KENWORTH HEAVY DUTY BODY BUILDER MANUAL

2022

T880 T680

W990









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Kenworth Heavy Duty 2.1m Cab Body Builder Manual



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SECTION 1 - INTRODUCTION

01/2022



This manual was created to provide body builders with appropriate information and guidelines useful for the body planning and installation process.

This manual contains appropriate dimensional information, guidelines for mounting bodies and modifying frames, electrical wiring information, and other information beneficial in the body installation process. This manual is specific to chassis with 2021 EPA emissions engines.

The Body Builder Manual can be very 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 provide valuable information that can reduce the end cost of the body installation.

In the interest of continuing product development, Kenworth reserves the right to change specifications or products at any time without prior notice. It is the responsibility of the user to ensure that they are utilizing the latest released information. Check Kenworth.com for the latest version.

If you require additional information or reference materials, please contact your local Kenworth dealer.

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SAFETY SIGNALS

We've 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 don't ignore any of these alerts.

WARNINGS, CAUTIONS, and NOTES



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 don't heed the warning, and how to avoid it.

Example:
WARNING! Be sure to use a circuit breaker designed to meet liftgate amperage requirements. An incorrectly 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 box and fuel tank fill neck.

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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 A for additional information.

INCOMPLETE VEHCILE CERTIFICAITON

An Incomplete Vehicle Document is shipped with the vehicle, certifying that the vehicle is not complete. See Figure 2–1. 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 A "VEHICLE IDENTIFICATION.

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.



FIGURE 2-1. Incomplete Vehicle Certification Document

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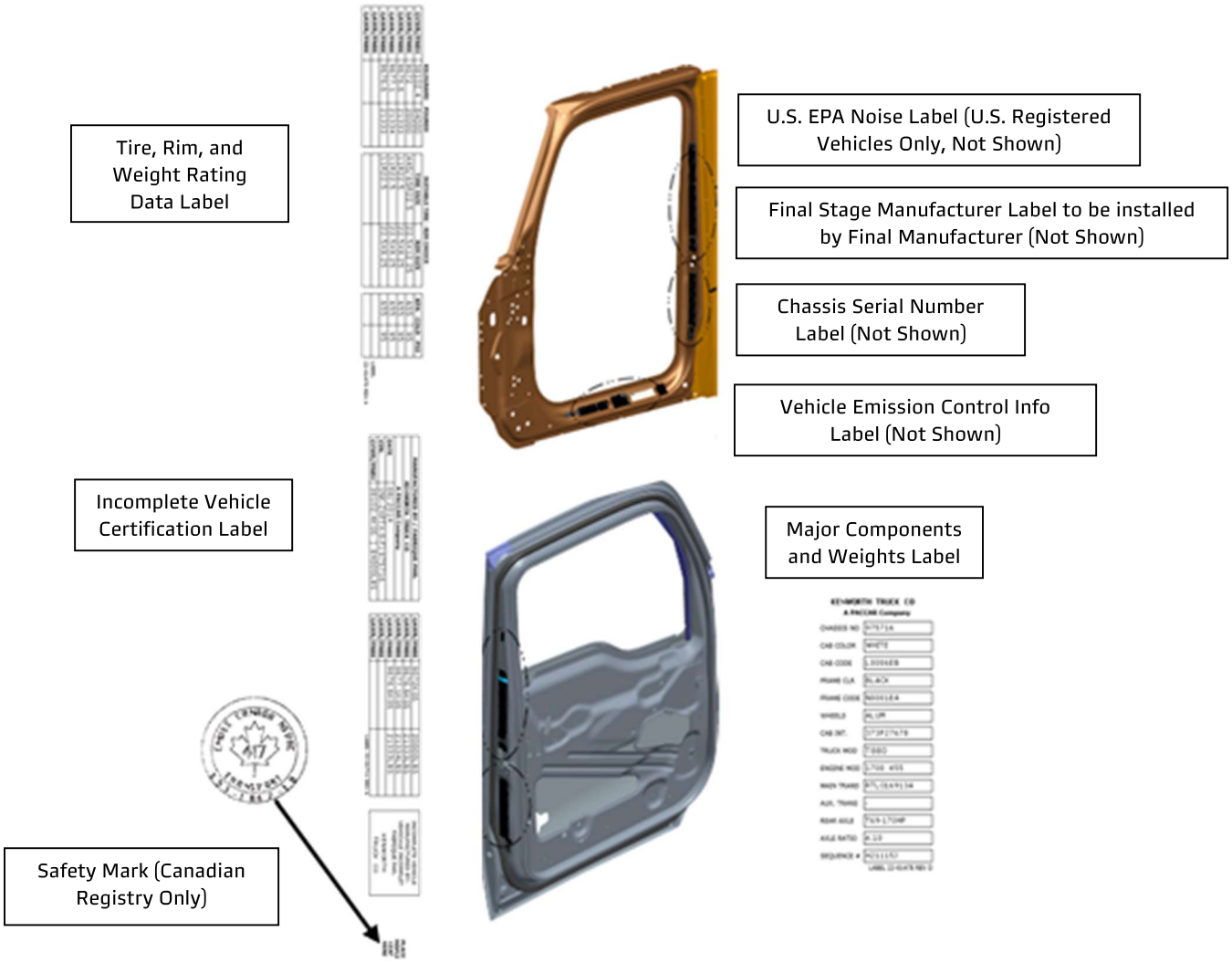


FIGURE 2-2 Locations of Certification Labels - Driver's Door and Frame

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 2–2.)

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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:

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 K1A 0N5 (613) 990-2309
TTY: 1-888-675-6863

NOISE AND EMISSIONS REQUIREMENTS

NOTE

This truck may be equipped with specific emissions control components/systems to meet applicable Federal and California noise and exhaust emissions requirements. Tampering with these emissions control components/systems is against the rules that are established by the U.S. Code of Federal Regulations, Environment Canada Regulations and California Air Resources Board (CARB). These emissions control components/systems may only be replaced with original equipment parts.

Additionally, most vehicles in North America will be equipped with a Greenhouse Gas (GHG) "Vehicle Emission Control Information" door label indicating its certified configuration. The vehicle components listed on this label are considered emission control devices.
Modifying (i.e. altering, substituting, relocating) any of the emissions control components/systems defined above will affect the noise and emissions performance/certification.

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Modifications that alter the overall shape and aerodynamic performance of a tractor will also affect the emission certification. If modifications are required, they must first be approved by the manufacturer. Unapproved modifications could negatively affect emissions performance/certification. There is no guarantee that proposed modifications will be approved.

Tires may be substituted provided the new tires possess a Coefficient of Rolling Resistance (CRR) equal to or lower than CRR of the original tires. Consult with your tire supplier(s) for appropriate replacement tires.

Contact the engine manufacturer for any requirements and restrictions prior to any modifications.

- For Cummins Engines, contact 1-800-DIESELS or you local Cummins distributor.
    - Reference AEB 21.102

It is possible to relocate the DEF tank, however the relocation requirements need to be followed. Any variances from the relocation requirements may cause the emissions control components/systems to operate improperly potentially resulting in engine de-rate.



NOTE

All 2021 engine emissions certified vehicles will be equipped with an On-Board Diagnostics (OBD) system. The OBD system is designed to detect malfunctions of any engine or vehicle component that may increase exhaust emissions or interfere with the proper performance of the OBD system itself.

The OBD system consists of a computer program on one or more of the vehicle's Electronic Control Units (ECUs). This program uses information from the control system and from additional sensors to detect malfunctions. When a malfunction is detected, information is stored in the ECU(s) for diagnostic purposes. A Malfunction Indicator Light (MIL) is illuminated in the dash to alert the driver of the need for service of an emission-related component or system.

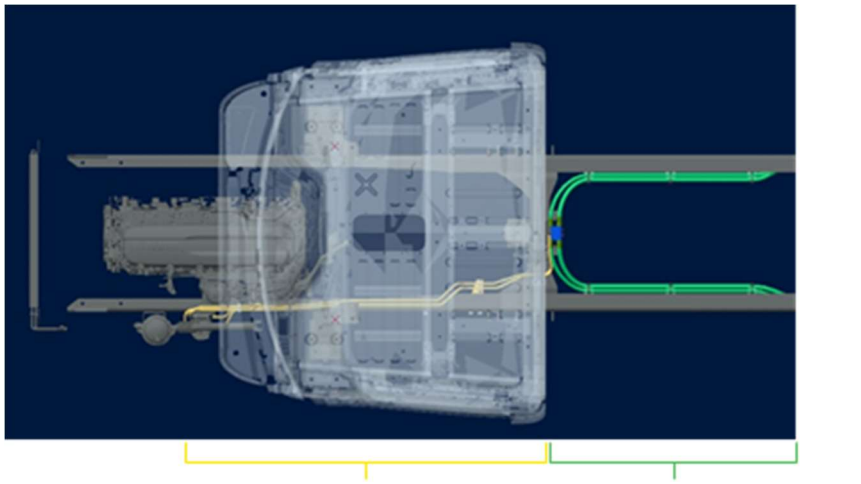
To ensure compliance to emissions regulations, the final configuration of certain features of the completed vehicle must meet specific requirements. This section describes requirements relevant for only the most common or critical modifications done by body builders. For a complete description of acceptable modifications, see the application guidance available from the manufacturer of the engine installed in the chassis.

FUEL SYSTEM

The following are highlights of some of the more common or critical aspects of this system.

The overall system restriction may not exceed the restriction limitations set forth by the engine manufacturer for both supply and return.

- Ensure that fuel lines are not pinched or can potentially be damaged when installed between body and frame
- Fuel lines must be routed and secured without dips or sags
- There must be easy access to filter(s) and fill cap
- The tank vent may not obstructed
- Added accessories (heaters, generators) cannot introduce air into system
- Fuel tank must be located so that the full level is not above cylinder head
- "Ultra Low Sulfur Fuel Only" labels must be present on the dash and fuel fill
- Modification of the pressure side secondary filter and plumbing is not allowed without engine manufacturer approval
- Body installation of fuel tank or routing of lines must not cause significant increase in fuel temperature
- Fuel hoses shall meet or exceed OEM supplied hose material construction specifications
- Formed nylon fuel lines with quick-connects are installed underneath the cab and hood along the frame rail. Behind the cab from the fuel tee to tanks are wirebraid-reinforced rubber lines. Supply and return fittings are poka-yoked to prevent incorrect assembly.



Nylon Wirebraid-Reinforced Rubber

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PARTS

Replacement nylon fuel line assemblies are available based on individual chassis and fuel system hardware. For other chassis changes, individual parts are listed below.

Table 2-1. Fuel System Parts

DESCRIPTION	USE	PART NO.
Supply Tee – All ports open	Dual LH and RH fuel tanks	K38-1057
Supply Tee – RH port closed	Only LH fuel tank(s)	K38-1058
Supply Tee – LH port closed	Only RH fuel tank(s)	K38-1059
Return Tee – All ports open	Dual LH and RH fuel tanks	K38-1060
Return Tee – RH port closed	Only LH fuel tank(s)	K38-1061
Return Tee – LH port closed	Only RH fuel tank(s)	K38-1062
Supply Fitting – Straight	Nylon line assemblies	K38-1069-001
Supply Fitting – 90˚	Nylon line assemblies	K38-1069-002
Return Fitting – Straight	Nylon line assemblies	K38-1069-003
Return Fitting – 90˚	Nylon line assemblies	K38-1069-004
Supply Union	Short-term repair, 12mm ID	K38-1069-010
Return Union	Short-term repair, 10mm ID	K38-1069-009
Supply Rubber Line Assembly	Fuel tee to fuel tank lines, xxx in inches	V50-14860082111xxx
Return Rubber Line Assembly	Fuel tee to fuel tank lines, xxx in inches	V50-14860063111xxx
Supply Steel Fitting – Straight	Rubber line assemblies, 1/2” barb	K38-1069-007
Return Steel Fitting – Straight	Rubber line assemblies, 3/8” barb	K38-1069-008
Retaining Clip	Collar on steel rubber hose fittings	K38-1069-015
Bulk Supply Nylon Line	Short-term repair, 12mm ID, xxxx in mm	V50-1178-1xxxx
Bulk Return Nylon Line	Short-term repair, 10mm ID, xxxx in mm	V50-1178-2xxxx
Supply APU Fitting	Additional fuel-powered unit, install in-line at tee	K38-1055
Return APU Fitting	Additional fuel-powered unit, install in-line at tee	K38-1056

Compressed Air System

The following are highlights of some of the more common or critical aspects of this system.

- Air system modification must meet applicable FMVSS regulations
- Compressed Air tank may not be modified (exception – addition or removal of fittings or relocation of the tank)
- Added devices or bodywork may not interfere with or rub air lines
- Air supply to the engine doser may not be restricted or disconnected
- Air lines should be routed, protected from heat, and properly secured to prevent damage from other components
- Care should be taken so that air lines do not rub against other components
- Care should be taken to protect the air system from heat sources.

Exhaust and Exhaust After-Treatment System

The following are highlights of some of the more common or critical aspects of this system.

