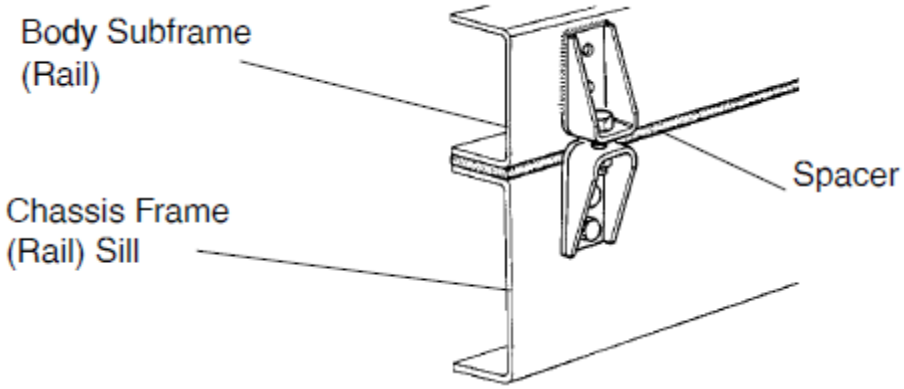


Figure 13 Spacer Between Frame Sill and Body Rail – Rubber or Plastic

BRACKETS

When mounting a body to the chassis with brackets, we recommend designs that offer limited relative movement, bolted securely but not too rigid. Brackets should allow for slight movement between the body and the chassis. For instance, Figure **14** shows a high compression spring between the bolt and the bracket and Figure **15**shows a rubber spacer between the brackets. These designs will allow relative movement between the body and the chassis during extreme frame racking situations. Mountings that are too rigid could cause damage to the body. This is particularly true with tanker installations.

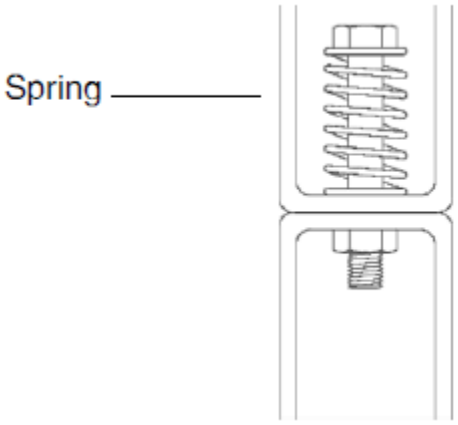


Figure 14 Mounting Brackets with Spring

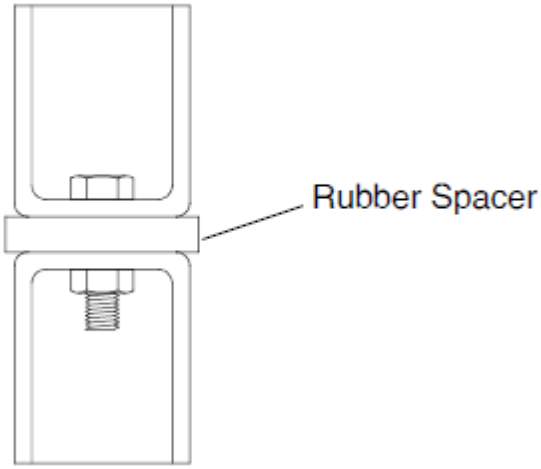


Figure 15 Mounting Brackets with Rubber Spacer

MOUNTING HOLES

When installing brackets on the frame rails, the mounting holes in the chassis frame bracket and frame rail must comply with the general spacing and location guidelines illustrated in Figure 16

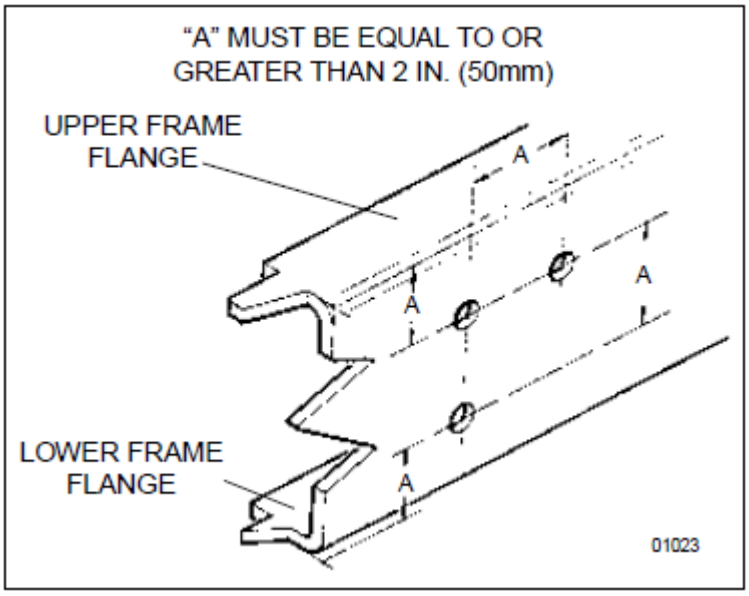


Figure 16 Frame Hole Location Guidelines for Frame Rail and Bracket

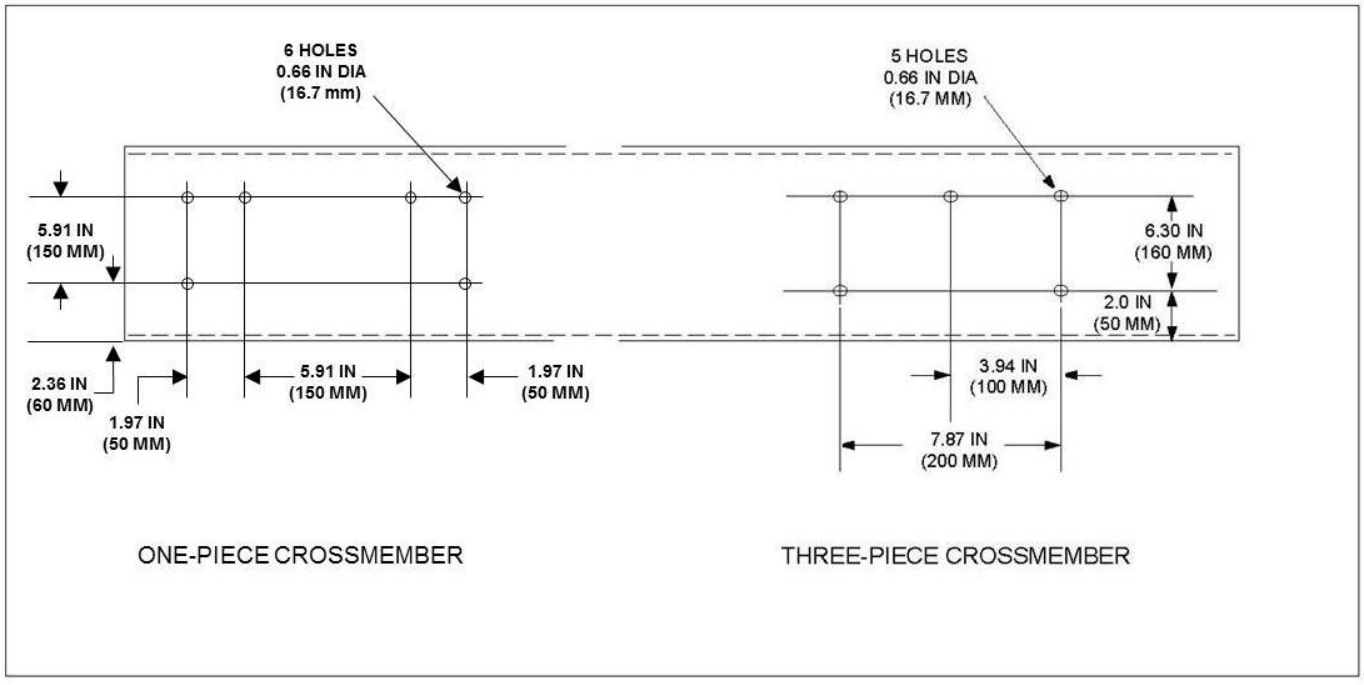


Figure 17 Crossmember Gusset Hole Patterns
(Additional Holes Available in 50 mm (about 1.97 in) Horizontal Increments)

FRAME DRILLING

WARNING! When mounting a body to the chassis, DO NOT drill holes in the upper or lower flange of the frame rail. If the frame rail flanges are **modified** or damaged, the rail could fail prematurely and cause an accident. Mount the body using body mounting brackets or U–bolts.

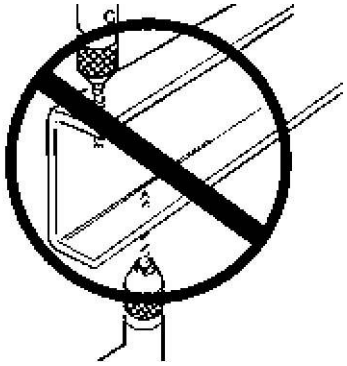


Figure 18 Frame Rail Flange Drilling Prohibited

WARNING! DO NOT drill closely spaced holes in the frame rail. Frame hole centers of two adjacent holes should be spaced no less than twice the diameter of the largest hole. Closer spacing could induce a failure between the two holes.

CAUTION: An appropriately sized bolt and nut must be installed and torqued properly in all unused frame holes. Failure to do so could result in a frame crack initiation around the hole.

CAUTION: Use care when drilling the frame web so the wires and air lines routed inside the rail are not damaged. Failure to do so could cause an inoperable electrical or air system circuit.

CAUTION: Never use a torch to make holes in the rail. Use the appropriate diameter drill bit. Heat from a torch will affect the material properties of the frame rail and could result in frame rail cracks.

CAUTION: The frame hole diameter should not exceed the bolt diameter by more than .060 inches (1.5mm)

BODY MOUNTING USING U–BOLTS

If the body is mounted to the frame with U–bolts, use a hardwood sill (minimum 1/2 inch thick) between the frame rail and body frame to protect the top surface of the rail flange.

WARNING! Do not allow the frame rails or flanges to deform when tightening the U–bolts. It will weaken the frame and could cause an accident. Use suitable spacers made of steel or hardwood on the inside of the frame rail to prevent collapse of the frame flanges.

Use a hardwood spacer between the bottom flange and the U–bolt to prevent the U–bolt from notching the frame flange. See Figure **19**.

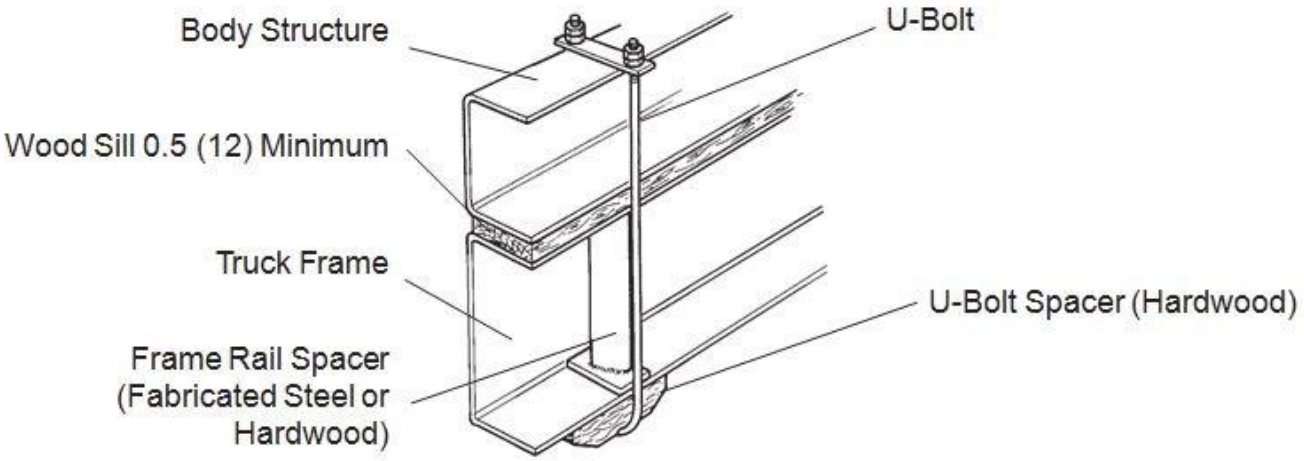


Figure 19 Acceptable U-Bolt Mounting with Wood and Fabricated Spacers

WARNING! Do not allow spacers and other body mounting parts to interfere with brake lines, fuel lines, or wiring harnesses routed inside the frame rail. Crimped or damaged brake lines, fuel lines, or wiring could result in loss of braking, fuel leaks, electrical overload, or a fire. Carefully inspect the installation to ensure adequate clearances for air brake lines, fuel lines, and wiring. See Figure 20.