- The following after-treatment and exhaust system components may not be modified:
- DPF assembly
- SCR Catalyst assembly
- Exhaust pipes between the engine and after-treatment devices (DPF, SCR Catalyst) and between after-treatment devices
- NOx Sensors
- PM Sensor
- The following modifications may only be done within the guidelines of the "DEF System Relocation Guide."
- Modifications to Diesel Exhaust Fluid (DEF) throttle, suction, or pressure lines
- Modification or relocation of the DEF tank
- Modification of coolant lines to and from the DEF tank
- All DEF and coolant lines should be routed, protected, and properly secured to prevent damage during vehicle operation or other components
- If relocation of the DCU or ACM is necessary, use existing frame brackets and mount inside of frame flanges where necessary. Do not extend the harnesses
- The DPF, the SCR catalyst, or their mounting may not be modified
- The NOx sensor may not be relocated or altered in any way; this includes re-clocking the after-treatment canister or reorienting the sensor(s)
- Exhaust pipes used for tailpipes/stacks must be properly sized, and must prevent water from entering
- Ensure adequate clearance between the exhaust and body panels, hoses, and wire harnesses
- The body in the vicinity of the DPF must be able to withstand temperatures up to 400°C (750°F)
- Do not add thermal insulation to the external surface of the DPF

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- The SCR water drain hole may not be blocked
- Allow adequate clearance (25mm (1 inch)) for servicing the DPF sensors, wiring, and clamped joints
- Drainage may not come in contact with the DPF, SCR catalyst, sensors or wiring
- Allow sufficient clearance for removing sensors from DPF. Thermistors require four inches. Other sensors require one inch
- Wiring should be routed, protected from heat, and properly secured to prevent damage from other components
- The exhaust system from an auxiliary power unit (APU) must not be connected to any part of the vehicle after-treatment system or vehicle tail pipe.

Cooling System

- The following are highlights of some of the more common or critical aspects of this system.
- Modifications to the design or locations of fill or vent lines, heater or defroster core, and surge tank are not recommended
- Additional accessories plumbed into the engine cooling system are not permitted, at the risk of voiding vehicle warranty
- Coolant level sensor tampering will void warranty

- When installing auxiliary equipment in front of the vehicle, or additional heat exchangers, ensure that adequate air flow is available to the vehicle cooling system. Refer to engine manufacturer application guide- lines for further detail
- When installing FEPTO drivelines, the lower radiator anti-recirculation seal must be retained with FEPTO driveline clearance modification only
- Changes made to cooling fan circuit and controls are not allowed, with the exception of AC minimum fan on time parameter
- See owner’s manual for appropriate winter front usage

Electrical System

The following are highlights of some of the more common or critical aspects of this system.

- Electrical harnesses providing battery power and electronic control signals to engine and emissions control/ vehicle OBD components including datalinks may not be spliced. These emissions control/vehicle OBD components include the following:
    - throttle pedal
    - vehicle speed sensor
    - after-treatment wiring
    - 9-pin OBD Connector
    - CAN Communication / OBD Diagnostic wiring (RP-1226)
- If the alternator or battery is substituted, it must meet the requirements of the engine manufacture's guide- lines. This includes alternator ground voltage drop and alternator ground cable effectiveness. See the engine manufacture's guidelines for recommended test procedure. Additionally, the maximum voltage differential and the peak-peak voltage differential between the engine ECM block ground stud and battery negative terminal may not exceed 500 mV under any combination of loads or operating conditions.
- Only an OBD compliant battery disconnect switch may be installed on vehicles equipped EPA 2013 and beyond compliant diesel engines. An OBD compliant switch and harness, even in the off position, supply a small amount of power to the engine controller and enable certain emissions critical functions (e.g. DEF line purge). Any modifications to the electrical system which interrupt this power supply will cause OBD fault codes and illumination of the MIL. In addition, such a modification will render the engine non-compliant with certain emission regulations. Generally, you can remove and replace a battery disconnect switch on a truck equipped with a battery disconnect switch at the factory. However, if a battery disconnect switch was not installed in the factory a significant harness modification is required before a battery disconnect switch can be added.
- Installation of aftermarket transfer-cases must address the vehicle speed sensor position. The standard position of the speed sensor is at the transmission tail shaft. When a transfer-case is added it is best to relocate the sensor to the axle side output shaft of the transfer-case. This is typically accomplished by adding a tone wheel into the driveline yoke assembly.
- Wiring extensions for the after-treatment wiring are available for relocating the DEF tank from your dealer via Paccar Parts. For relocation of DEF tank, refer to the after-treatment section of this manual.

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- The emission system requires an accurate Outside Air Temperature (OAT) reading to accurately operate control algorithms. The OAT sensor is in the driver's side mirror assembly on Kenworth trucks and is shown in the figures below. If the body builder needs to modify the mirror assembly in any way, it is important the OAT sensor stay positioned on the mirror assembly. Running the vehicle without the OAT sensor connected will cause the MIL lamp to illuminate. If needed, a replacement sensor can be ordered from your Kenworth dealer.

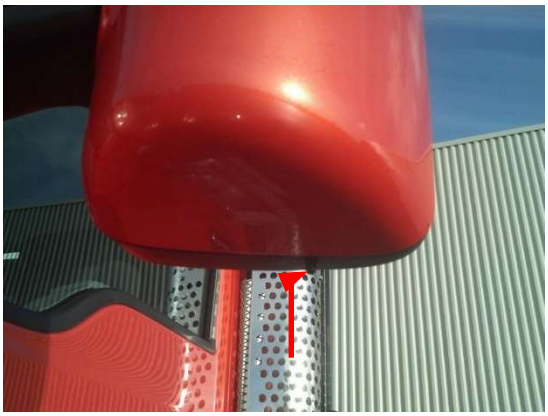


Figure 2-3 Aerodynamic Mirror OAT Sensor Location

- Coolant Sensor considerations are given in the Cooling section above
- The OBD/Diagnostic connector port is located below the dash to the left of the steering wheel. This connector and its location may not be changed.

- All vehicles equipped with EPA 2013 compliant diesel and bi-fueled engines must be equipped with a Malfunction Indicator Lamp (MIL) lamp. This lamp is required to be an engine outline symbol as defined by ISO (Inter- national Standards Organization). The figure below shows the instrument cluster and MIL lamp position. Note this lamp location is fixed with respect to the controls and its location may not be changed if you are updating the warning lamp cards.



Figure 2-4 Digital Dash (15in) for T680/T880/W990 (EPA 2021+)

- In addition to the sensors and lamps above, the emission system also depends on signals from the exhaust DPF (Diesel Particulate Filter), SCR (Selective Catalytic Reduction), and NOx sensor. Wiring between these devices, the Dosing Control Unit (DCU) and engine ECM should not be tampered with or altered in any way.

Air Intake System

The following are highlights of some of the more common or critical aspects of this system.

- The air intake screen may not be blocked, either fully or partially
- Modification to the air intake system may not restrict airflow. For example, pipe diameter may not be reduced
- All sensors must be retained in existing locations
- To retain system seal, proper clamp torque must be used. Refer to service manual for proper clamp torque

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Charge Air Cooler System

The following are highlights of some of the more common or critical aspects of this system.

- The Charge Air Cooler may not be modified
- The installation of engine overspeed shutdown devices must not introduce restriction in the intake system
- All plumbing associated with the charge air cooler may not be modified

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DIMENSIONS

This section has been designed to provide enough information to successfully layout chassis in the body planning process. Optional equipment may not be depicted. Please contact your local Kenworth dealer if more dimensional information is desired.

ABBREVIATIONS

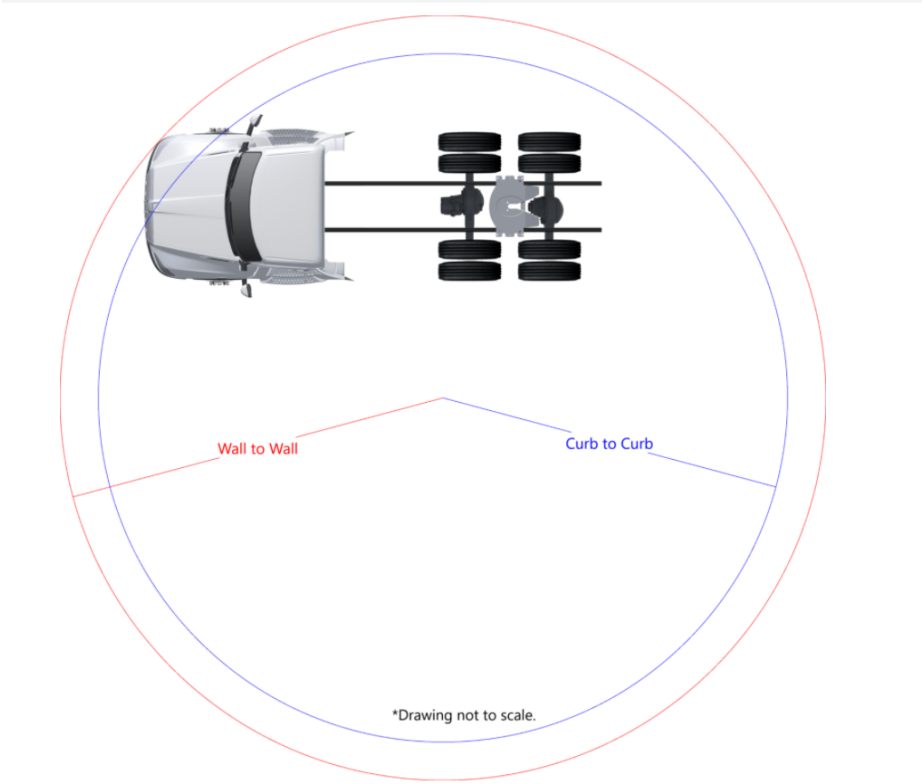
Throughout this section, and in other sections as well, abbreviations are used to describe certain characteristics on your vehicle. The chart below lists the abbreviated terms used.

TABLE 3-1. Abbreviations Used

CA	BACK OF CAB TO CENTERLINE OF REAR AXLE OR CENTERLINE OF TANDEMS ON TANDEM SUSPENSION
EOF	FRAME RAIL OVERHANG BEHIND REAR AXLE – MEASURED FROM THE CENTERLINE OF TANDEMS
FS	FRONT SUSPENSION HEIGHT
RS	REAR SUSPENSION HEIGHT
WB	WHEELBASE
SOC	SIDE OF CAB
BOC	BACK OF CAB

TURNING RADIUS

Approximate turning radius specifications are available through the PremierSpec tool. For custom turning radius calculations, please consult with your local dealer.



LEFT TURN RADIUS		RIGHT TURN RADIUS	
Curb to Curb	27.6	**Curb to Curb**	27.6
Wall to Wall	30.0	**Wall to Wall**	30.0

VEHICLE SUMMARY			
Truck	T680 Series Conventional / TRACTOR	**Wheelbase**	188
Axle	Meritor MFS12E PLUS 12.5K 3.5in. drop standard	**Weight**	14,974
Tire	Front Tires: Bridgestone BR R213 ECOPIA 295/75R22		
Wheel	Front Wheel: Accuride 51487 22.5x8.25 steel		

Figure 3-1 PremierSpec Turning Radius Analysis

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OVERALL DIMENSIONS

This section includes drawings and charts for the following Class 8 models: T680, T880, and W990 including 40in, 52in Mid Roof, 52in Flat Roof, 76in Mid Roof, and 76in High Roof sleepers.

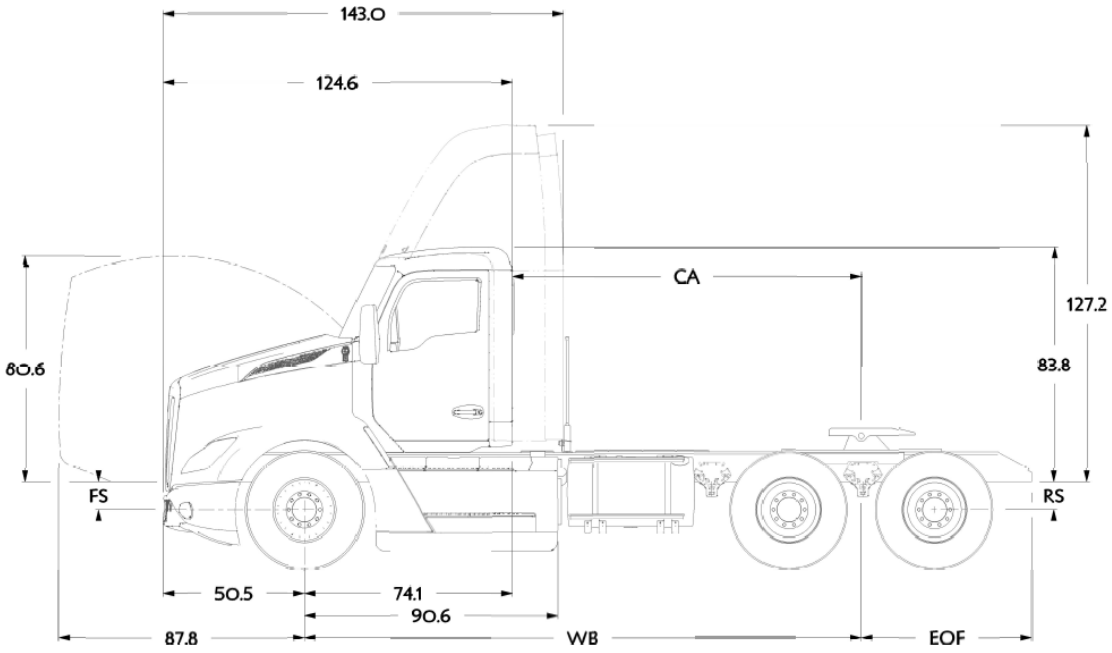
All dimensions are in inches (in). The drawings and dimensions illustrate important measurements critical to designing bodies of all types. See the “Contents” at the beginning of the manual to locate the drawing that you need.

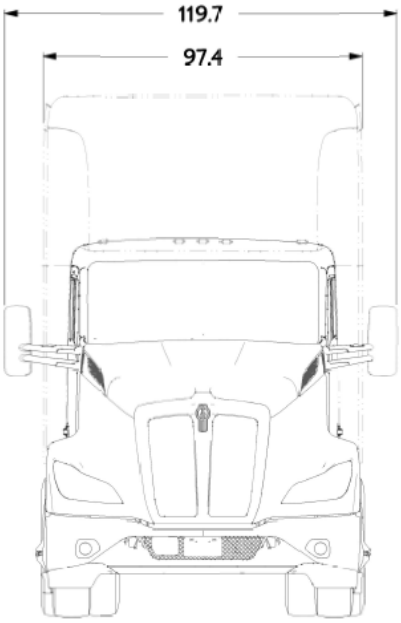
Note: To determine overall height please locate the chart Table 3-2 on page 3-12 and add that value to the height. All heights are given from the bottom of the frame rail.

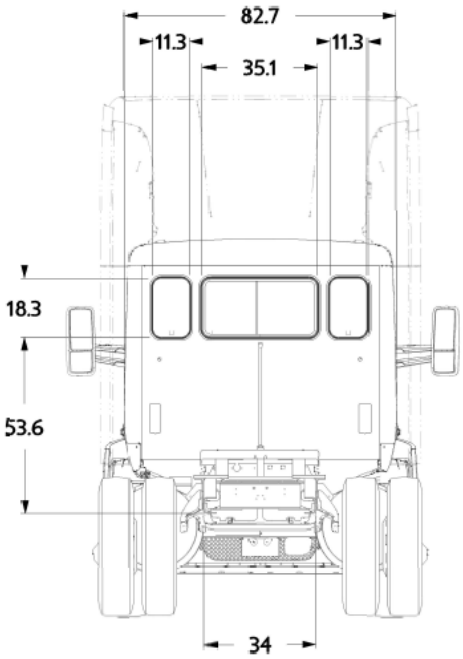
Kenworth also offers .dxf files and 3D frame layouts for chassis on order, four-six weeks prior to build. Please speak with your salesperson to request this feature when specifying your chassis.

T680 STANDARD HOOD DAYCAB

The following drawings are of a standard T680 Standard Hood Daycab, shown with standard chassis components.



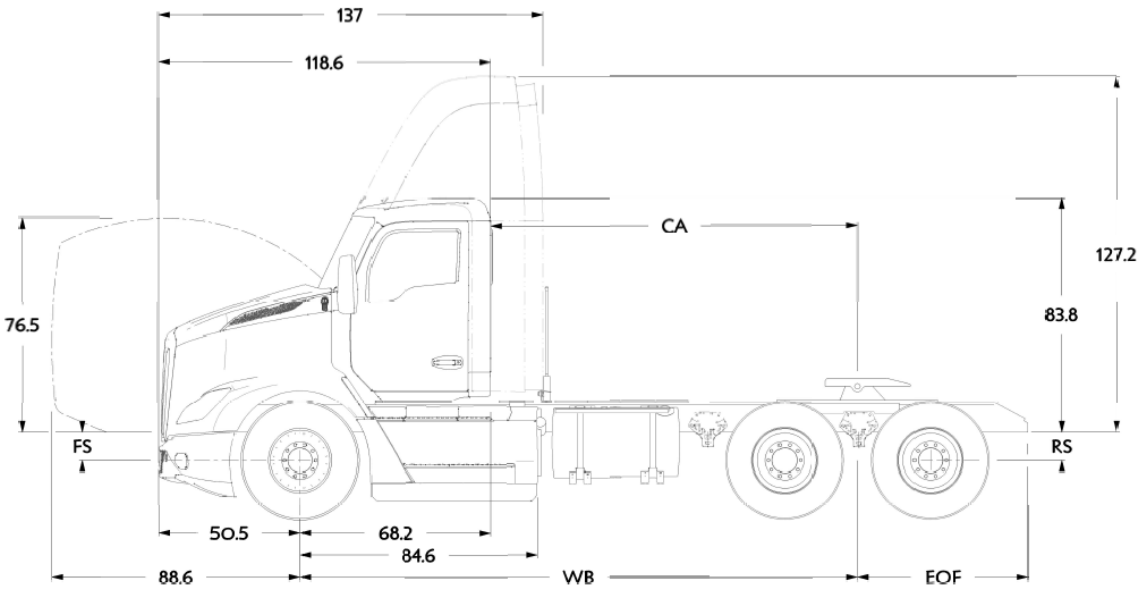


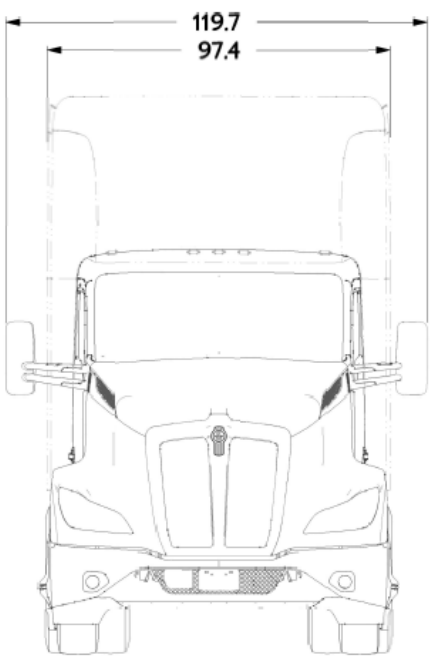


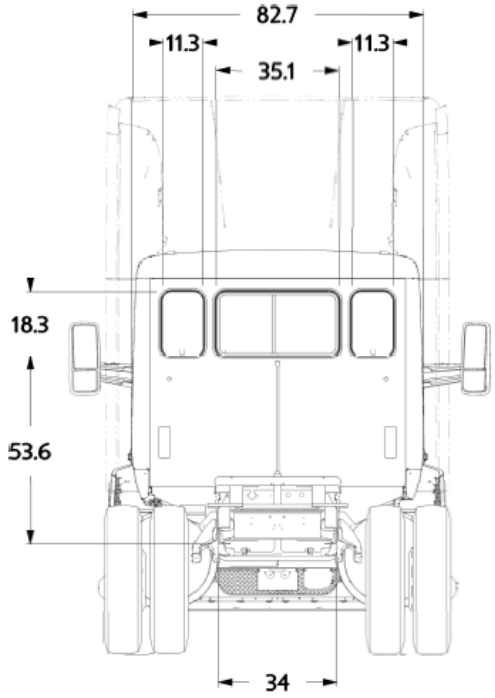
SECTION 3 - DIMENSIONS

T680 MX OPTIMIZED HOOD DAYCAB

The following drawings are of a standard T680 MX Optimized Hood Daycab, shown with standard chassis components.



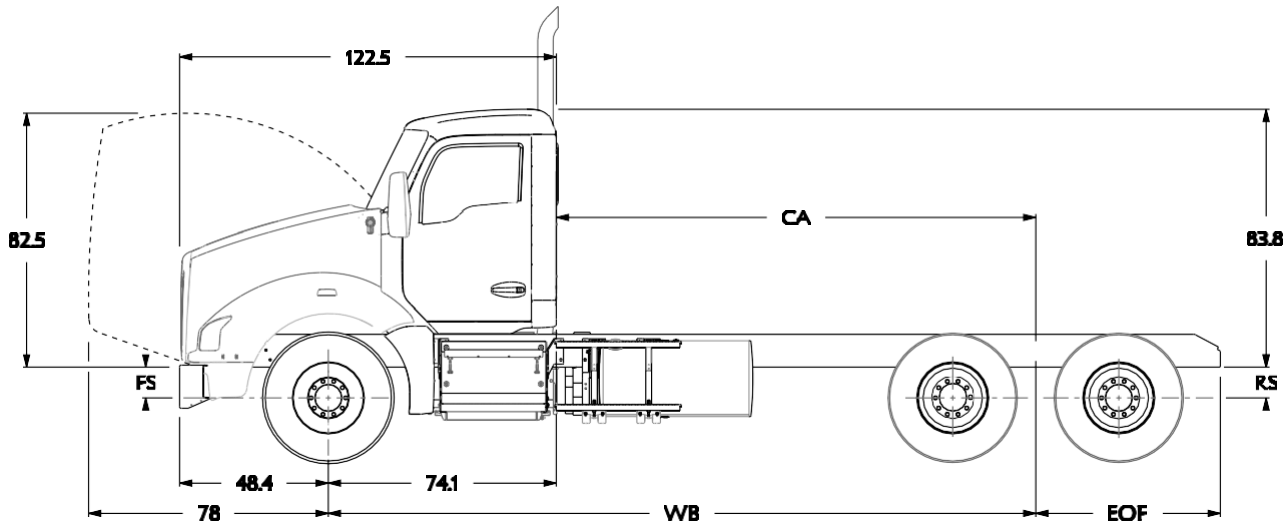


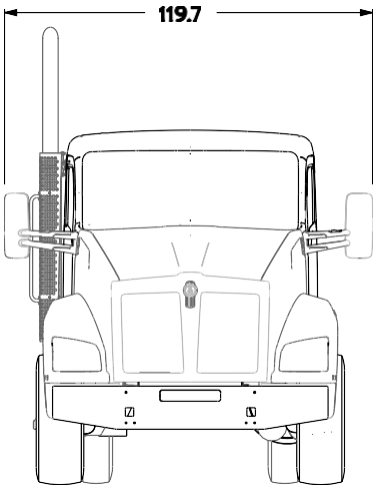


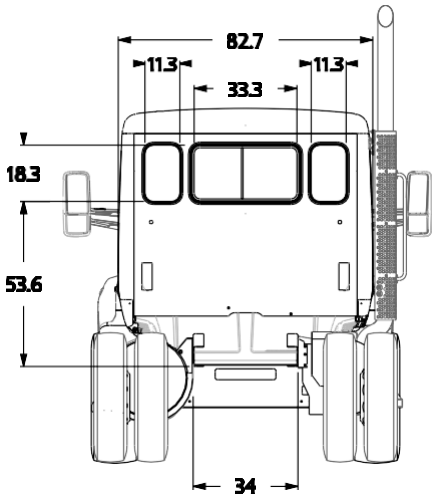
SECTION 3 - DIMENSIONS 01/2022

T880 STANDARD HOOD DAYCAB

The following drawings are of a standard T880 Standard Hood Daycab, shown with standard chassis components.

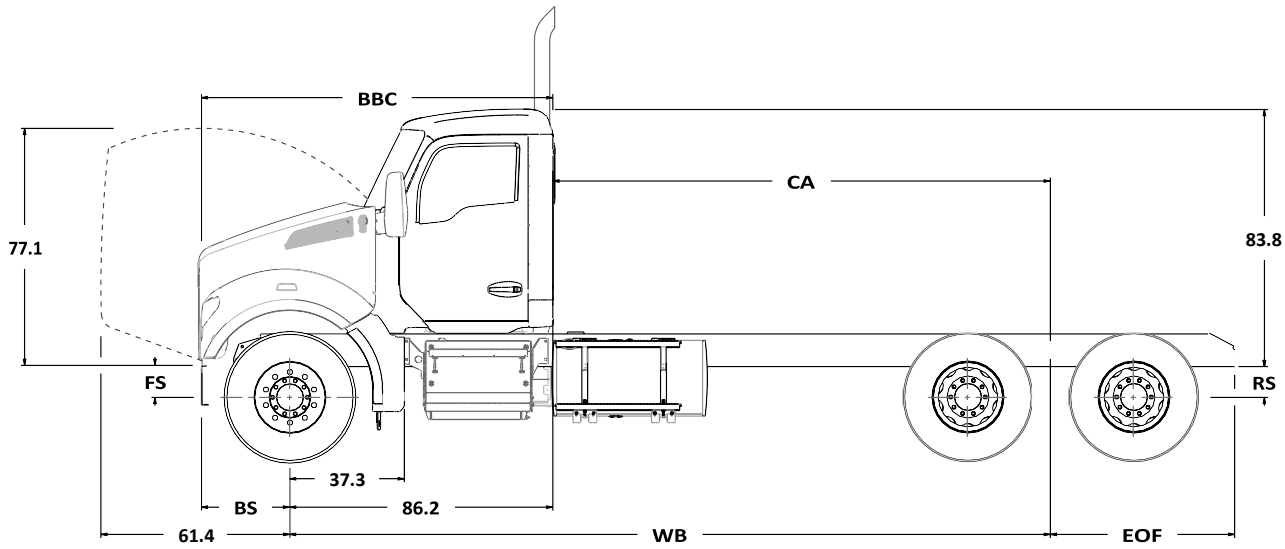


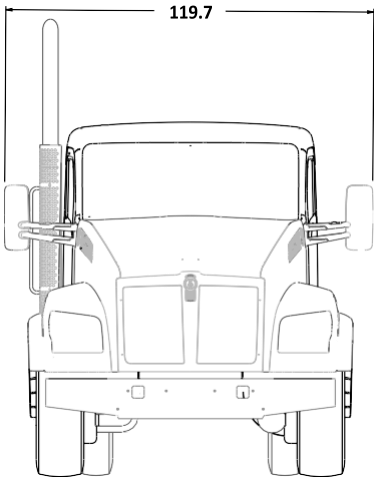


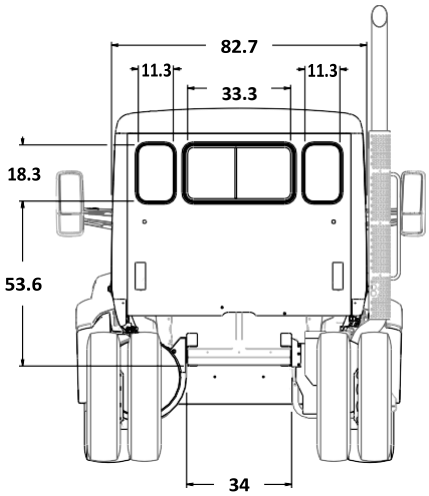


T880S (SFFA) MX-OPTIMIZED HOOD DAYCAB

The following drawings are of a standard T880S (SFFA) MX-Optimized Hood Daycab, shown with standard chassis components.