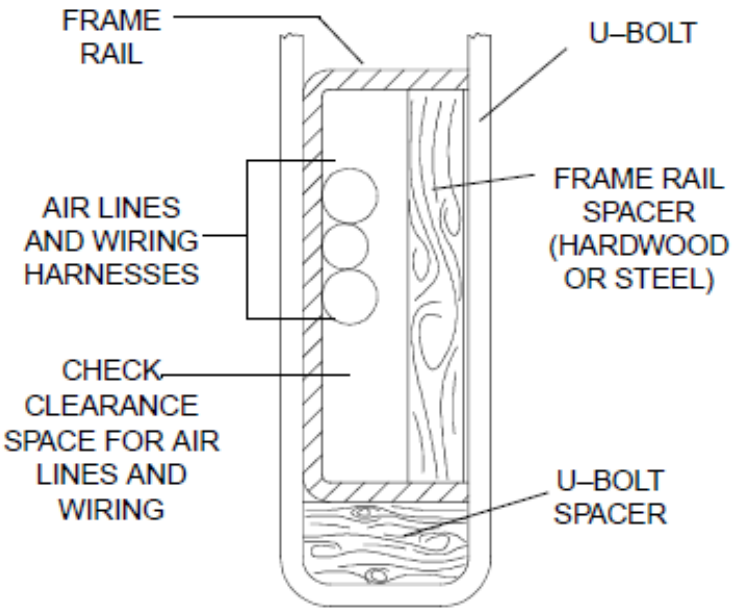


Figure 20 Clearance Space for Air Lines and Cables

WARNING! Do not notch frame rail flanges to force a U–bolt fit. Notched or damaged frame flanges could result in premature frame failure. Use a larger size U-bolt

CAUTION: Mount U–bolts so they do not chafe on frame rail, air, or electric lines.

REAR BODY MOUNT

When U–bolts are used to mount a body**,** we recommend that the last body attachment be made with a "fishplate" bracket. See Figure 21. This provides a firm attachment point and helps prevent any relative fore or aft movement between the body and frame. For frame hole location guidelines, see Figure 21**.**

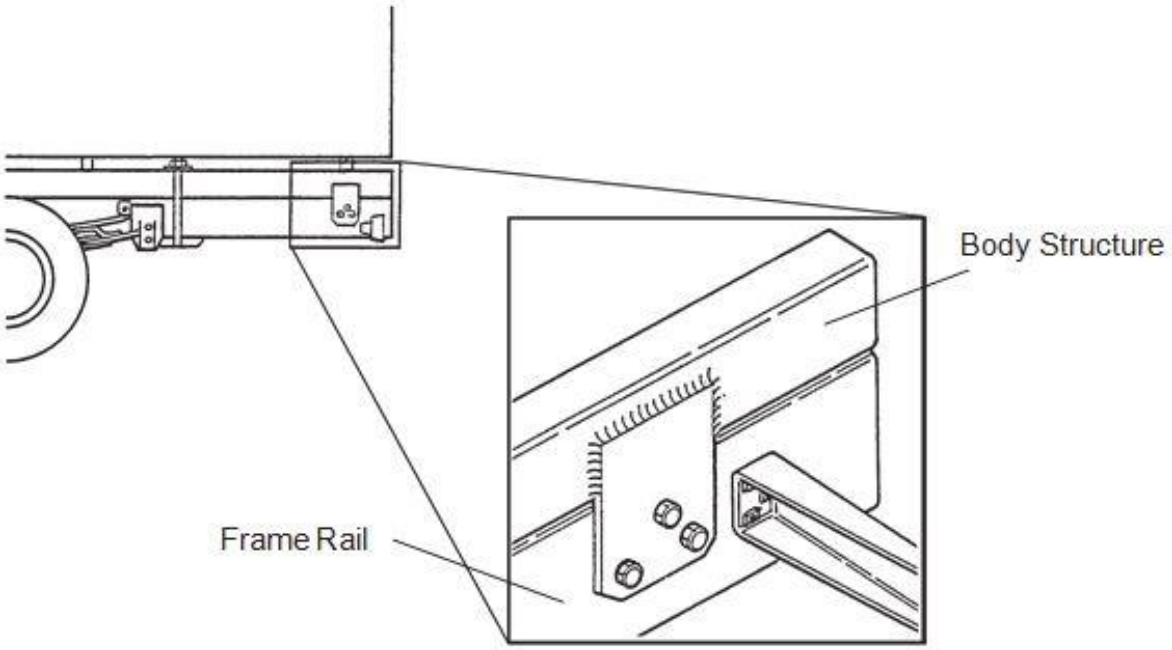


Figure 21 Fishplate Bracket at Rear End of Body

SECTION 5 FRAME MODIFICATIONS

INTRODUCTION

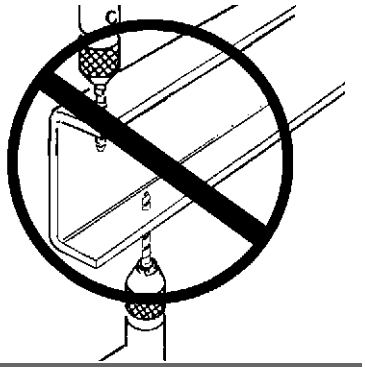
Kenworth offers customer specified wheelbases and frame overhangs. Therefore, in most cases frame modifications should not be necessary.

However, some body installations may require slight modifications, while other installations will require extensive modifications. Sometimes an existing dealer stock chassis may need to have the wheelbase changed to better fit a customer's application. The modifications may be as simple as modifying the frame cutoff, or as complex as modifying the wheelbase.

DRILLING RAILS

If frame holes need to be drilled in the rail, see Section 4 FRAME DRILLING**,** for more information.

WARNING! When mounting a body to the chassis, DO NOT drill holes in the upper or lower flange of the frame rail. If the frame rail flanges are modified or damaged, the rail could fail prematurely and cause an accident. Mount the body using body mounting brackets or U–bolts.



WARNING! Do not drill new holes any closer than 2 inches (50mm) to existing holes. Frame drilling affects the strength of the rails. If the holes are too close together, the rail could fail prematurely and cause an accident.

WARNING! Never use a torch to make a hole in the rail. Use the appropriate diameter drill bit. Heat from a torch can change material properties and weaken the frame rail.

CAUTION: Use care when drilling the frame web so the wires and air lines routed inside the rail are not damaged.

MODIFYING FRAME LENGTH

The frame overhang after the rear axle can be shortened to match a particular body length. Using a torch is acceptable; however, heat from a torch will affect the material characteristics of the frame rail. The affected material will normally be confined to within 1 to 2 inches (25 to 50mm) of the flame cut and may not adversely affect the strength of the chassis or body installation.

CHANGING WHEELBASE

Changing a chassis' wheelbase is not recommended. Occasionally, a chassis' wheelbase will need to be shortened or lengthened. Before this is done there are a few guidelines that need to be considered.

WARNING! When changing the wheelbase, be sure to follow the driveline manufacturer's recommendations for driveline length or angle changes. Incorrectly modified drivelines can fail prematurely due to excessive vibration. This can cause an accident and severe personal injury.

Before changing the wheelbase, the driveline angles of the proposed wheelbase need to be examined to ensure no harmful vibrations are created. Consult with the driveline manufacturer for appropriate recommendations.

Before the rear suspension is relocated, check the new location of the spring hanger brackets. The new holes for the spring hanger brackets must not overlap existing holes and should adhere to the guidelines in the "FRAME DRILLING" section of this manual.

When shortening the wheelbase, the suspension should be moved forward and relocated on the original rail. The rail behind the suspension can then be cut to achieve the desired frame overhang. See Figure 22 Wheelbase Customization.

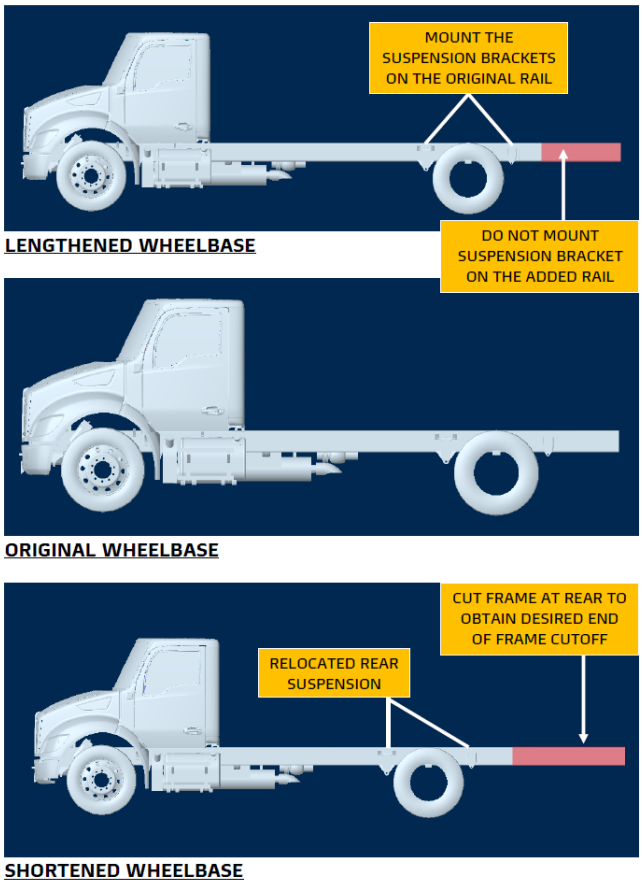


Figure 22 Wheelbase Customization

CROSSMEMBERS

After lengthening the wheelbase, an additional crossmember may be required to maintain the original frame strength. The maximum allowable distance between the forward suspension crossmember and the next crossmember forward is 47.2 inches (1200 mm). If the distance exceeds 47.2 inches (1200 mm) after the wheelbase is lengthened, add a crossmember between them.

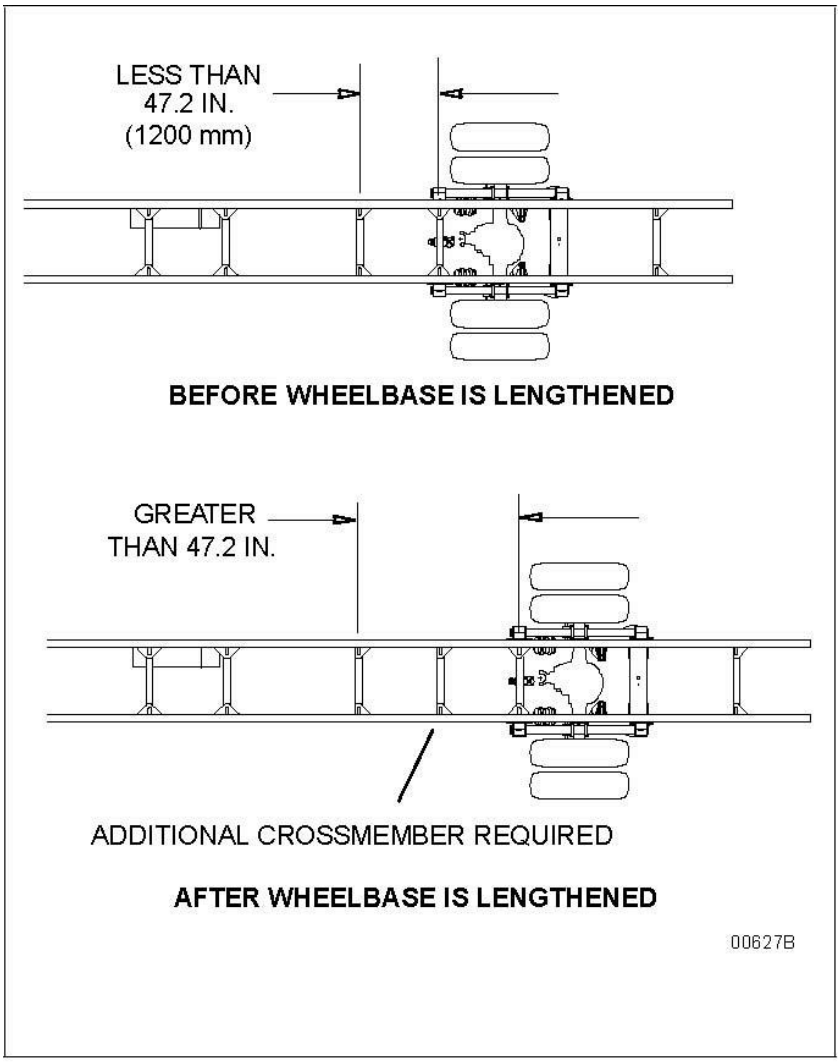


Figure 23 Crossmember Spacing Requirements

TORQUE REQUIREMENTS

Torque values apply to fasteners with clean threads, lightly lubricated, with hardened steel washers, and nylon-insert nuts.

Table 6 Customary Grade 8 UNF or UNC

Fastener	Torque	
Size	Nm	lb.-ft
5/16	27–34	20–25
3/8	47–60	35–44
7/16	76–96	56–71
1/2	117–148	86–109
9/16	167–214	123-158
5/8	235–296	173–218
3/4	411–523	303–386
7/8	654–846	482–624
1	973–1268	718–935

Table 7 U.S. Customary – Grade 8 Metric Class 10.9

Fastener	Torque	
Size	Nm	lb.-ft
M6	9–11	7–8
M8	24–27	18–20
M10	47–54	35–40
M12	83–95	61–70
M14	132–150	97–111
M16	206–235	152–173
M20	403–458	297–338

WELDING

The frame rails are heat treated and should not be welded. The high heat of welding nullifies the special heat treatment of the rails, greatly reducing the tensile strength of the frame rail. If a frame member becomes cracked from overloading, fatigue, surface damage or a collision, the only permanent repair is to replace the damaged frame member with a new part.