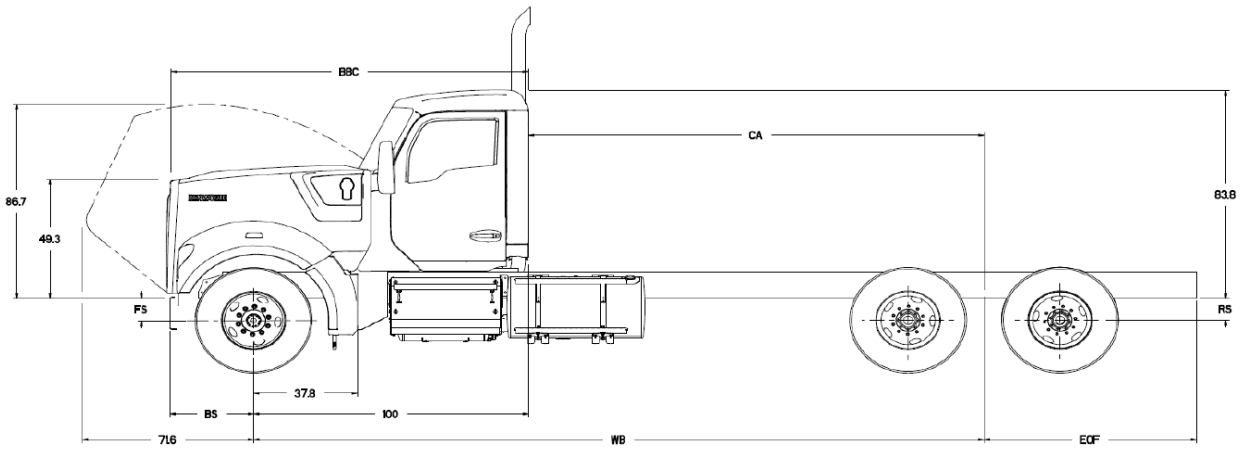


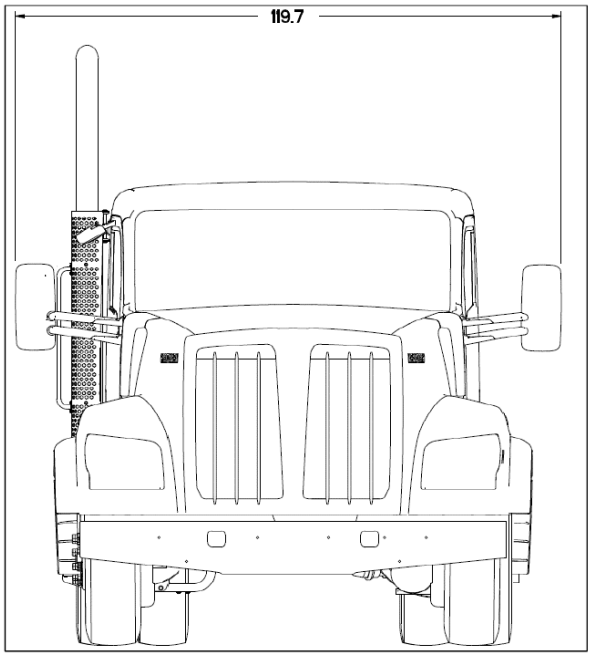


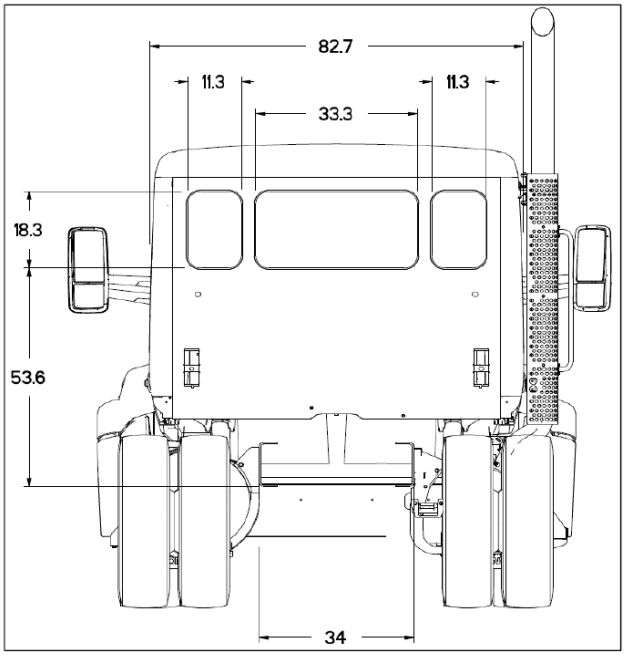
SECTION 3 - DIMENSIONS

W990 DAYCAB

The following drawings are of a standard W990 Daycab, shown with standard chassis components.

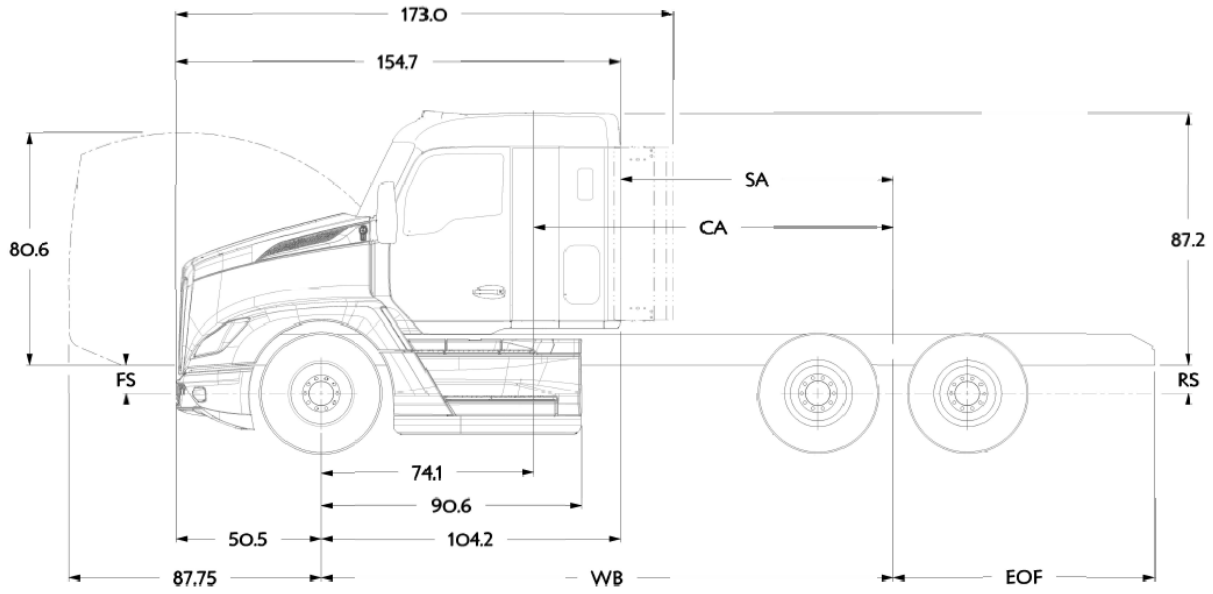


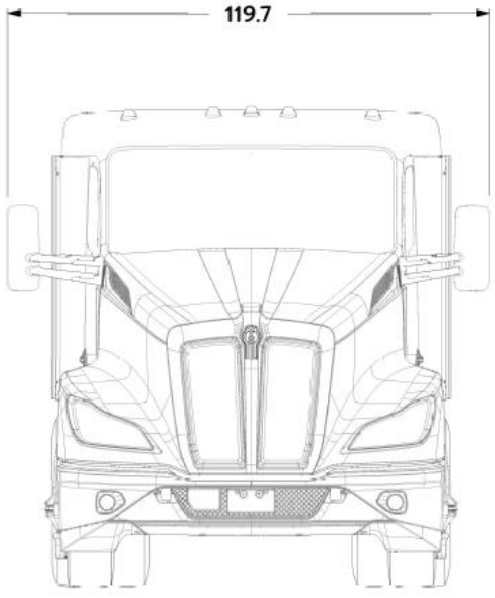


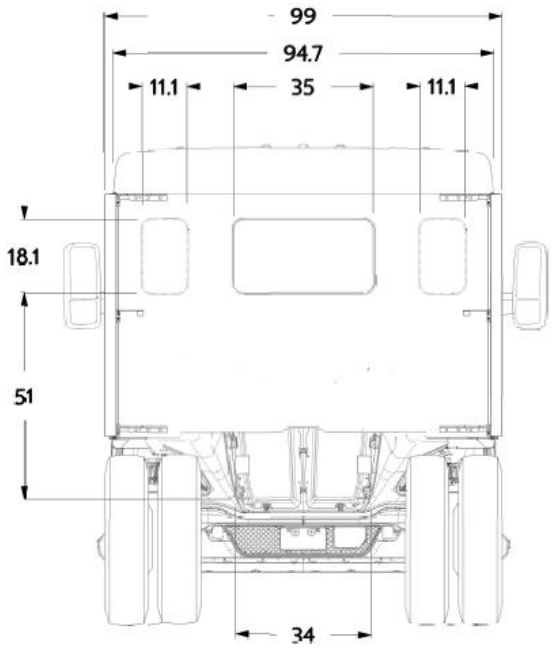


T680 STANDARD HOOD 40in SLEEPER

The following drawings are of a standard T680 Standard Hood 40" Sleeper, shown with standard chassis components.

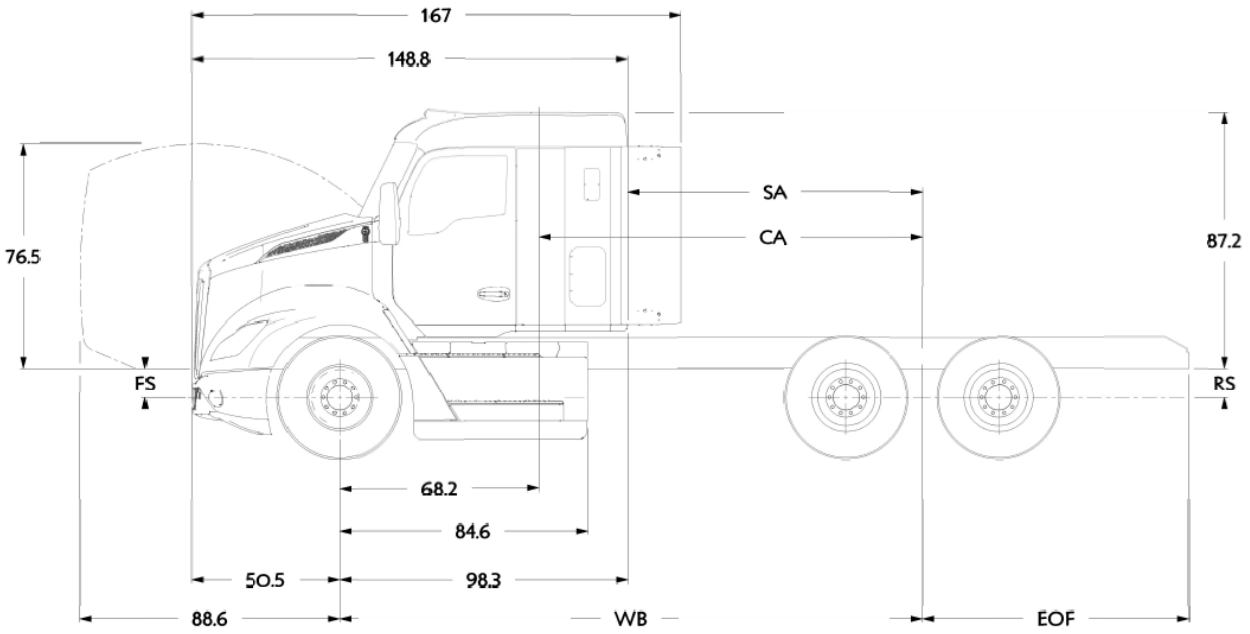


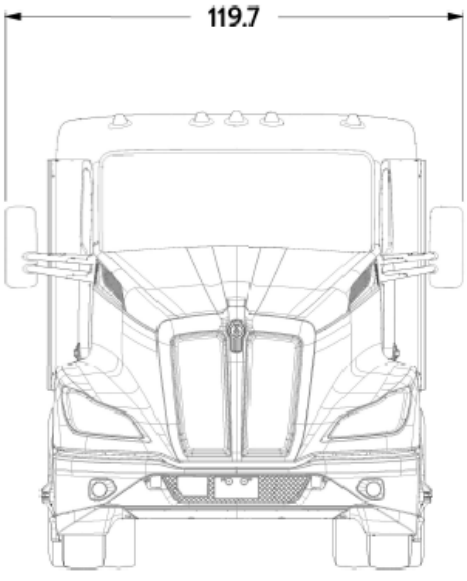


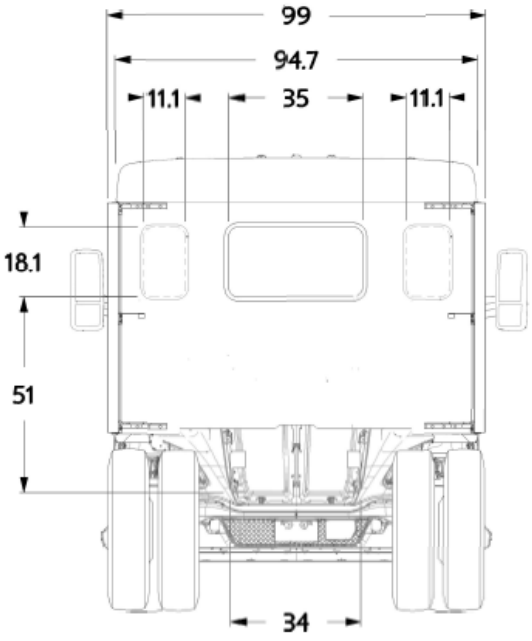


T680 MX OPTIMIZED HOOD 40in SLEEPER

The following drawings are of a standard T680 MX Optimized Hood 40in Sleeper, shown with standard chassis components.

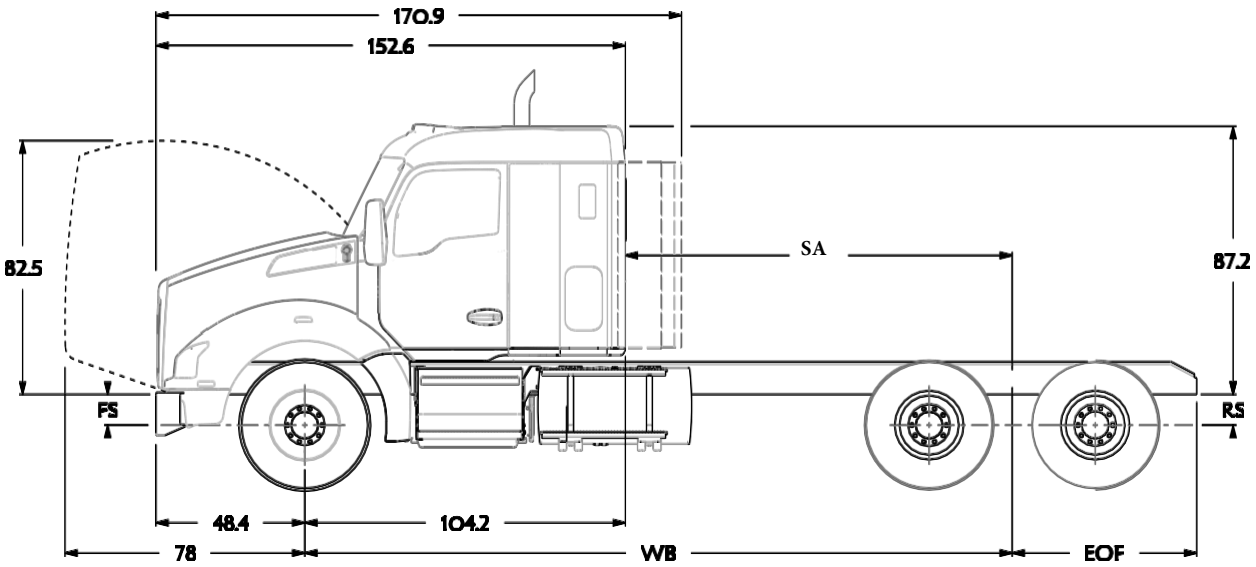


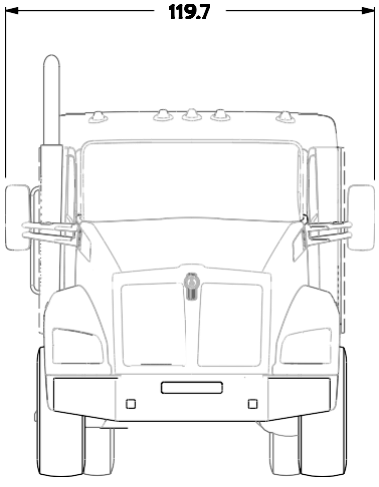


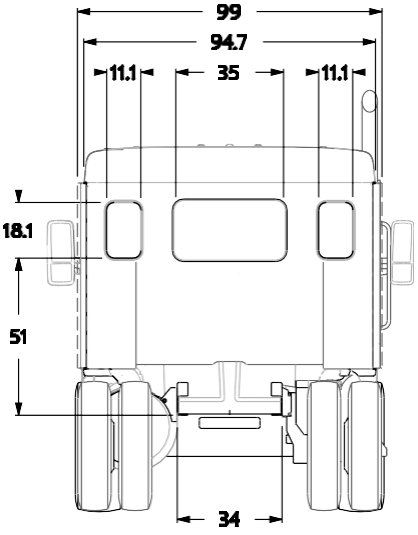


T880 STANDARD HOOD 40in SLEEPER

The following drawings are of a standard T880 Standard Hood 40in Sleeper, shown with standard chassis components.



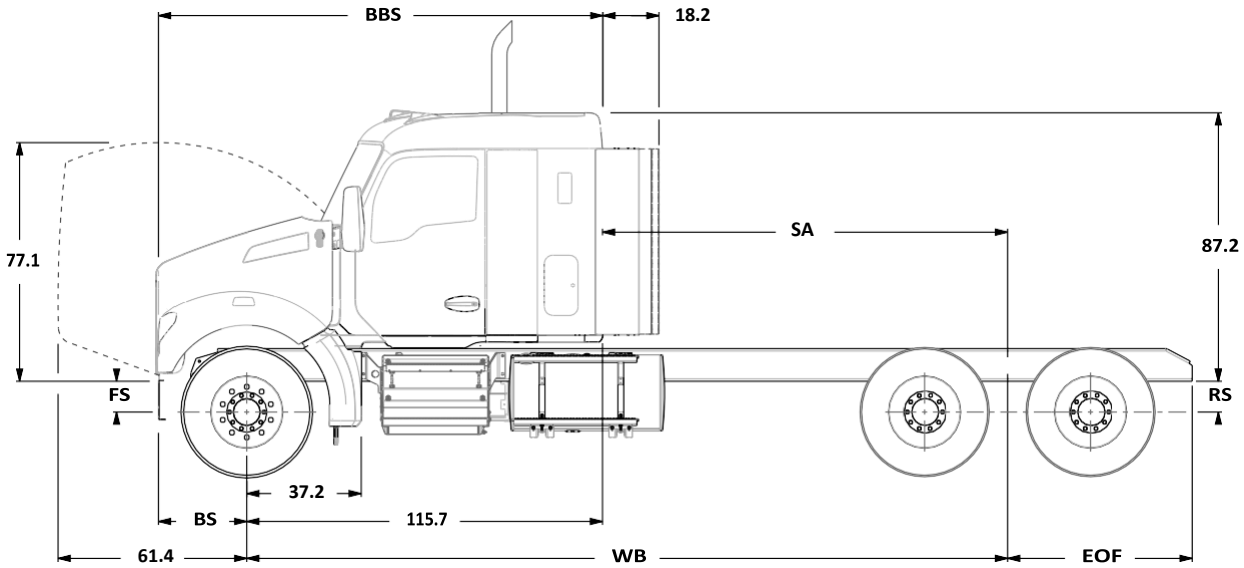


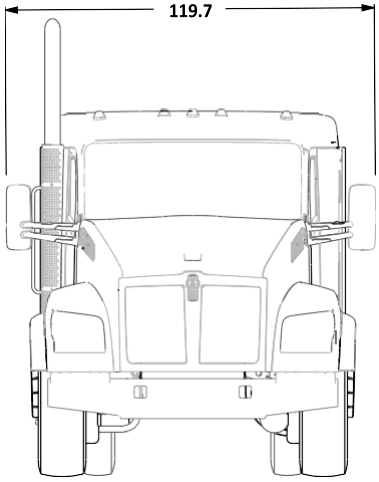


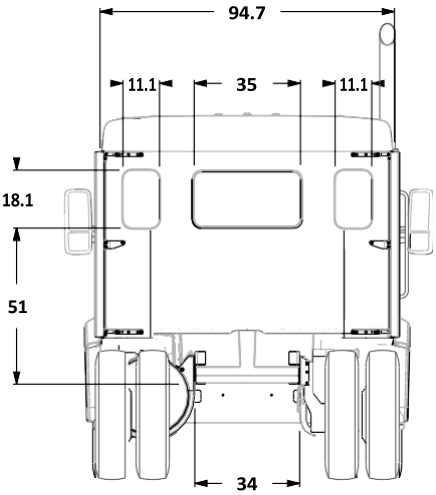
SECTION 3 - DIMENSIONS

T880S (SFFA) MX-OPTIMIZED HOOD 40in SLEEPER

The following drawings are of a standard T880S SFFA (Short) Hood 40in Sleeper, shown with standard chassis components.

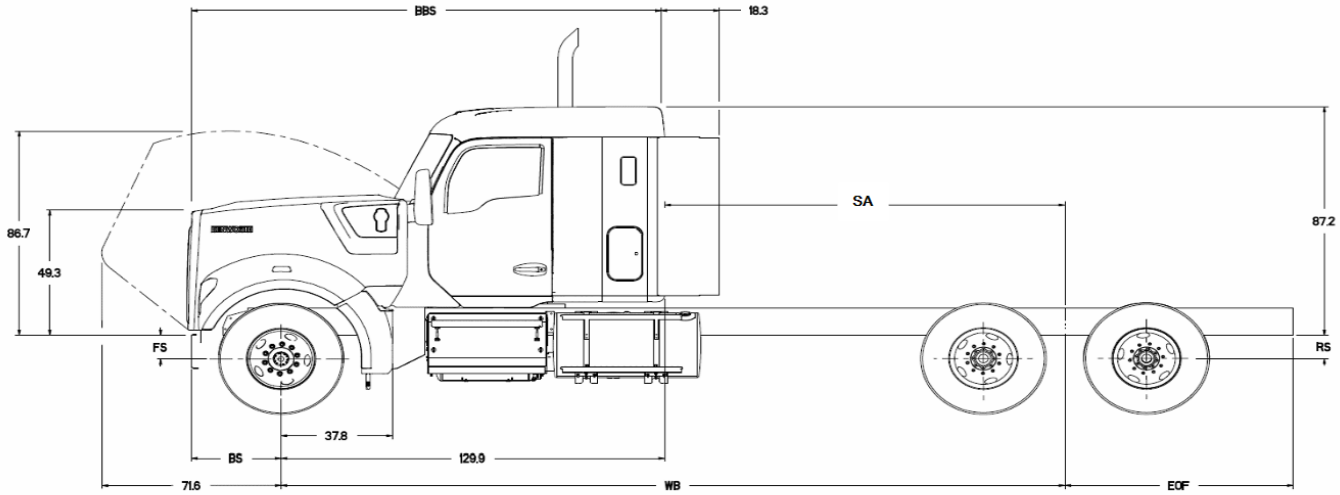


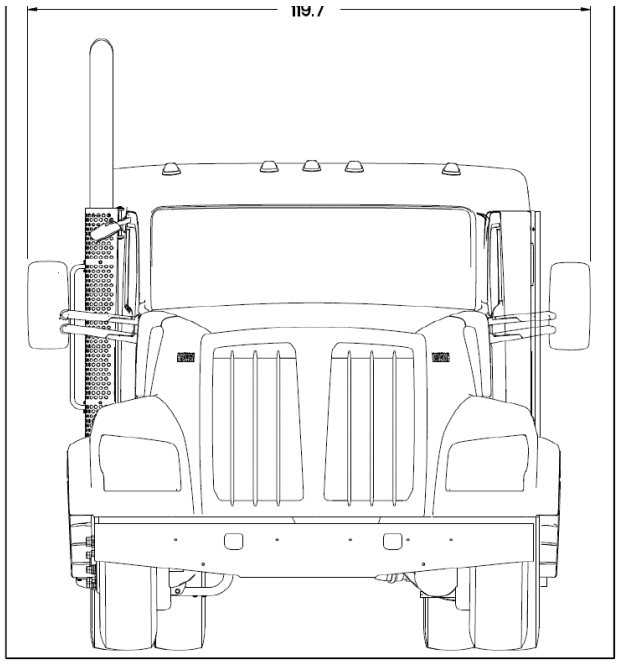


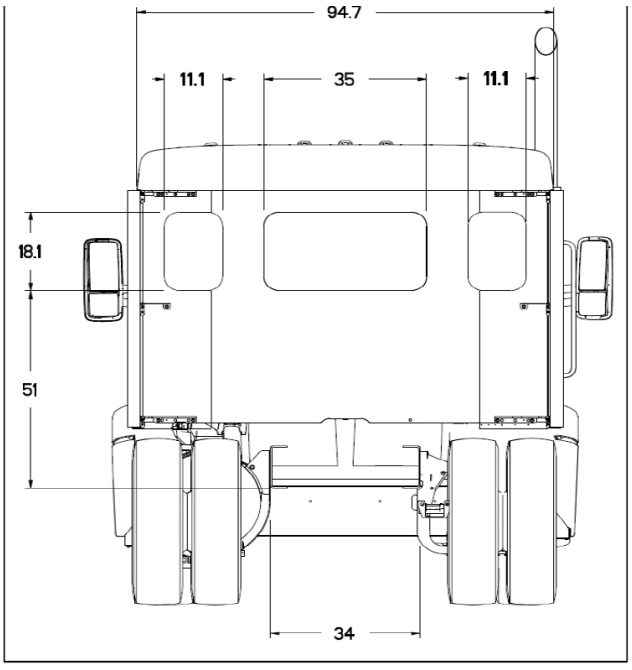


W990 40in SLEEPER

The following drawings are of a standard W990 40in Sleeper, shown with standard chassis components.