The following information is provided for temporary emergency repair. Prior to welding a cracked frame rail, the area should be beveled (V'd out) to allow for a better weld. To prevent spreading of the crack, a 7 to 9 mm (1/4 in. to 3/8 in.) dia. hole should be drilled at the end of the crack. Widen the crack along its full length by using two hack saw blades together. When welding steel frames use the shielded arc method. When welding aluminum frames use either the tungsten inert gas (TIG) or consumable electrode method. Be sure to obtain full weld penetration along the entire length of the crack.

CAUTION: Before welding, disconnect the negative terminal battery cable.

CAUTION: Before welding, disconnect the alternator terminals. Failure to do so could result in damage to the voltage regulator and/or alternator.

CAUTION: To prevent damage to electrical equipment, disconnect battery cables before arc-welding on a truck, and be sure that the welding ground lead is connected to the frame. Bearings and other parts will be damaged if current must pass through them to complete the circuit.

WELDING PRECAUTIONS: ALL ELECTRONIC ENGINES

Before welding on vehicles with electronic engines, the following precautions should be observed.

1. Disconnect all electrical connections to the vehicle batteries.
2. Disconnect all ECM (Engine Control Module) and VECU (Vehicle Electronic Control Unit) connectors.

3. Do not use the ECM, VECU or engine ground stud for the ground of the welding probe.
4. Ensure that the ground connection for the welder is as close to the weld point as possible. This ensures maximum weld current and minimum risk to damage electrical components on the vehicle.
5. Turn off the key.

NOTE:

Bendix ABS (Antilock Braking System) and Wabco ABS: Disconnect ECU (Electronic Control Units).

SECTION 6 – ELECTRICAL

Introduction

Through an optional body harness and spare circuits, we have reduced the complexity associated with adding common circuits to a body installation.

WARNING! When working near High Voltage components or cabling, follow the service manual's instructions for the High Voltage Shutdown procedure. Failure to follow these instructions with a Level 3 certified technician could result in property damage, serious injury, or death.

WARNING! Changes to the High Voltage system on the BEV should be done by a qualified EV technician. Failure to follow these instructions with a Level 3 certified technician could result in property damage, serious injury, or death.

Note: The most common circuits that body builders may need are pre-connected to this optional wiring harness.

ELECTRICAL CIRCUITS

WARNING! Do not install an electrical circuit that requires more amperage (electrical capacity) than what is available in the specific chassis circuit. An overloaded circuit may cause severe damage. Compare the amperage requirements of the new circuit to the electrical current capacity of the existing chassis circuit before adding the body or other equipment.

Data Bus Communication

WARNING! The Data Buss for the communication between electronic control units must adhere to the guidelines outlined under SAE J1939 documentation. The Euro 6 LFNA Model has multiple CAN (Controller Area Networks) buses and care must be taken if an interface is required. Please contact the local Paccar Service Representative for appropriate assistance and information.

Euro-VI LFNA CAN Bus Architecture

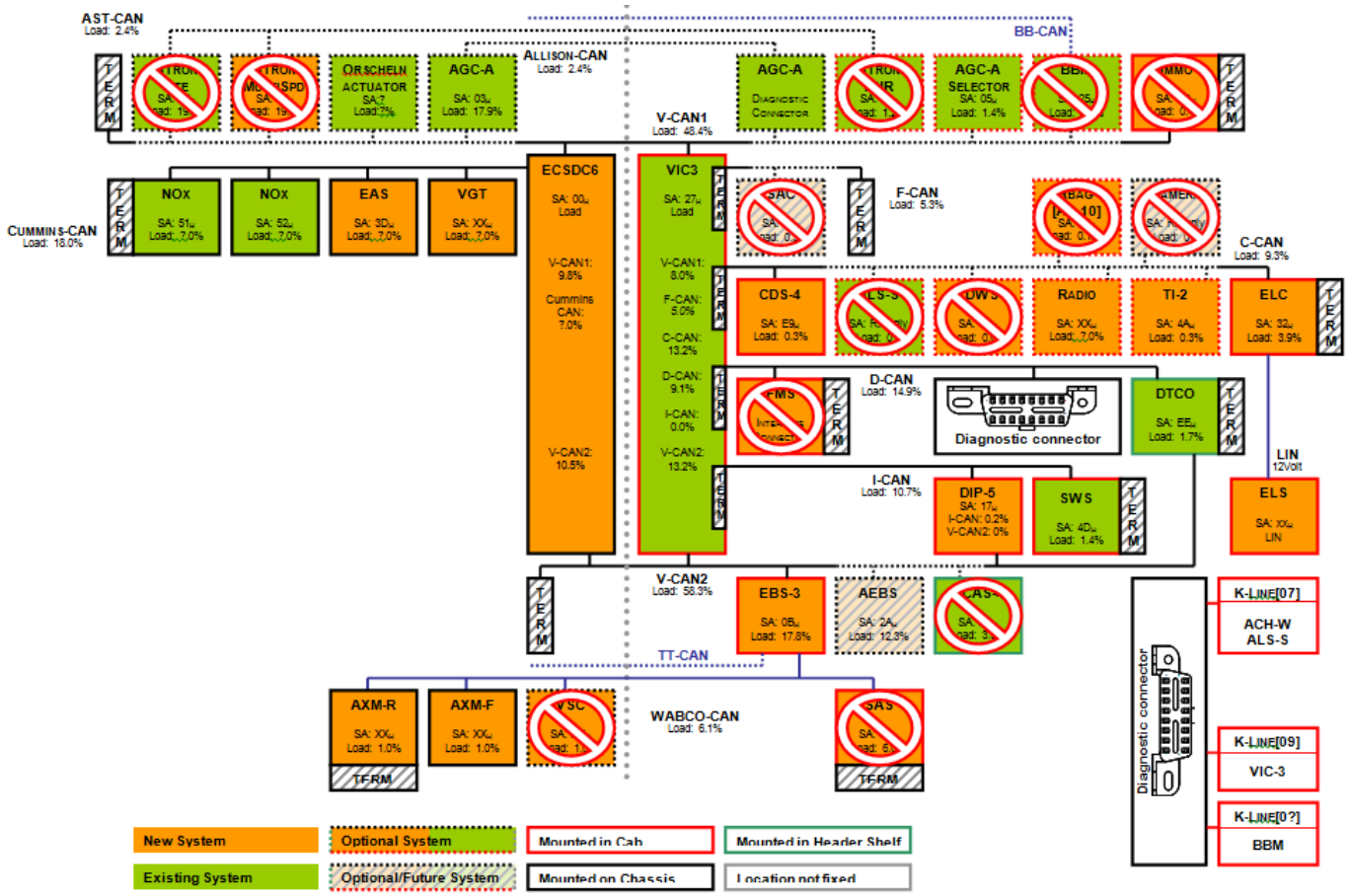


Figure 24 25 Data Bus Communication Architecture

Cab/Chassis Interface:

The EJB (Electrical Junction Box)

Location: Firewall (opposite side of steering column)

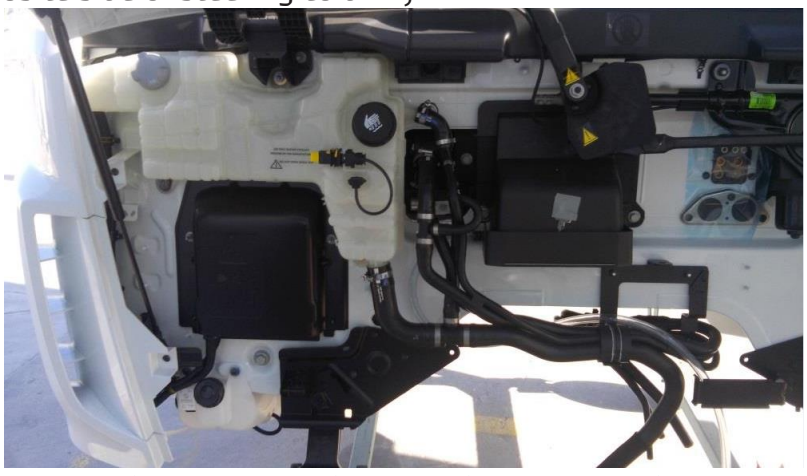


Figure 26 Electrical Junction Box Location

Figure 27 Inside View - Electrical Junction Box Location

EJB Connector Identifiers:

Front View = Front of Vehicle view

Rear View = Passenger Seat view

LF EURO 6 CAB INTERFACE NAMES

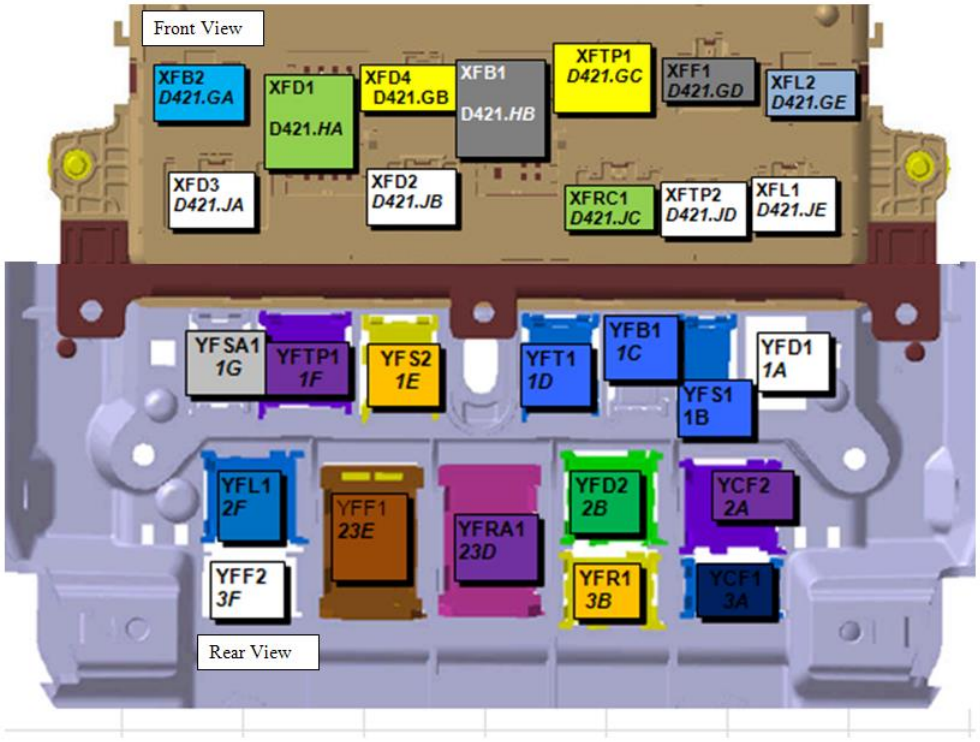


Figure 28 LF Euro 6 Cab Interface Names

The EJB contains both 24VDC and 12VDC circuitry for the vehicle. Contact the local Paccar Service Representative for the appropriate circuitry identification if access to this panel is required

XFB2	XFD1	XFD4	XFB1	XFTP1	XFF1	XFL2
XFD3		XFD2		XFRC1	XFTP2	XFL1
YFD1	YFS1	YFB1	YFT1	YFS2	YFTP1	YFSA1
YCF2	YFD2		YFRA1	YFF1		YFL1
YCF1	YFR1					YFF2

Controllers

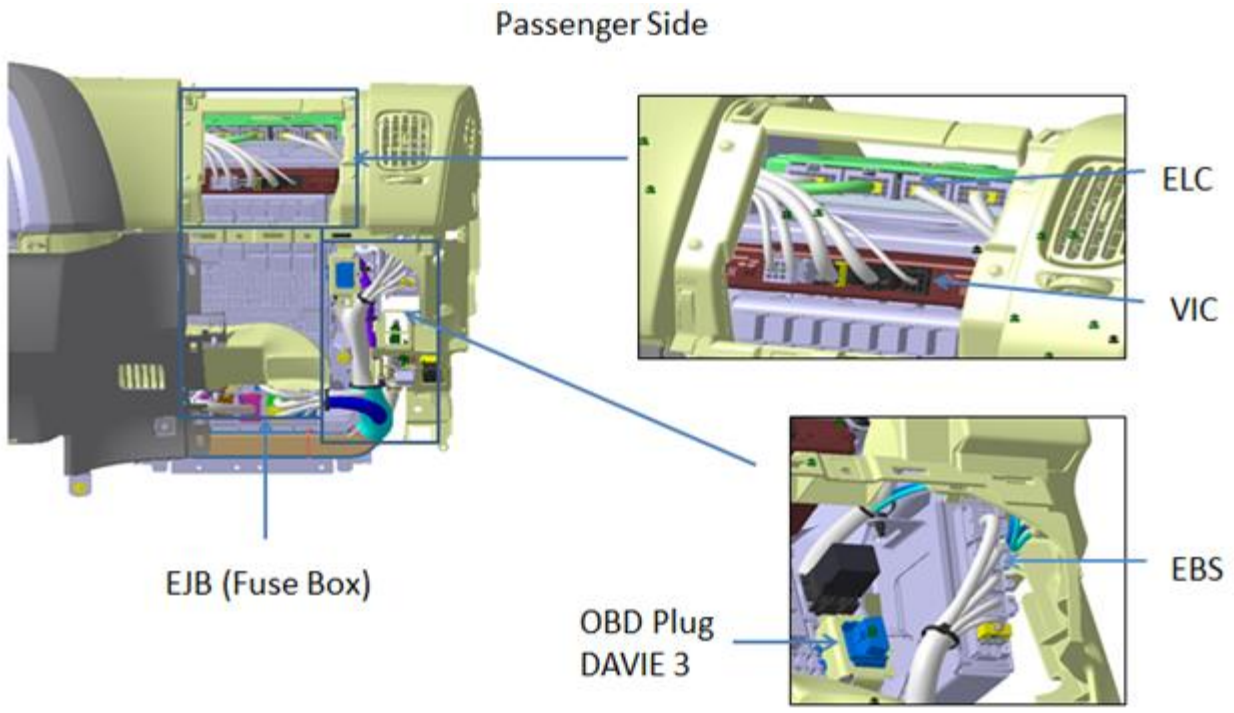


Figure 29 Controllers

The EJB is the electrical load center for the cab. The cab and the associated controllers listed operate on 24VDC. The 12/24 VDC converter located in the battery box supplies the necessary power requirements.
The ELC (Electronic Lighting Controller) supplies the signals for all the lighting functions (24VDC in cab and roof) and its outputs are used to activate 24VDC relays in the electrical load center mounted in the battery box. These relays in turn control all the 12VDC exterior lighting.
The VIC (Vehicle Intelligence Center) is the main controller and communicator for the vehicle.
The EBS (Electronic Braking System) is the controller for the EoA(Electric over Air) braking system.
The OBD plug in the image above is the 16-pin style OBD connector typically found in passenger cars. It is 24VDC and is to be used with the DAVIE Service Tool. Communication with the engine must be done through the 9-pin Diagnostic connector(12VDC) located in the lower dash between the steering wheel and door aperture.