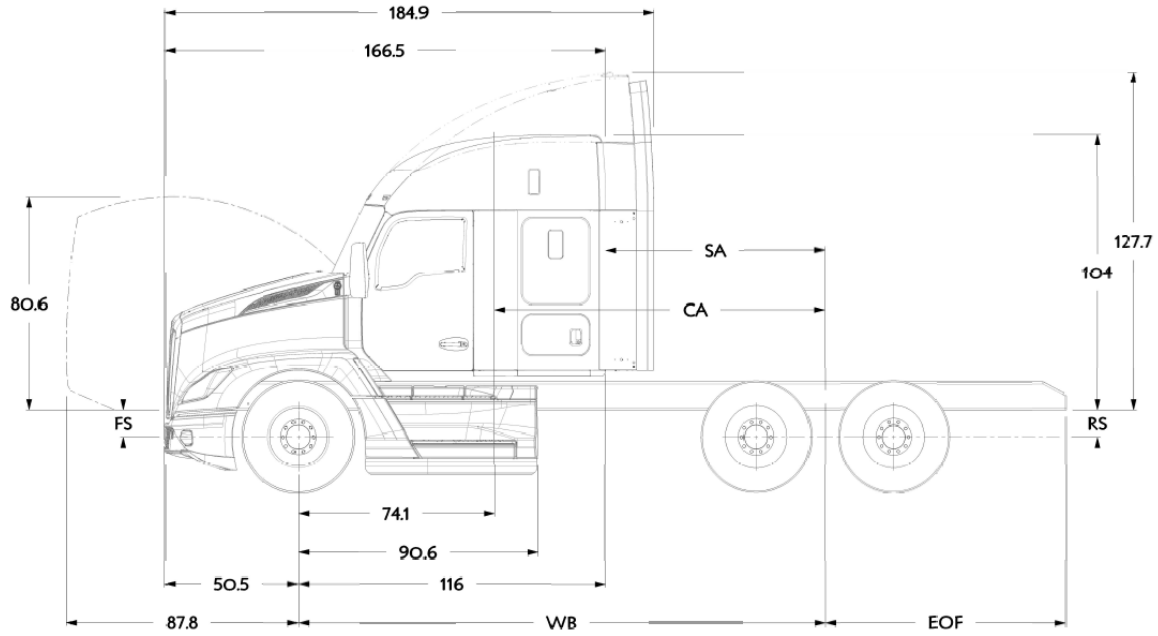


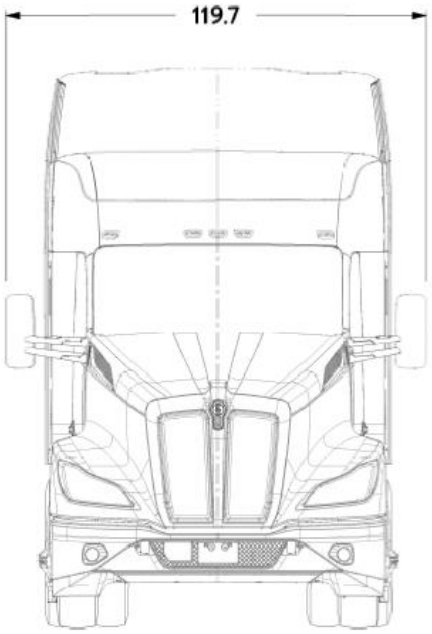


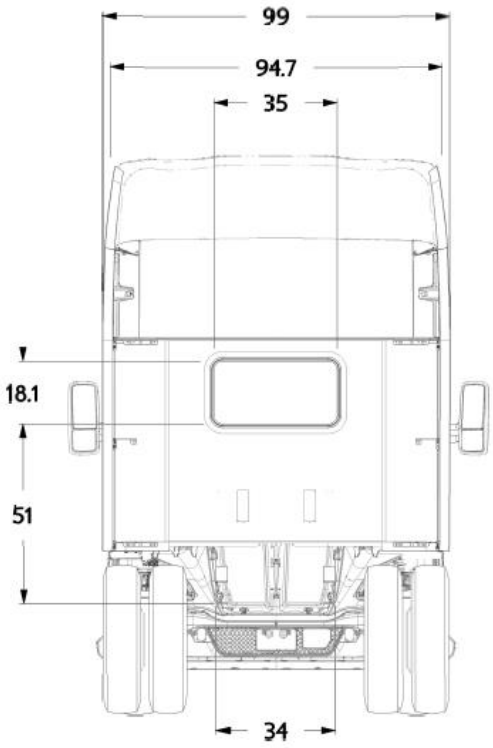
SECTION 3 - DIMENSIONS

T680 STANDARD HOOD 52in SLEEPER

The following drawings are of a standard T680 Standard Hood 52in Sleeper, shown with standard chassis components.



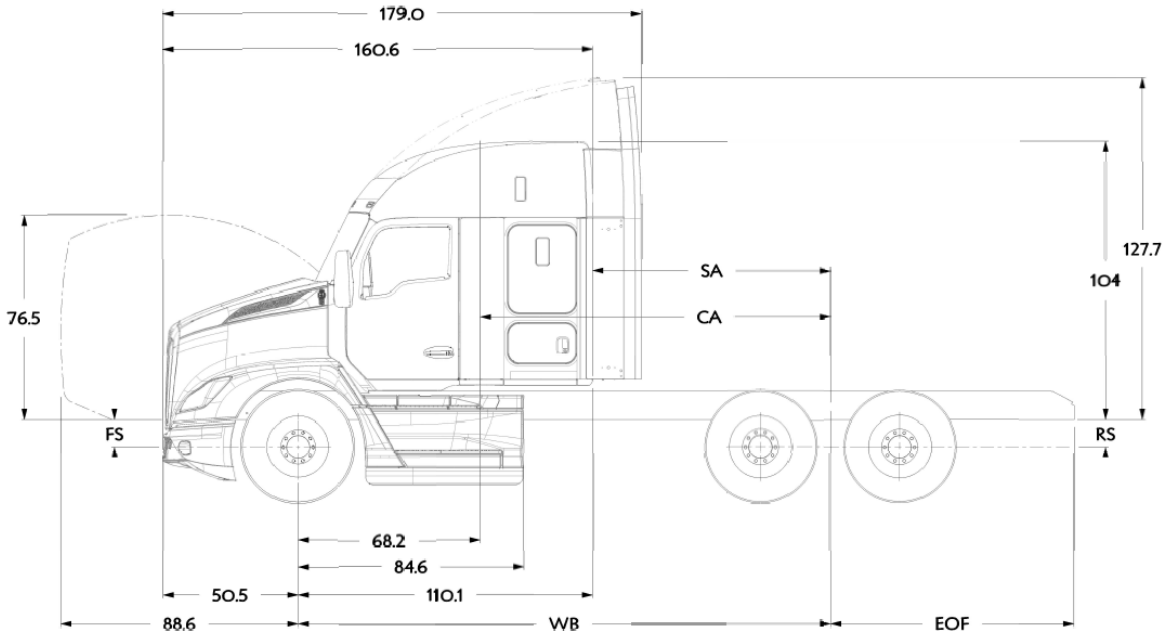


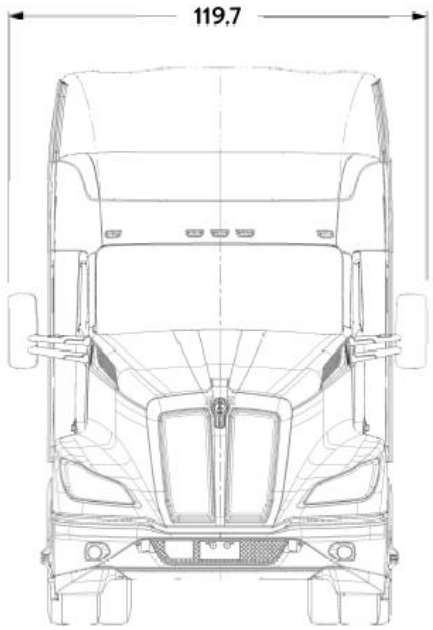


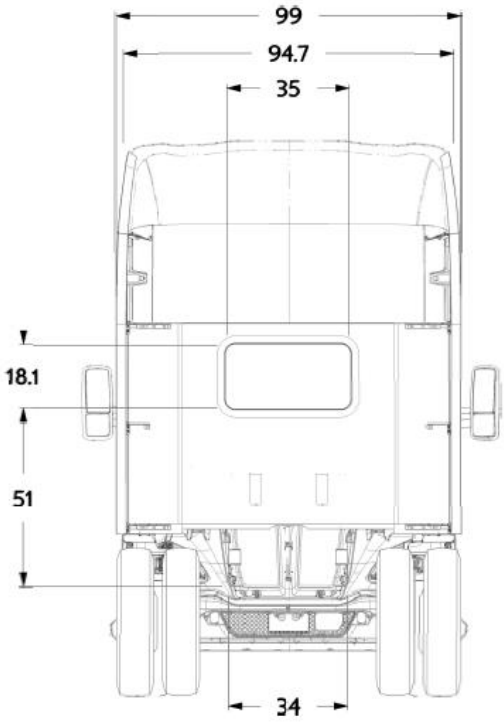
SECTION 3 - DIMENSIONS

T680 MX OPTIMIZED HOOD 52in SLEEPER

The following drawings are of a standard T880 MX Optimized Hood 52in Sleeper, shown with standard chassis components.

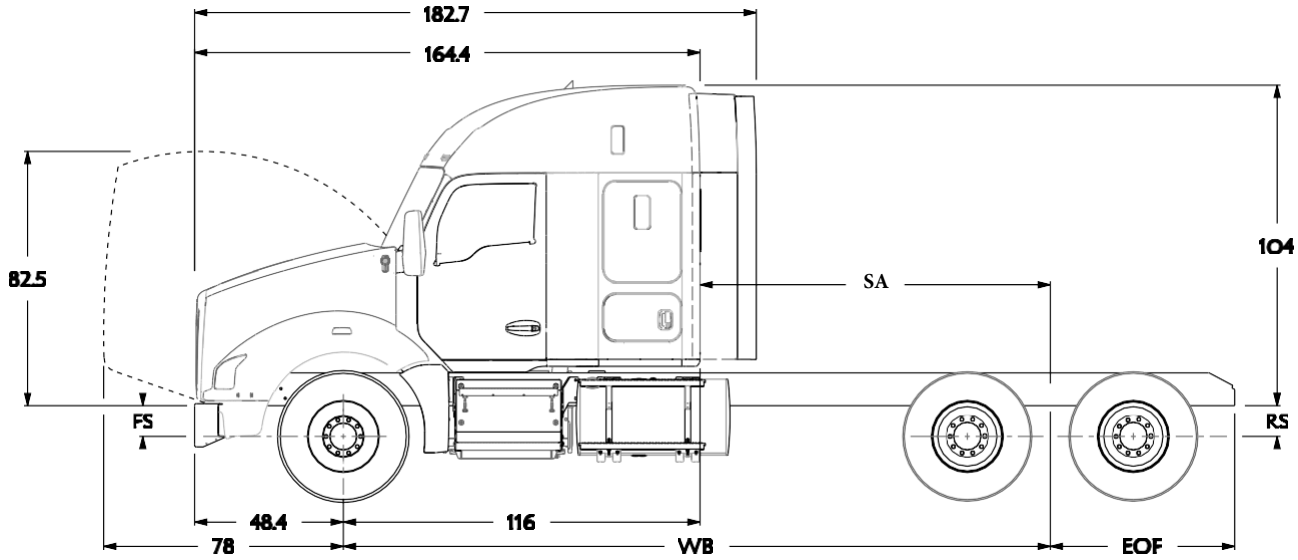


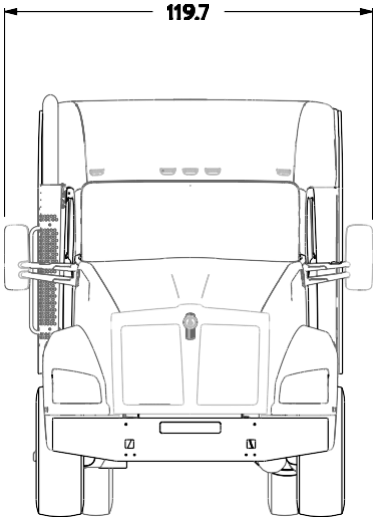


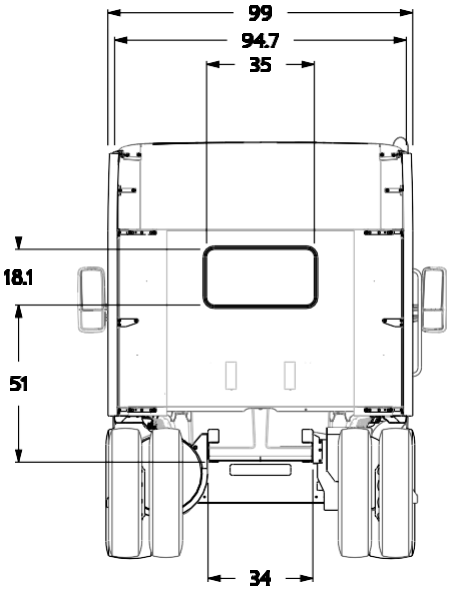


T880 STANDARD HOOD WITH 52in SLEEPER

The following drawings are of a standard T880 Standard Hood with 52in Sleeper, shown with standard chassis components.