Dash Controls

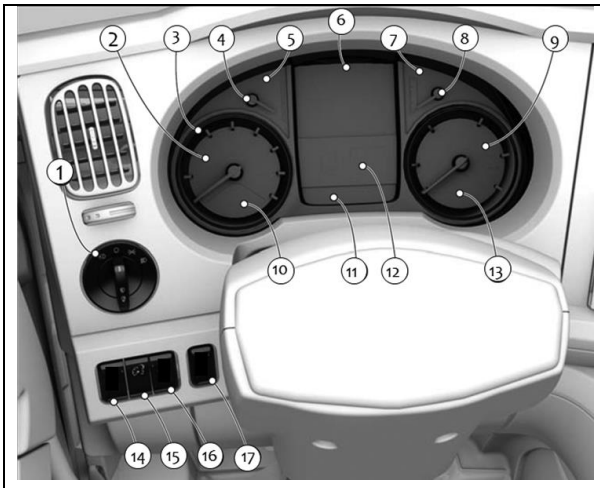


Figure 30 Dash Controls

1 Light switch
2 Instrument panel
3 Speedometer
4 Fuel level and DEF (Diesel Exhaust Fluid) level gauges
5 Warning indicators
6 Master display
7 Warning indicators
8 Air pressure gauge
9 Tachometer
10 Speedometer display
11 Clock, outside temperature and trip odometer display
12 Warning indicators
13 Gear display
14 N/A
15 Instrument lighting (ON/OFF)
16 N/A
17 N/

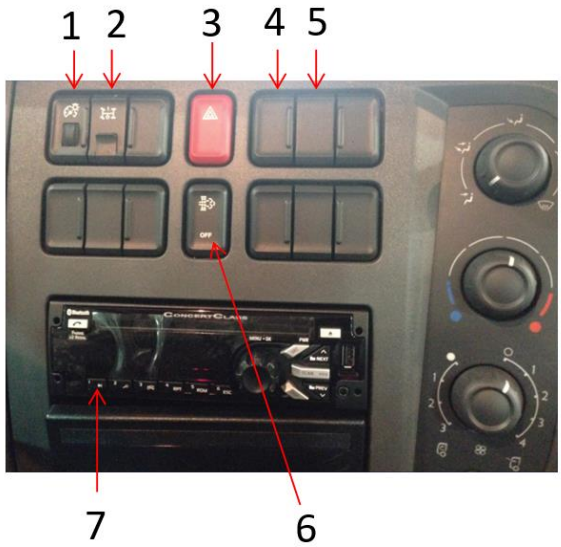


Figure 31 Dash Contols-2

1 Instrument lighting dimmer
2 PTO (Power Take Off) switch (Optional)
3 Hazard lights
4 Air suspension dump switch position (if optioned)
5 Differential lock switch position (if optioned)
6 Diesel particulate filter Regen (DPF)
7 Radio and storage

Power Distribution Center

Figure 32 Power Distribution Center

Pin		Description	Pin		Description
		Orange			Grey
4C		PDC Ground	1A		DIP HL (12V+)
4D		PDC Ground	1B		DIP HL (24V+)
4F		ECM Power (12V+)	1C		LH Turn (12V+)
4G		ECM Power (12V+)	1D		LH Turn (24V+)
4B		XMSN ECU (12V+)	1E		RH Turn (24V+)
			1F		RH Turn (12V+)
			1G		Main HL (24V+)
			1H		Main HL (12V+)
		Black			Brown
3A		Heat Fuel Filter (12V+)	12A		Fog Lamp (12V+)
3F		PDC Ground	12B		Fog Lamp Sw (24V+)
3G		PDC Ground	12C		Chassis Ignition (12V+)
3H		Converter Ignition	12D		Ignition Signal (24V+)
3C		9-pin Diagnostic(12V+)	12E		NOX up (12V+)
3B		XMSN Actuator	12F		NOX down (12V+)
			12G		Body Lamp (24V+)
			12H		Body Lamp (12V+)
		Red			Green
		Stop Lamp (12V+)			DCU Power (12V+)

2C			11A		
2D		Stop Lamp (24V+)	11B		Line heat (12V+)
2E		Clearance (24V+)	11C		Starter sol (12V+)
2F		Clearance (12V+)	11D		Start Signal (24V+)
			11E		Ignition Signal (24V+)
			11F		Engine Ignition (12V+)
			11G		ECM w/u (12V+)
			11H		DCU w/u (12V+)

The voltage converter provides 24V to cab systems. They are inside the battery box. This voltage converter works with the Power Distribution Center (PDC) with the following characteristics:

- 12V Input – 24V output
- Input Current: 80 Amps
- Output Current: 40
- Amps
- Temperature range: -40C to +85C

The output voltage from cab to chassis is 24V. The spare circuits in the PDC located in the battery box as described in Table 8 Additional Spare Circuits for Wiring are 12V.

Table 8 Additional Spare Circuits for Wiring

Spare Circuit Powered Through:	Minimum Wire Gauge	Pin A	Pin B	Circuit PDC Terminal	Capacity (Fuse number/Amperes). Install a fuse of appropriate rating.	Numbered connector Location PDC at battery box.
Spare 1	16	RG7	RH7	2B	F20/10Amp	Red Connector (B068-7099-F)
Spare 2	16	RG7	RH7	2G	F20/10Amp	Red Connector (B068-7099-F)

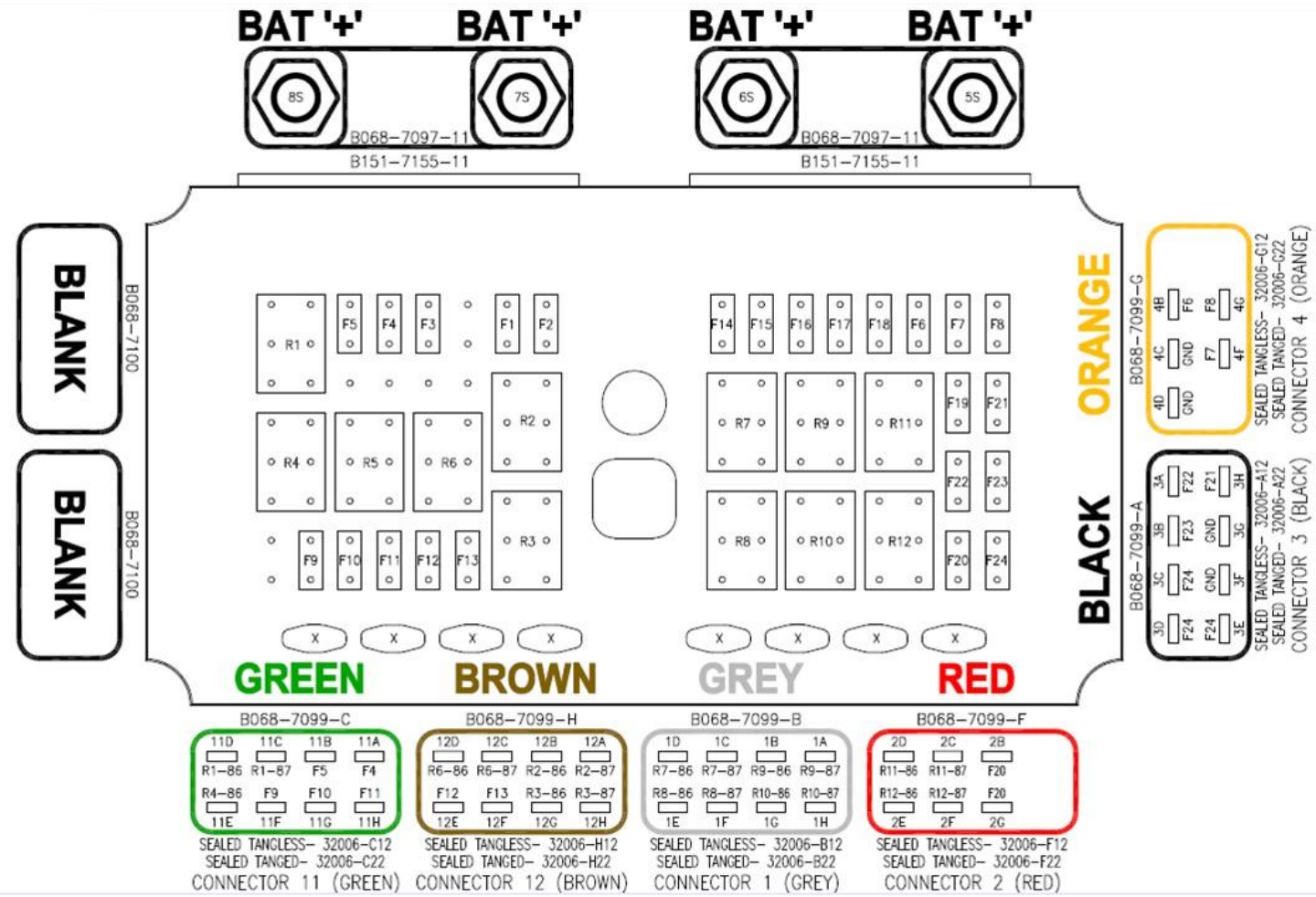


Figure 33 Power Distribution Center (Chassis)

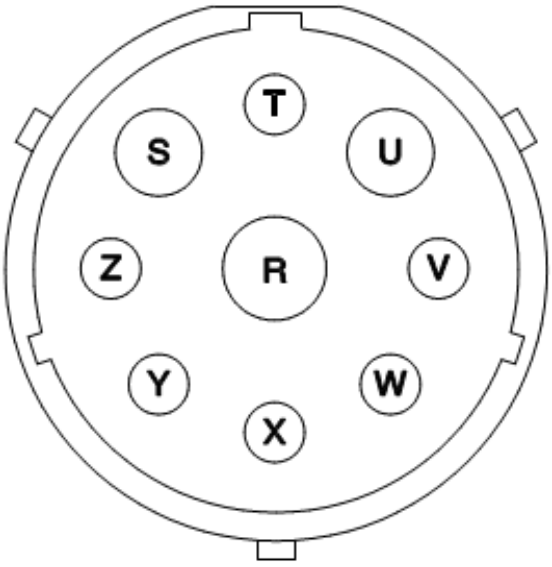


Figure 34 Body Builder 9 Pin Connector

The connector shown above is available for exterior lighting functions and lighting circuits at the end of frame.

WIRE DESCRIPTION	FUNCTION	PIN	CIRCUIT	WIRE COLOR	CAPACITY FUSE (AMPERES NUMBER)	WIRE GAUGE
GND	Ground	R	WHT2400	White		6
Stop LP	Stop lamp	S	YEL2601	Yellow	F18 / 25A	8
Not Connected		T	Not Connected			
Not Connected		U	Not Connected			
Tails/Marker LP	Tails / markers lamps	V	YEL2422	Yellow	F19 / 20A	12
Turn RH rear	Turn signal right-hand	W	YEL2007	Yellow	F15 / 15A	12
Backup LP	Backup lamp	X	YEL2960	Yellow	TCU Relay	12
Turn LH rear	Turn signal left-hand	Y	YEL2006	Yellow	F14 / 15A	12
Markers LP	Markers lamps	Z	YEL2412	Yellow	F19 / 20A	12

K series PTO Wiring Information

The wiring of the Current K- E series is different from previous versions of K series. Please see the information below for basic wiring and functionality.

1) If equipped, the factory PTO dash switch will tell the VIC to go to PTO mode.
2) J124 connector on the transmission needs 12V to tell the Allison TCM to enable PTO mode.
3) J125 connector on the transmission is a ground output signal from the Allison TCM for the PTO.
4) J126 connector on the transmission is a 24V output signal from the VIC when the PTO dash switch is on.
5) J128 connector on the transmission needs a ground to feedback to the VIC for PTO engaged status (must occur within 3-4 seconds after PTO switch). Option 1: Provide a ground from the PTO engaged switch to J128. Option 2: J128 & J125 can be spliced together for the feedback ground to the VIC. Please note: J128 & J125 will not mate together, so connectors will have to be cut off and spliced.
6) Pin 10 of the 12-pin Remote PTO connector (P124) on the engine harness –OR- pin B of the 3-pin connector (J144) on the engine harness needs a ground to feedback to the VIC for PTO engaged status. **This performs the same function as item 5 above.** This is primarily used for remote set-ups outside the cab.

As an example, for setting up a PTO if using the factory PTO dash switch and one pre-set RPM: (Refer Figure 7.9)

A) Use J126 to drive your PTO solenoid. This is 24V, so you may need to use a relay if the PTO requires 12V or a ground.
B) Send 12V to connector J124 for the Allison TCM when the PTO is engaged. This 12V can be "borrowed" from the relay used in step A) above.
C) Provide a ground to J128 for feedback to the VIC when the PTO is engaged. This can be done by either splicing J125 & J128 together or by running a separate wire from the switch directly on the PTO (if equipped) to J128. This ground must be applied within 3-4 seconds after the PTO switch is enabled.

D) Set your desired engine RPM for pre-set speed with DAVIE. This is found under Customer Parameters.
Please note: This information relates only to setting up the mechanical PTO for operation. This does not address the additional function of ESC (Engine Speed Control), as this is a separate function. Engine Speed Control must be enabled in the VIC programming and requires a modified PRS file. Instructions for use of ESC follow.

Engine Speed Control (ESC)

ESC can be fixed (pre-programmed) engine speed or variable engine speed. The Euro 6 only has two pre-programmed engine speeds N2 and N3. N VAR is available using the "SET+" and "SET- "to increase and decrease speed.
To activate these speeds the ESC must first be enabled by providing a high signal (12-24V) on pin 12 of the 12-pin connector on the engine harness (P124).
The N2 and N3 can then be activated by providing a high signal on pins 7 and 6 respectively of the 12-pin connector on the engine harness (P124).
N VAR can be activated by providing a high signal on pin 8 of the 12-pin connector on the engine harness (P124). (N refers to a Speed Set point)

If N VAR variable control is desired with the steering wheel switches:

A high signal (12-24V) is provided to pin 12 of the 12pin connector on the engine harness (P124).
A high signal is provided to pin 8 of the 12pin connector (P124).
Use the "SET+" and "SET- "steering wheel switches to bump the throttle up and down.
The parking brake must be set for proper functionality.

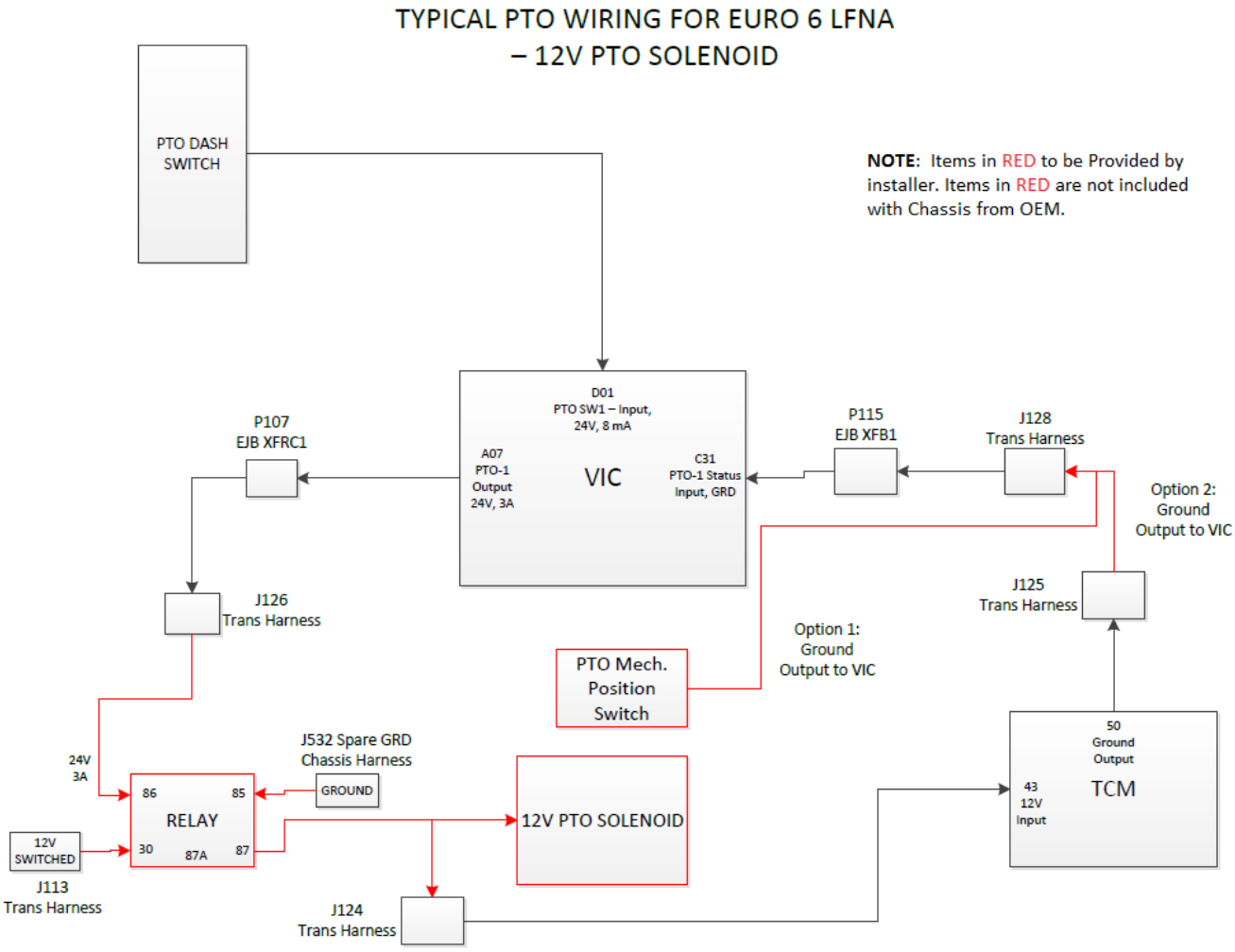
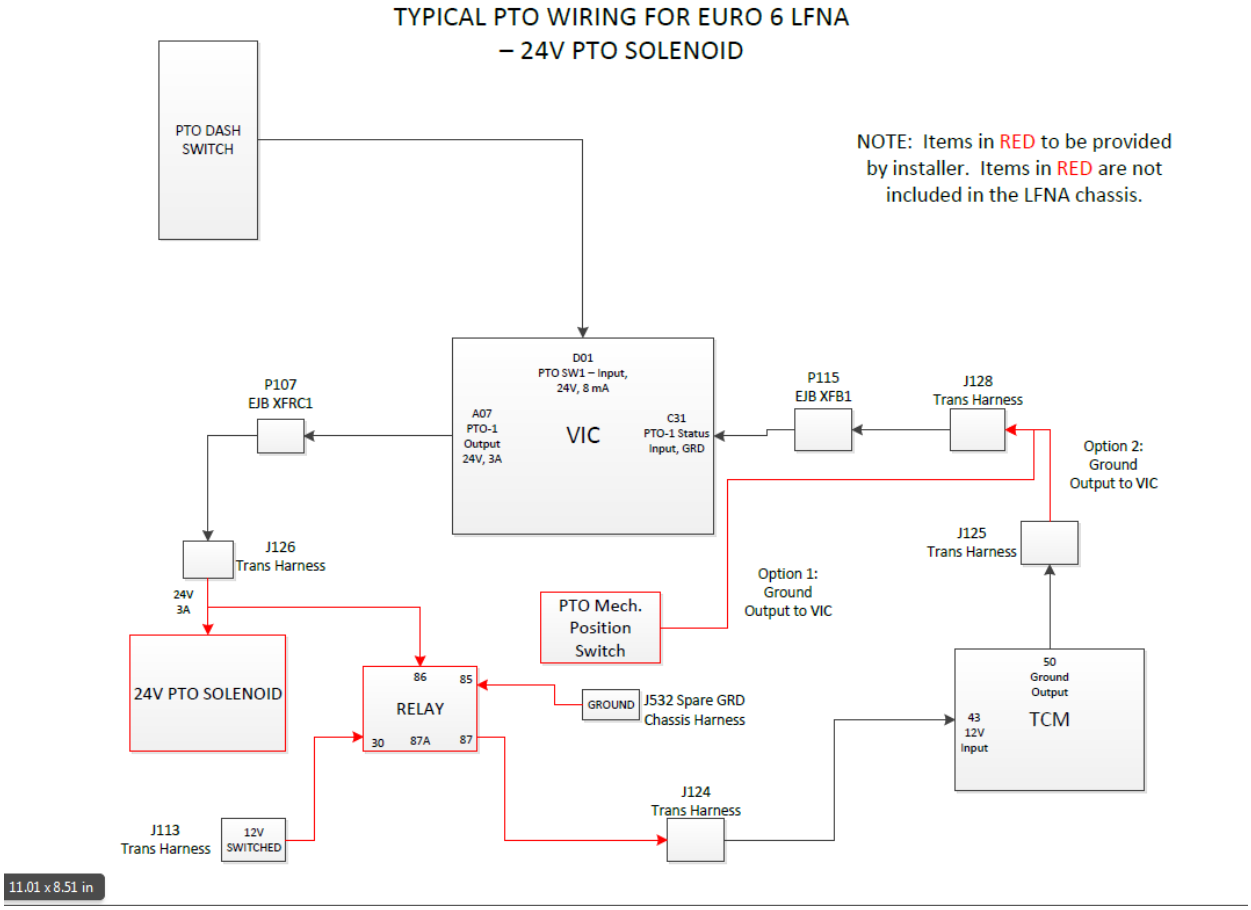


Figure 7-8.1 Typical PTO Wiring for Euro 6 LFNA – 12V PTO Solenoid



Remote PTO / Throttle Harness

This option provides a connection from the engine ECU to the end of the frame to fit the engine throttle remote control and PTOs (Power Take Off). Controls are not provided. A 12-pin Deutsch connector (Deutsch P/N DT06-12SA-P012) is included.

Adding Electrical Options

⚠ WARNING

Follow the engine manufacturer's guidelines for use of these circuits. See your engine manufacturer to verify that the engine is programmed correctly for the intended applications. Failure to properly program the engine or wire these circuits could cause an accident.