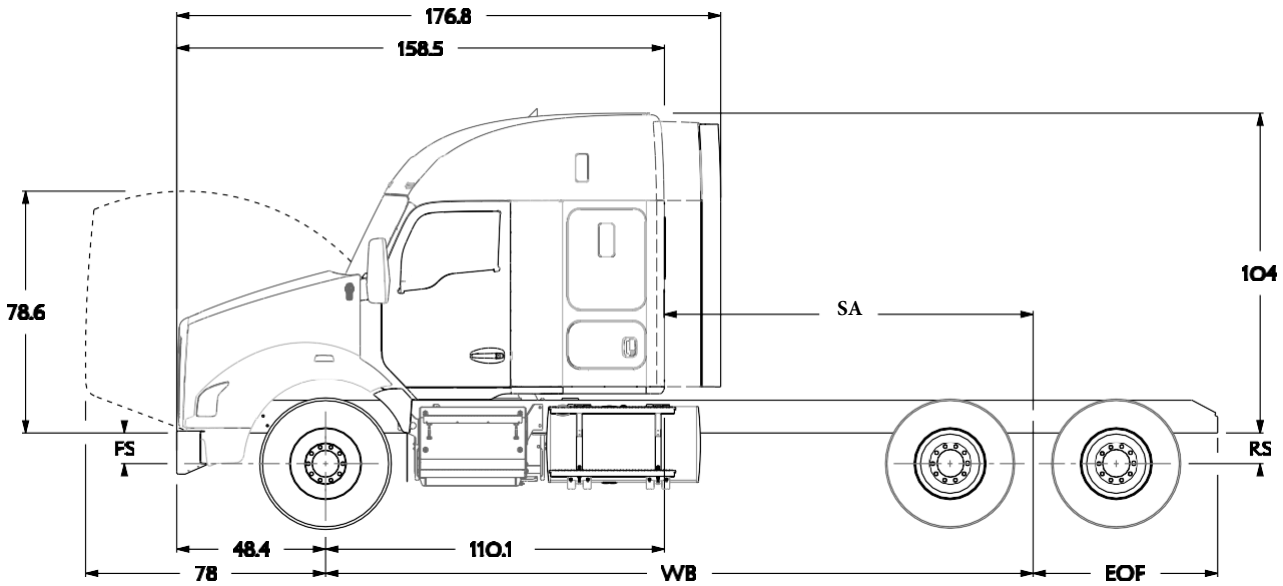


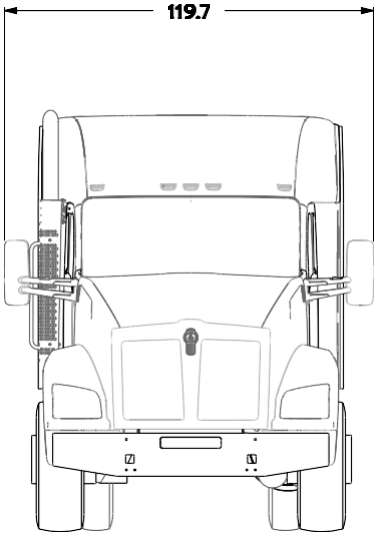


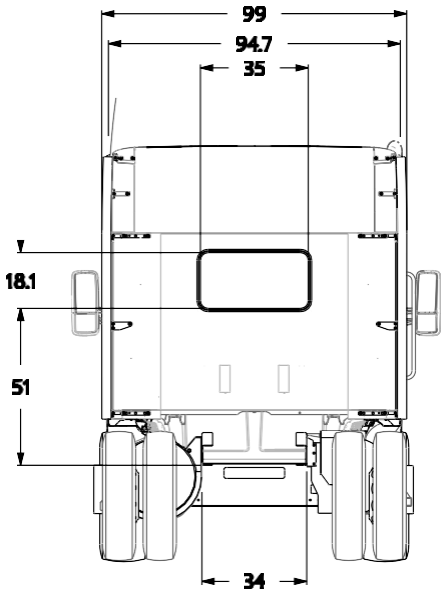
SECTION 3 - DIMENSIONS

T880 MX OPTIMIZED HOOD WITH 52in SLEEPER

The following drawings are of a standard T880 MX Optimized Hood with 52in Sleeper, shown with standard chassis components.



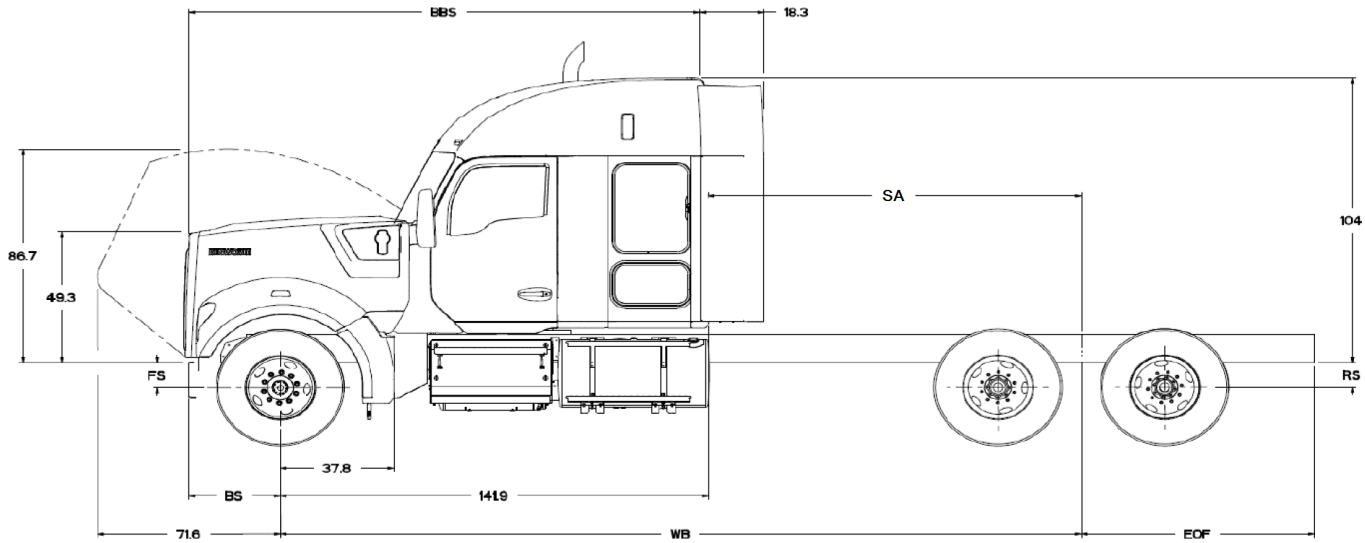


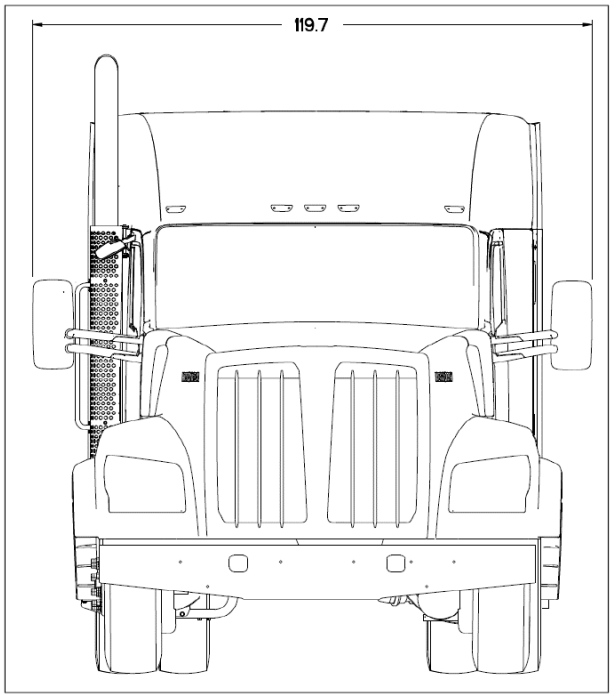


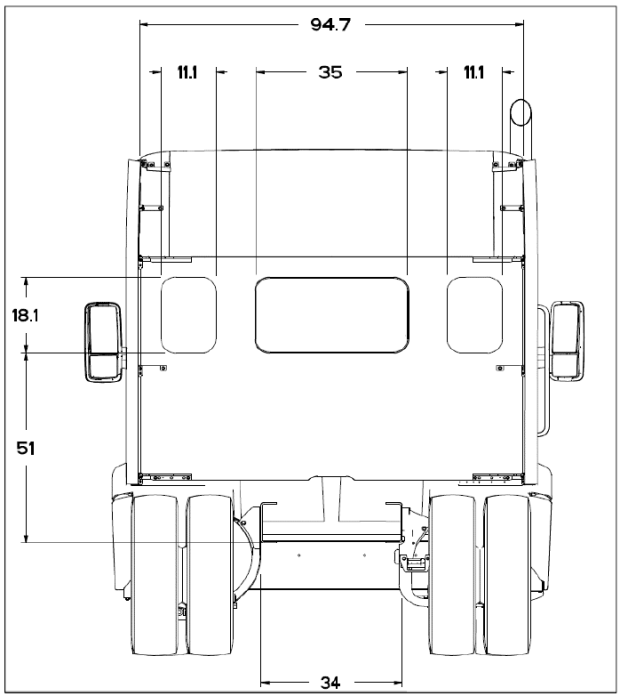
SECTION 3 - DIMENSIONS

W990 52in SLEEPER

The following drawings are of a standard W990 52in Sleeper, shown with standard chassis components.