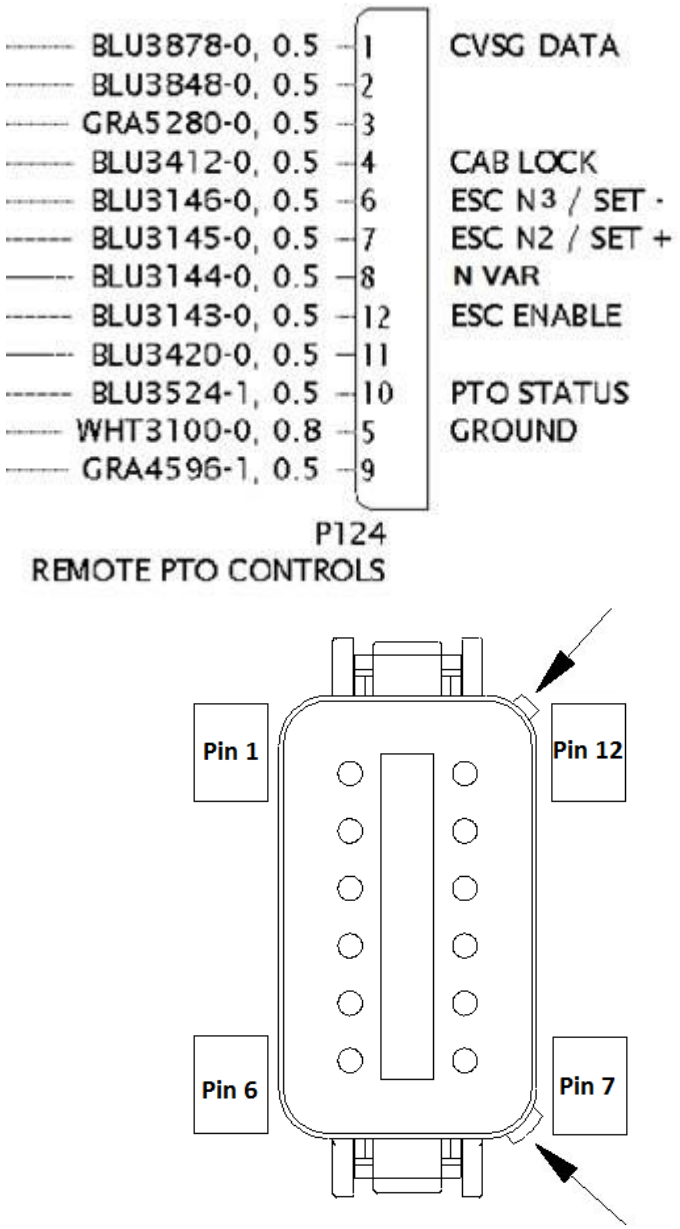
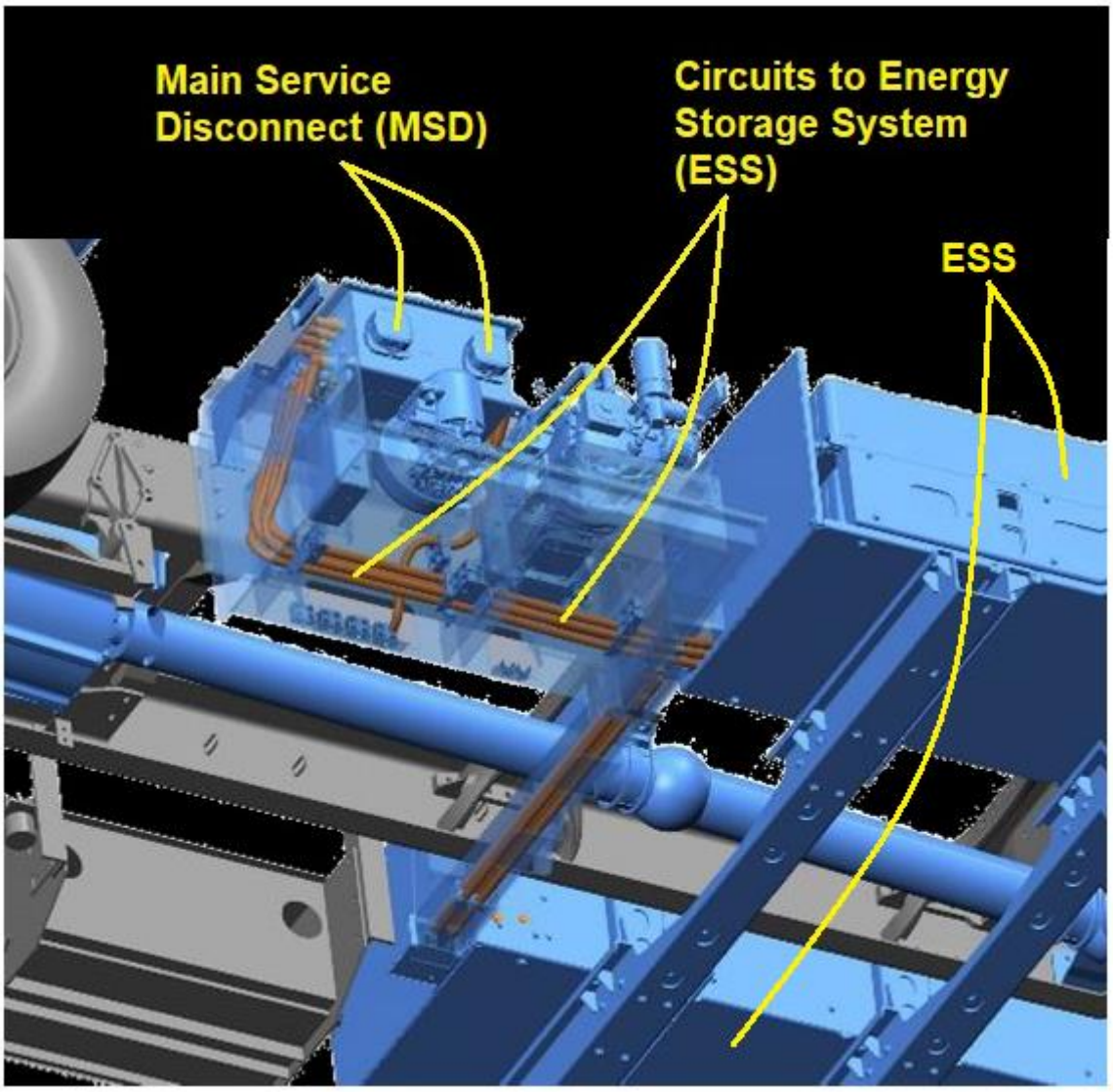


Figure 7-9 A 12-pin Deutsch connector and remote PTO Control

BEV Chiller Box

WARNING! Within the Chiller box is the Main Service Disconnect (MSD) and the circuits connecting to the Energy Storage System (ESS) which are the main propulsion batteries. These Circuits will be live with the high voltage of the ESS batteries even if the MSD modules are removed. To be fully de-energized, the fuses from the ESS battery packs must be removed on the left and right sides of the truck. A technician with Level 3 safety training is REQUIRED to remove fuses from ESS battery enclosures.



ePTO

ePTO Overview

The ePTO module on the K series BEV is an inverter that supplies fixed-frequency, 3-phase AC (Alternating Current) power Body builders will need to furnish their own harnesses, controls, and driven equipment. The unit is controlled by the VCU and is activated by providing a signal from the body builder to the VCU.

Inverter Part #: Sevcon HVLP-10

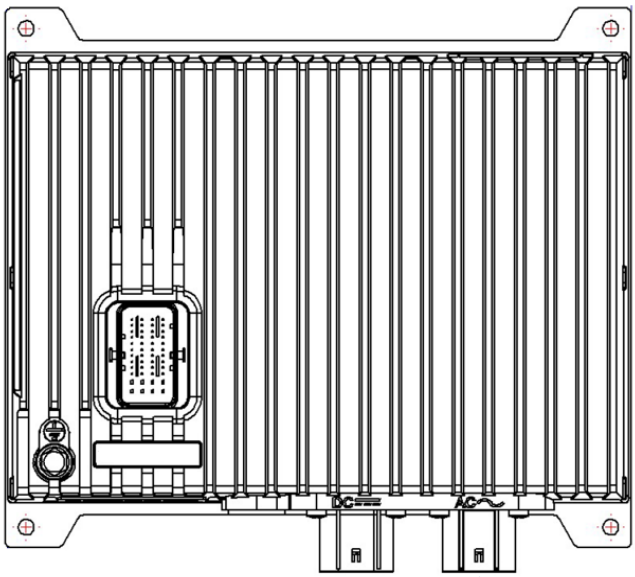
Characteristic	Value
Output Voltage	208 Vrms, 3-phrase, 60 Hz
Output Current - Peak	24 A (60 seconds)
Output Current – Continuous	19 A
Minimum Charge Level for ePTO Operation	10% Charge Level remaining
Ambient Operation Temperature	-30° to 45° C (no derate), -40° to 85° C (with derate)

Application Notes:

- **The output of the ePTO is not a sine wave output. Only use with inverter-rated equipment or with a sine wave filter.**
- All equipment connected to the inverter must be capable of safely handling 800VDC.
- The ePTO comes configured from the factory
  Caution! Do not attempt to reconfigure or reflash the ePTO unit. Reconfiguring the ePTO could result in equipment damage and failure of the body builder equipment.
- The body builder must ensure that their equipment operates within the above limits. If these limits are exceeded, the ePTO may shut down
- The ePTO will be disabled when Charge Level drops to less than 10% remaining
- The ePTO will drop from peak to continuous current rating automatically
- The ePTO will reduce output current automatically for temperature derating
- Because the output of the ePTO can be reduced or stopped without warning, **the ePTO should not be used for systems which do not contain built in safety mechanisms independent of supplied power.**
- The following interlock conditions will prevent the ePTO from starting or stop the output if the ePTO is already running. No other interlocks are present to prevent ePTO operation.
  - The high voltage system is disabled
  - The battery Charge Level is below 10% remaining

High Voltage Wiring

The ePTO uses TE HVA-280 series connections for its output. This connector is shown in the image below.



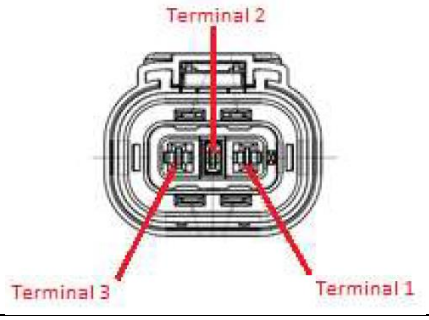
ePTO Output Connector

The body builder is responsible for supplind the mating connector and cable. The information below is provided for guidance only and is based on TE application specification 114-32056.

HV (High Voltage) Connector Information

Connector Series	TE HVA 280
Connector Keying	A
Contact Positions	3
Reference Part Number	TE 21033090-1
Reference Cable Specification	Cable Supplier: COROPLAST Cable Construction: 3x 2.5 mm^2 Supplier PN: 9-2641

The pinout for the ePTO output connector is shown below and the pinout is described in the following table:



Terminal	Description
1	L1
2	L2
3	L3

Figure 35 pinout for the ePTO output connector

Installation Notes:
Uses shielded power cables
Ensure that minimum bend radius specifications are complied with for HV cables (typ. 5x cable diameter)
Ensure cables are clipped/retained within 200 mm (about 7.87 in) of the connector
Try to ensre that cables do not flex relative to the connector, as this may lead to failure
Low Voltage Wiring
The body builder connector for the ePTO is located on the bottom of the cradle, near the ePTO. This connector is only present on vehicles equipped with an ePTO. The connector is a 4-pin Deutsch connector. The body builder is required to provide the mating connector and harness.

Connector	Connector Number	Supplier Part Number
Harness Connector	C23	Deutsch DT04-4P-C017
Mating Connector	N/A	Deutsch DT06-4S or equivalent

Table 9 The ePTO connector pinout is described in the table below:

Pin	Harness Color	Name	Voltage	Description
Pin 1	Yellow	*ePTO_IGN_FOR_BB*	12 V	Indicates that the ePTO is ready to be enabled
Pin 2	Grey	*ePTO_REQ_FROM_BB*	12 V	Request from body builder to enable ePTO
Pin 3	Grey	*ePTO_ALLOWED_BB*	12 V	Not Used

Pin 4	N/A	N/A	N/A	Not Used

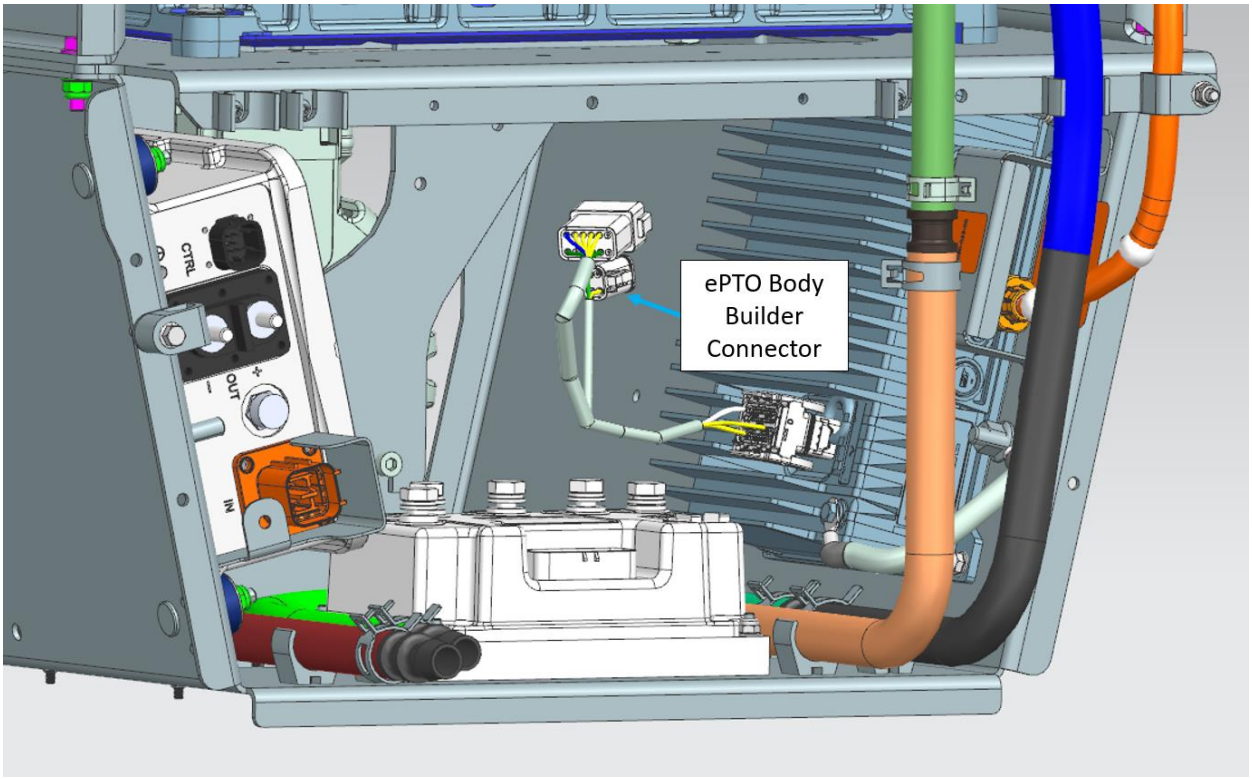


Figure 36 ePTO Operation

The diagram below shows the integration of the ePTO with the body builder equipment and the vehicle systems.

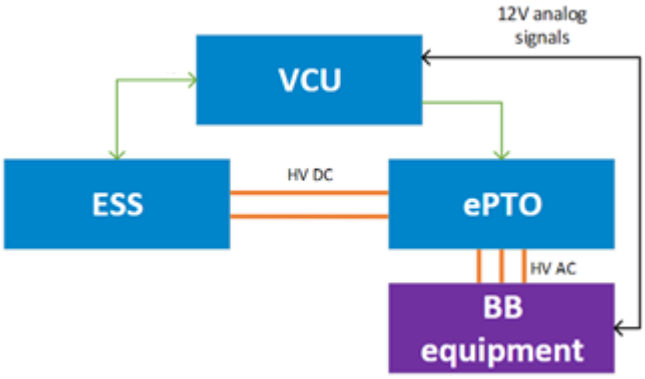


Figure 37 Systems Diagram for ePTO

As shown in the diagram, the vehicle controller unit (VCU) controls the ePTO and the supply of energy from the Energy Storage System (ESS). The body builder (BB) activates the ePTO by providing a signal to the VCU. The sequence for activating the ePTO is as follows:

1. The vehicle is requested to enter drive mode (key in start) or charge mode (by inserting the charge plug)

2. The VCU executes the pre-charge sequence and the HV power is enabled
3. When the ePTO is ready to be enabled, the VCU sets the pin *ePTO_IGN_FOR_BB* to high (+12 V). This happens when the following conditions are met:
4. The high voltage system is enabled
5. The Charge Level is above minimum threshold (10% remaining)
6. To enable the ePTO, the body builder sets the pin *ePTO_REQ_FROM_BB* high (+12 V)

Once the ePTO is enabled, the VCU controls the output of the ePTO. If the Charge Level threshold is reached or the HV system

INTRODUCTION

This section specifies the general requirements for securing hoses and electrical wires to present an orderly appearance, facilitate inspection and maintenance, and prevent potential damage to these lines.

DEFINITIONS

Bundle: Two or more air, electrical, fuel, or other lines tied together to form a unitized assembly.
Clamp: A cushioned rigid or semi-rigid, anti-chafing device for containing the bundle and securing it to the frame or other structural support. Standard clamps have a black elastomer lining. High temperature clamps (e.g., those used with compressor discharge hose) have a white or red elastomer lining (most applications for these are called out in the bills of material). An assembly of two clamps fastened together to separate components is referred to as a "butterfly" clamp.

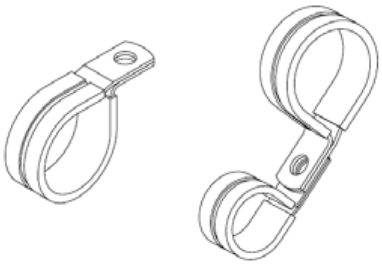


Figure 38 Clamp and Butterfly Clamp

NOTE:

The metal portion of clamps shall be stainless steel or otherwise made capable, through plating or other means, of passing a 200-hour salt spray test per ASTM B117 without rusting.

Butterfly Tie: A tough plastic (nylon or equivalent) locking dual clamp tie strap used to separate bundles or single lines, hoses, etc. These straps must be UV stable. (Tyton DCT11)

Figure 39 Butterfly Tie

Tie Strap: A tough plastic (nylon, or equivalent) locking strap used to tie the lines in a bundle together between clamps or to otherwise secure hoses and wires as noted below. Straps must be UV stable.

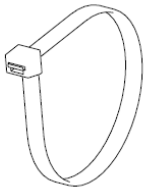


Figure 40 Tie Strap

Button Tie Strap: A tough plastic (nylon, or equivalent) locking strap used to secure lines to the frame or other structural support. Straps must be UV stable.

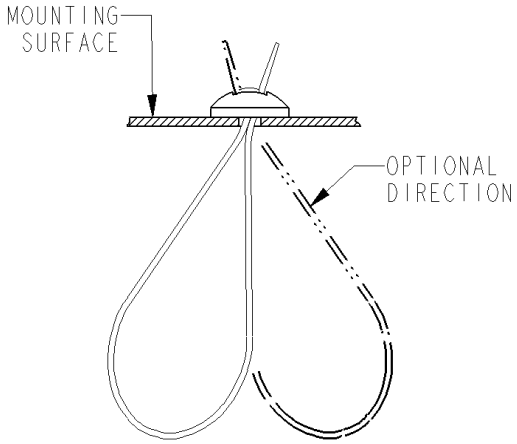


Figure 41 Button Tie Mount

Fir Tree Mount: A tough plastic mount, inserted into a bracket or other intended support structure, used for securing routed bundles via a tie strap. Mounts must be UV stable.

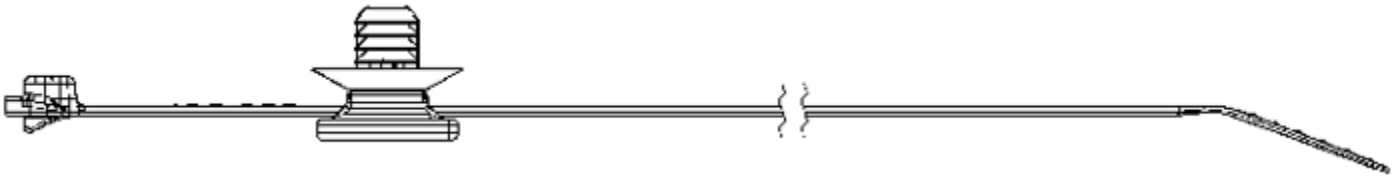


Figure 42 Fir Tree Mount

Heavy Duty (HD) Mount: A black rigid device used for securing a tie strap to the frame or other structural support. Mounts are made of impact modified, heat stabilized UV resistant nylon capable of continuous operation between temperatures 220°F (150°) and -40°F (-40°).

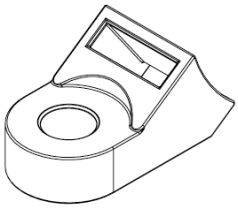


Figure 43 Heavy Duty (HD) Mount

NOTE: Heavy duty tie straps 0.50in (12.7mm) wide (Tyton T255ROHIR or similar) shall be used whenever HD mounts are specified, although 0.25in (6.4mm) tie straps may be used in some specified applications.

Excess of material: More than 3 inches of slack for every 18-inch section of hose routing, except for air conditioner hoses.
Shortness of material: Less than 1 inch of slack on an 18-inch section of hose routing.

ROUTING REQUIREMENTS

Electrical Wiring

- Electrical ground wire terminals must be securely attached, and the complete terminal surface must contact a clean bare metal surface. See R414-558 for grounding wire connection practice. Apply electrical contact corrosion inhibitor Nyogel 759G grease (made by William F. Nye, Inc., New Bedford, MA) per R414-558.
- Do not bend wires or use tie straps within 75 mm (3 inches) of (connected) wire connectors or plugs.
- Electrical wiring must be routed so that other components do not interfere with it
- Electrical wiring must be routed away from moving components so that at least 13.0 mm (0.5 in.) of clearance exists when the component is in operation and at maximum limits of the component's travel
- Electrical wiring must be protected in the locations where they are routed
- Electrical wiring must be routed to avoid heat sources
- Electrical wiring must be secured to a crossmember when going from one frame rail to the other
- When crossing other components, electrical wiring must have a covering of convoluted tubing, PSA tape, or must be separated from the component with a standoff or butterfly clamp
- Electrical wiring must not be routed directly over a sharp edge unless separated from the edge by a clip, standoff bracket, or similar spacing feature that prevents any risk of chafing or cutting
- Alternatively, the installation of windlace applied to the edge along with PSA tape or convoluted tubing on the harness is acceptable
- Electrical wiring must be routed in a way that will not place strain on connectors.

WIRES IN BUNDLES

Electrical wires (other than the exceptions covered below) running parallel with air or coolant hose bundles, may be included in the bundle if they are isolated from the hoses with a covering of convoluted plastic tubing.

EXCEPTIONS:

Battery cables (including jump start cables) may be bundled with or tied to the charging wire harness. They shall not be bundled with or tied directly to any other components, including hoses, wires, or bundles. They shall be separated from other routed components using butterfly ties at intervals not exceeding 18 inches (356 mm). Battery strap (W84-1000) tie down shall be used without exception to secure battery cables to frame mounted or other major component (e.g., engine, transmission, etc.) mounted standoffs at intervals not exceeding 18 inches (356 mm). The (positive) battery cable shall be covered with convoluted plastic tubing from terminal to terminal.

110/220-volt wires for engine heaters, oil pan heaters, transmission oil heaters and battery pad warmers, shall not be included in any hose/wire bundle with a fuel hose. Individual heater wires not in a bundle shall be separated from other components by using butterfly clamps or butterfly ties at intervals not exceeding 18 inches (356 mm). Heater wires with a secondary covering shall be covered with convoluted tubing whether they are in bundles or not.

WIRES CROSSING OTHER COMPONENTS

Electrical wires crossing over other components, such as lines, bolt heads, fittings, engine components lifting eyes, engine block, cylinder head, etc., close enough to rub shall be isolated with a covering of convoluted tubing and separated from the component by using butterfly clamps, butterfly ties, or plastic sheathing. 110/220-volt engine heater wiring shall be installed with butterfly ties or butterfly clamps

PIPING

Use no street elbows in air brake, water, fuel, or hydraulic systems unless specified on the piping diagram and the build instructions.

Use no elbows in the air brake system unless specified on the air piping diagram and the build instructions.

HOSES CROSSING COMPONENTS

Hoses crossing over other components close enough to rub shall be protected with a secured covering of convoluted plastic tubing (part number K344-813), another section of hose, or plastic sheathing (part number K213-1312). The usage of butterfly ties, or butterfly clamps are also recommended.

AIR COMPRESSOR DISCHARGE HOSES

Wires or hoses shall not be tied to the high temperature air compressor discharge hose. Hoses and wires may be routed across the air compressor discharge hose at a distance of 18 inches (457 mm) or greater from the compressor discharge port. In this case the crossing hoses and wires shall be "butterfly" clamped to the air compressor discharge hose and covered with convoluted tubing at the clamp point (use high temperature clamps on the compressor hose).

BUNDLES

HD mount and tie strap, or clamp shall be located at intervals not to exceed 18 inches (356 mm) along the bundle.

Regular tie straps shall be located at intervals not to exceed 7 inches (178 mm) between HD mount or clamps. Extra tie straps may be used as needed to contain the hoses and wires in the bundle.

ROUTING OF WIRES AND HOSES NEAR MOVING COMPONENTS

Wires and Hoses shall be routed away from moving components, such as fans, shackle links, drivelines, steering linkages, etc. so that there is at least 0.5 inches (12.7 mm) clearance when the component is operating at its maximum travel limits.

A minimum clearance of 1.0 inches (25.4 mm) shall be maintained between steering axle tires (and associated rotating parts) in all positions and routed components, such as hoses, oil lines, wires, pipes, etc.

ROUTING OF WIRES AND HOSES NEAR EXHAUST SYSTEM

Table 10 Exhaust – System Clearance

Description	Minimum Clearance Shielded	Minimum Clearance Unshielded
Coolant hoses (Silicone, colored)	1″	2″
HVAC hoses, tubing, and hard lines	5″	7″
Electrical wires	6″	8″
Fuel Hoses		
within 15″ of the turbo	N/A	4″
over 15″ from the turbo	2″	3″
Fuel Tanks and Hydraulic Tanks		
Crossing Tank	N/A	2″
Parallel to Tank	N/A	2″
End of Tank	N/A	1″
Aluminum/Ceramic-coated exhaust crossing tank	N/A	1.5″
Air Hose		
Nylon	3″	10″
Wire Braid	5″	7.5″

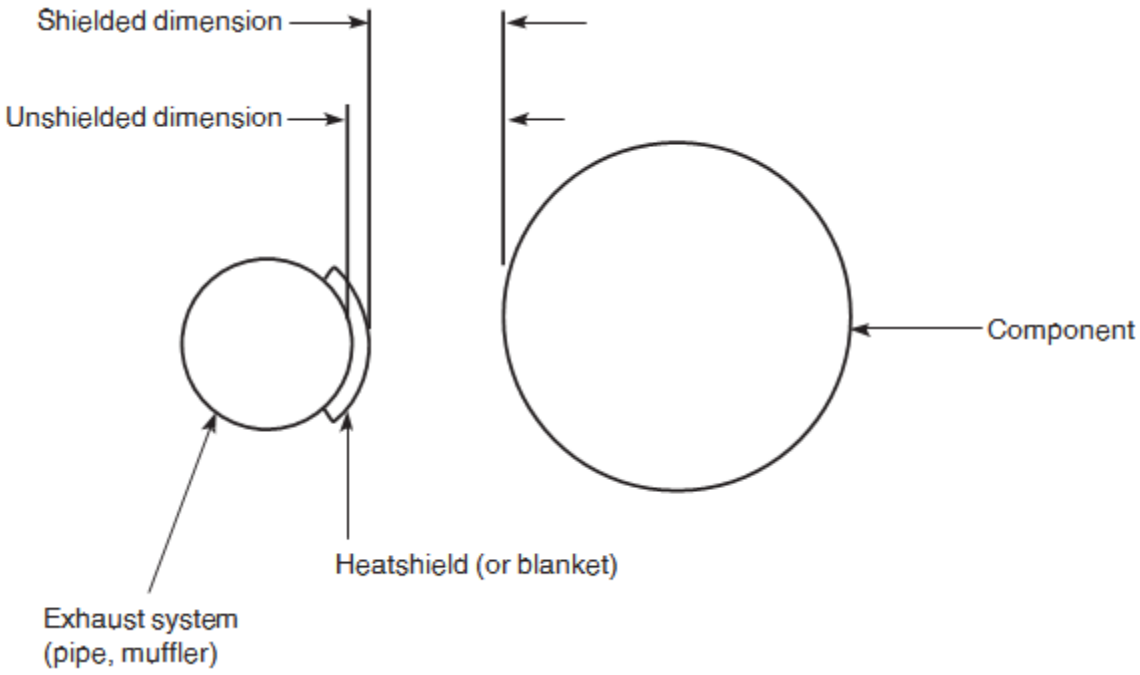
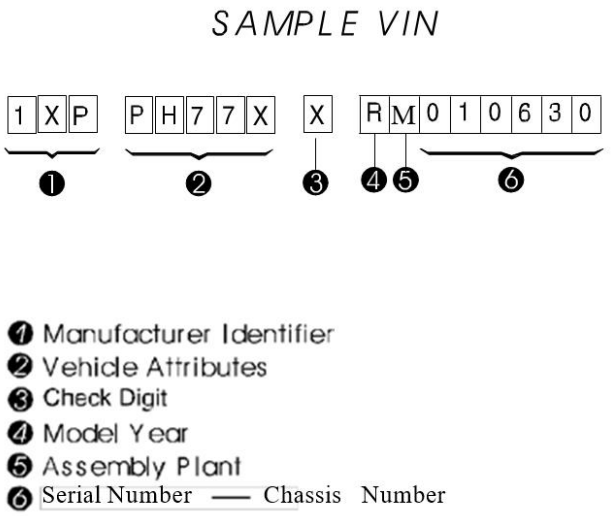


Figure 44 Definition of Measurement

Appendix

VEHICLE IDENTIFICATION NUMBER

A 17–character number (numeral and letter combination) forms the Vehicle Identification Number (VIN) which includes the Chassis Number. It contains, among other information, the model year (4), assembly plant (5), and vehicle serial number (6). See A 1 **Vehicle Identification Number (VIN).**



A 1 ***Vehicle Identification Number (VIN).***

The model year (4) is designated by an alphanumeric code in the tenth character position in the VIN. See Table 11 Model Year (Code) Designations and A 1 **Vehicle Identification Number (VIN).**

Table 11 Model Year (Code) Designations

Code	Year
C	2012
D	2013
E	2014
F	2015
G	2016
H	2017

Chassis Number Locations

The Chassis Number comprises the last six characters of the VIN.

- The K series chassis number is shown in multiple locations.
- Right frame rail, bottom flange (underside), about 4 to 4.5 ft. from the front end: stamped.
- Left frame rail, top of flange, about 4 to 4.5 feet from front end: stamped
- Tire, Rim, and Weight Rating Data label.
- Major Components and Weights label.
- Paint Identification label.

CERTIFICATION LABELS

The Major Components and Weights Label is located on either the driver's side door edge or on the door frame. See Figure A–2. It includes chassis weight and gross weight; plus, model and serial numbers for the vehicle, engine, transmission, and axles.

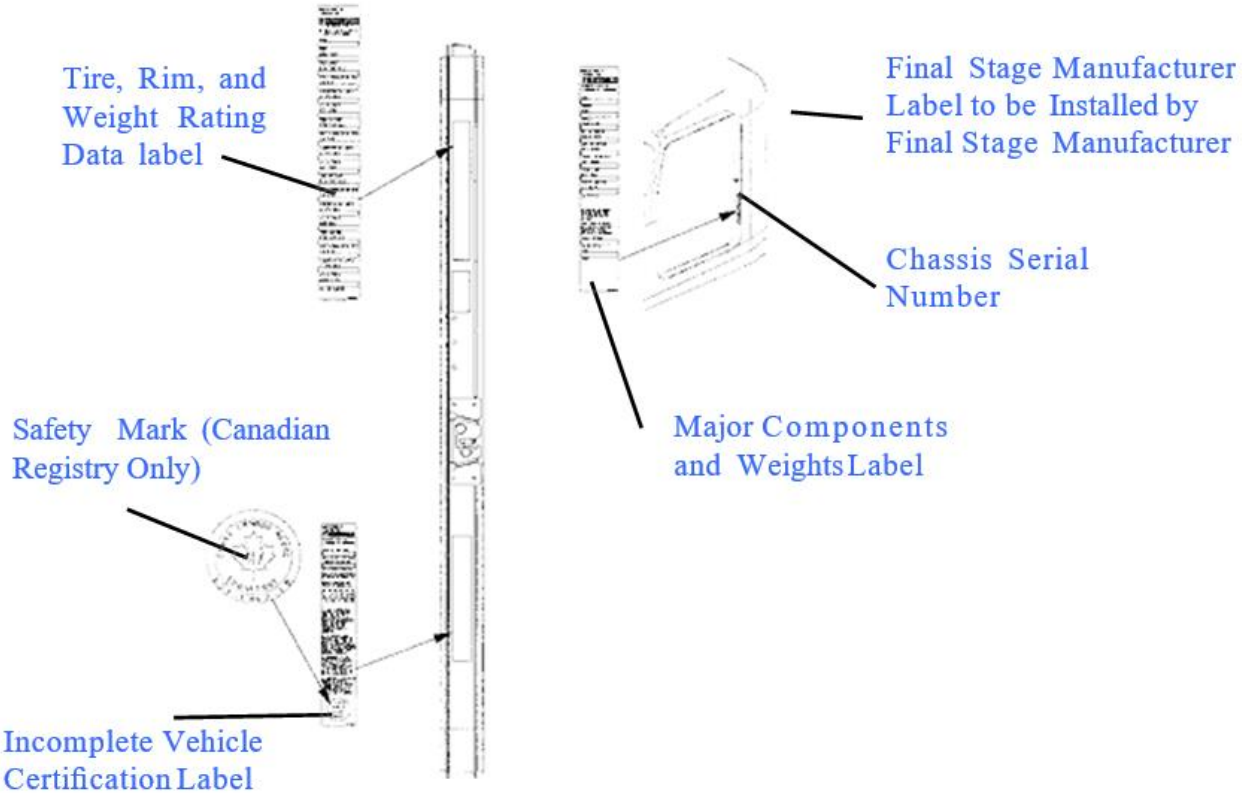


Figure 45 Drivers Door and Door Frame Label

Tire/Rim and Weight Rating Data Label

The Tire/Rim and Weight Rating Data Label is on the driver's side door edge, above the door latch. Figure 45 Drivers Door and Door Frame Label. It contains the following information:

- GVWR — Gross Vehicle Weight Rating
- GAWR FRONT and REAR — Gross Axle Weight Ratings for Front and Rear Axle
- TIRE/RIM SIZES AND INFLATION PRESSURES — Tire/Rim Sizes and Cold Pressure Minimums Chassis (Serial) Number

Note:	GVWR is the TOTAL WEIGHT the vehicle is designed to carry. This includes the weight of the empty vehicle, loading platform, occupants, fuel, and any load. Axle weight ratings are listed on the edge of the driver's door

Incomplete Vehicle Certification Label

The Incomplete Vehicle Certification Label is on the driver's side door edge below the latch. See Figure 45 Drivers Door and Door Frame Label. It contains the following information

- DATE OF MANUFACTURE
- VIN — Vehicle Identification Number
- LISTING OF APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS

Weight Distribution with body

INTRODUCTION

In the Medium Duty truck market, matching the wheelbase to the body specification is extremely important. Se- lection of the wrong wheelbase may lead to premature component failure, poor performance, and ultimately a dissatisfied customer. Before selecting the proper wheelbase, it is important to have a basic understanding of weight distribution.

Abbreviations

Throughout this section, abbreviations are used to describe certain features and requirements of the vehicle (see the list below). Review this list frequently so you know what the abbreviations mean.

AF	=	Frame rail overhang length – behind the rear axle
BL	=	Body Length
CA	=	Back of cab to centerline of rear axle

Note:	The K series CA figures are measured from the true back of cab to the centerline of the rear axle. To obtain a usable CA the body builder must subtract any required space behind the cab, which may be needed for other equipment.

There are two primary equations used in weight distribution calculations:

1. The first equation determines the portion of the load carried by the rear axle (Lr).
   a. $\mathrm{Lr} = \frac{CFf}{WB} * L$ Portion of Load Carried by the Rear Axle

2. The second determines the portion of the load carried by the front axle (Lf).
   $\mathrm{Lf} = L - \mathrm{Lr}$ Portion of Load Carried by the Rear Axle

Note:	For calculation purposes, the load (L) in these equations can be either actual revenue-producing load or other weight carried such as the van body or an optional fuel tank.

CG	Center of gravity: the balance point or center of a load. It is usually identified by a circle with alternating black and white quarters.
CGf	Distance from the centerline of the front axle to the center of gravity of the load (L). The load can be any load such as a fuel tank, a body, or the payload.
FA	Front Axle
GVWR	Gross Vehicle Weight Rating
L	Load: the weight that is carried. This could be the body, the payload or any item that has its weight distributed between the two axles
Lf	Portion of load (L) carried by front axle

Lr	Portion of load (L) carried by rear axle
RA	Rear Axle
WB	Wheelbase Length

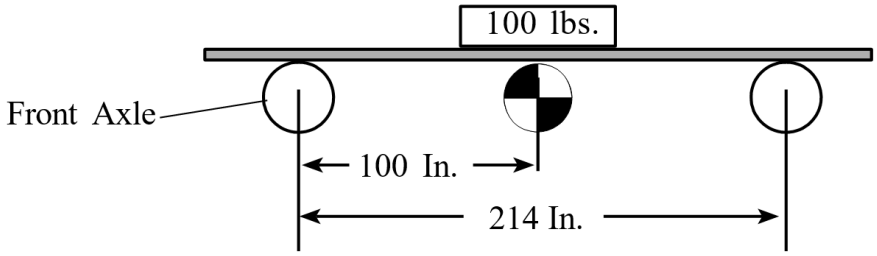


Figure 46 Balanced Load: CGf 100 in. from front axle

Figures B–1 and B–2 show a representation of a 214-inch (5435.6 mm) wheelbase (WB) truck designed to carry a 100–lb. (45.3–kg) load. Figure B–1 represents a truck with the load placed an equal distance between the two axles.

a. For our balanced load example, we need to establish the center of gravity location (CGf, as shown in Figure B–1) by dividing the wheelbase by 2:
   i. $CGf = \frac{214}{2} = 107\ in. (2717.8\ mm)$
b. Use equations 1 and 2 to determine the portions of the load carried by each axle.
   i. The weight distribution is calculated as illustrated below:
   $Lr = CGfWB * L\ 107214 * (100) = 50$ lbs (23 kg)
   $Lf = L - Lr\ 100 - 50 = 50$ lbs (23 kg)

- Since the load is centered between both axles, 50 percent of the load is carried by each axle: i.e., 50 lb. (22.6 kg) is distributed to each axle.

In Figure B–2, the load (L) is located 133 in. (3378 mm) from the front axle. Moving the load towards the rear axle changes the weight distribution. Use equations 1 and 2 to determine the portion of the load carried by each axle.

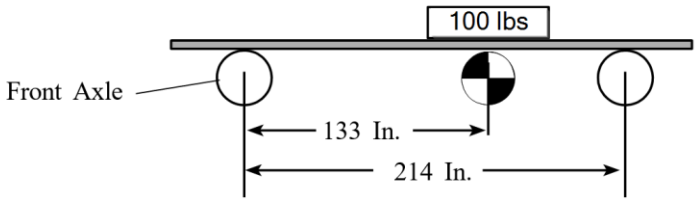


Figure 47 Unbalanced Load: CGf 133 In. From Front Axle

$$CGf = 133 \text{ in. } (3378 \text{ mm})$$

$$Lr = \frac{CGf}{WB} \times L \quad \left| \quad \frac{133}{214} (100) = 62.14 \text{ lbs. } (28.18 \text{ kg}) \right.$$

$$Lf = L - Lr \quad \left| \quad 100 - 62.14 = 38.86 \text{ lbs. } (17.6 \text{ kg}) \right.$$

- The rear axle now carries a greater proportion of the load than the front axle.

Although it is usually not important to know the CG of the chassis; it is important to know the CG location of truck bodies, accessories, or loads that may be placed on the chassis. This example shows that the location of the CG of an object relative to the front and rear axles (FA and RA) affects the load carried by each axle.

For most relatively uniform objects such as van bodies and fuel tanks, the CG is close to the object's midpoint. For non–uniform objects such as liftgates and refrigeration units, obtain the CG from the equipment manufacturer.

Revision Log

1/16/2023	Creation Date	Sales and Applications	RP

Table of Figures

Table of Tables