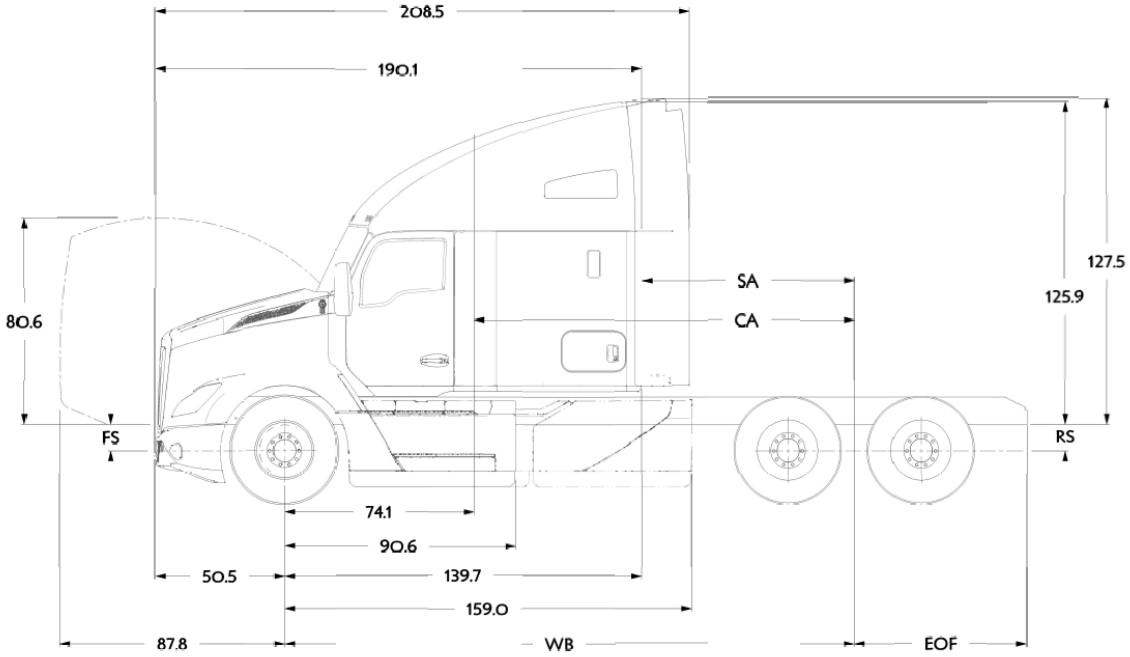


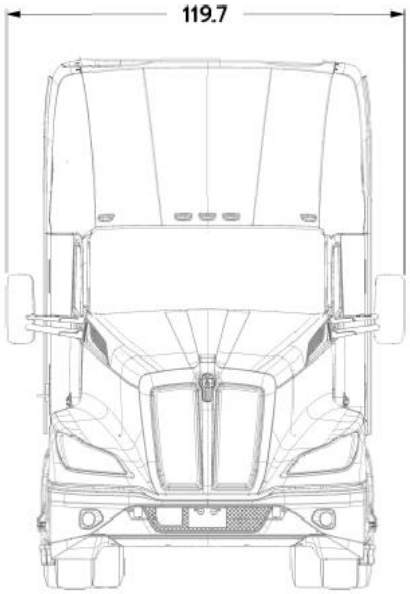


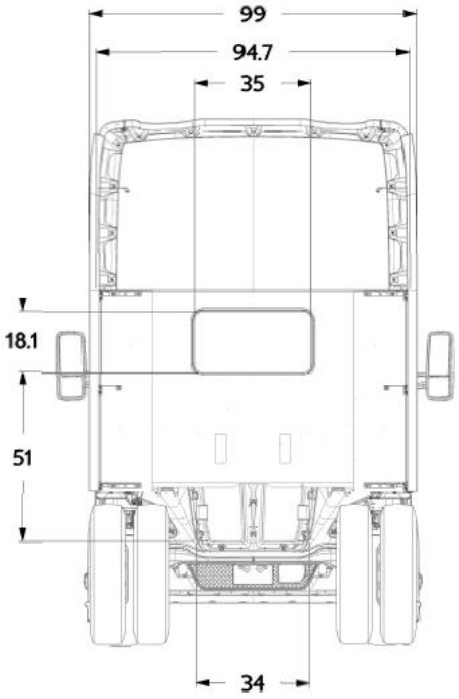
SECTION 3 - DIMENSIONS

T680 STANDARD HOOD WITH 76in HIGH-ROOF SLEEPER

The following drawings are of a standard T680 Standard Hood with 76in High-Roof Sleeper, shown with standard chassis components.

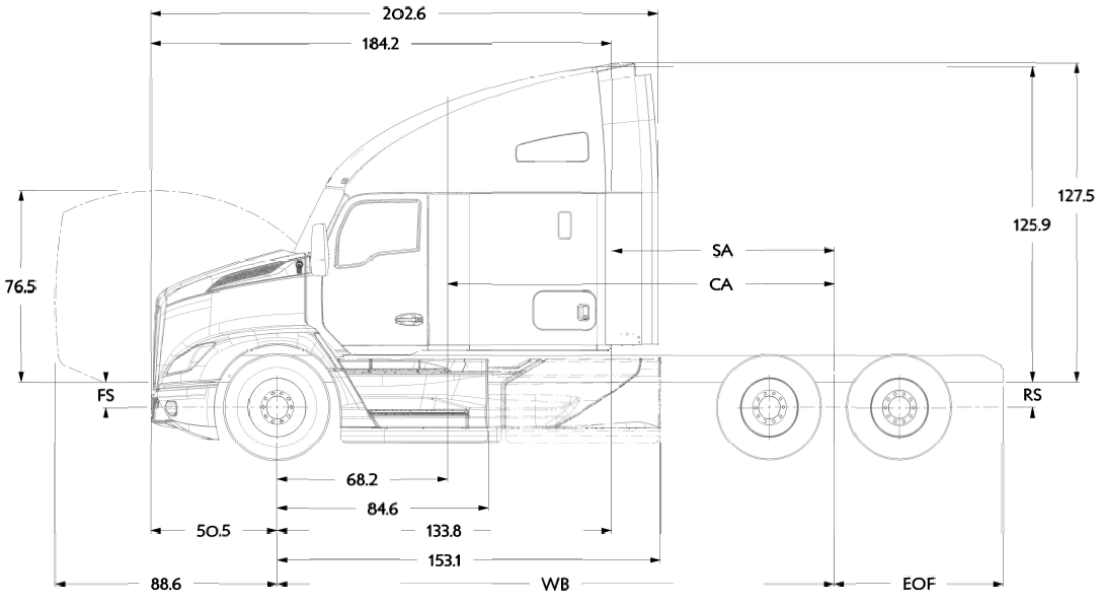


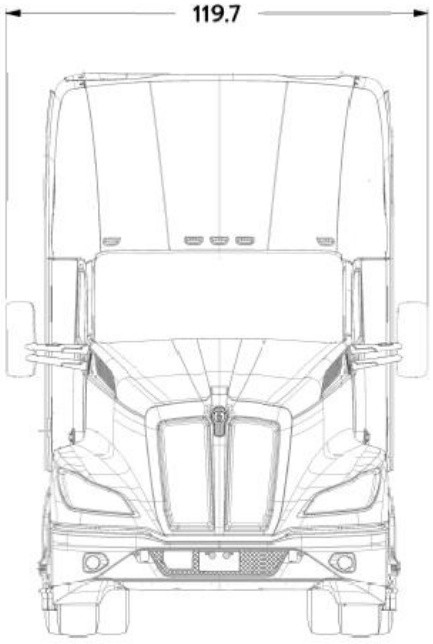


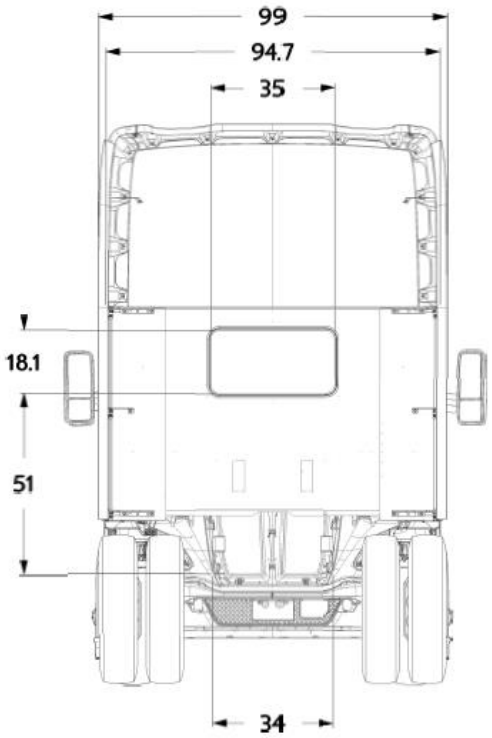


T680 MX (SHORT) HOOD WITH 76in HIGH-ROOF SLEEPER

The following drawings are of a standard T680 MX (Short) hood with 76in High-Roof Sleeper, shown with standard chassis components.



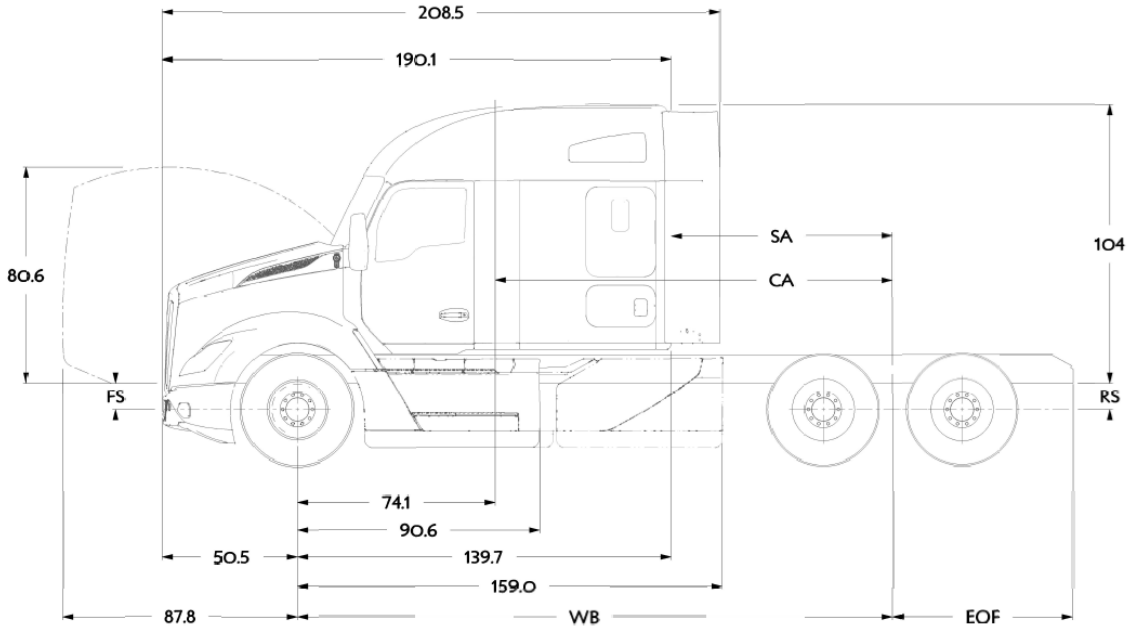




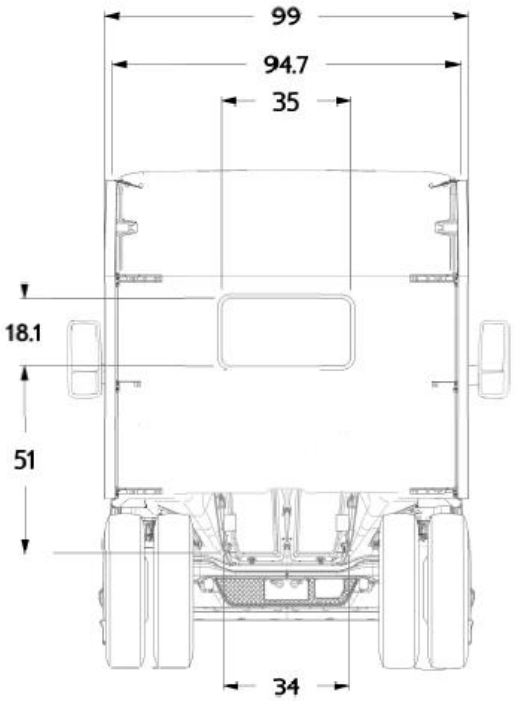
SECTION 3 - DIMENSIONS 01/2022

T680 STANDARD HOOD WITH 76in MID-ROOF SLEEPER

The following drawings are of a standard T680 Standard Hood with 76in Mid-Roof Sleeper, shown with standard chassis components.

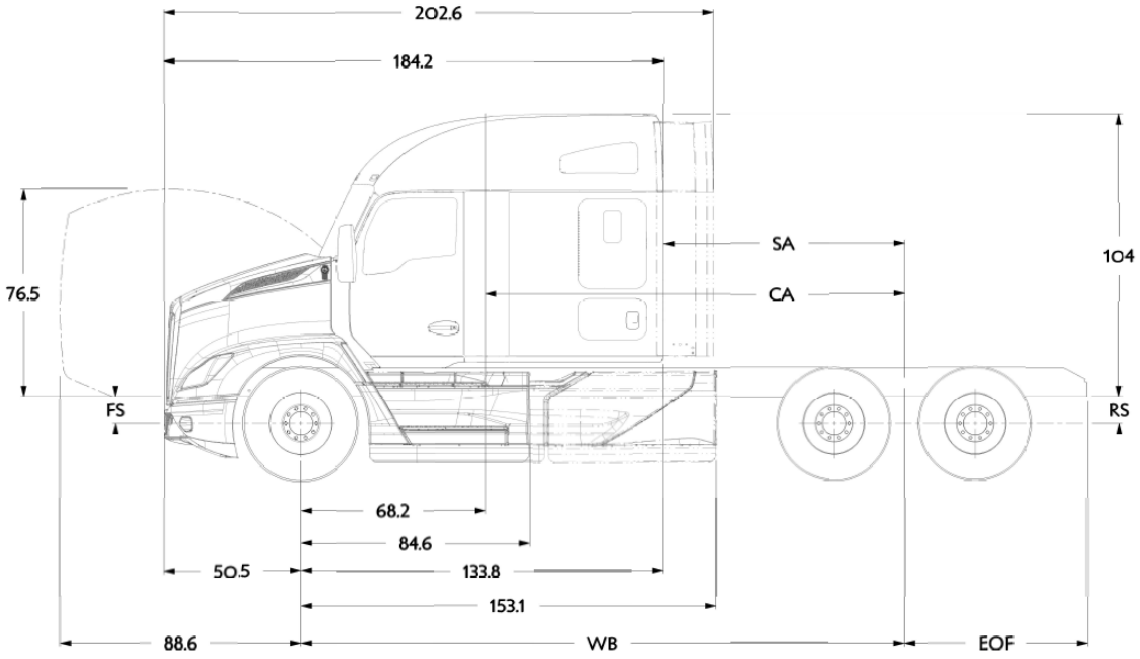




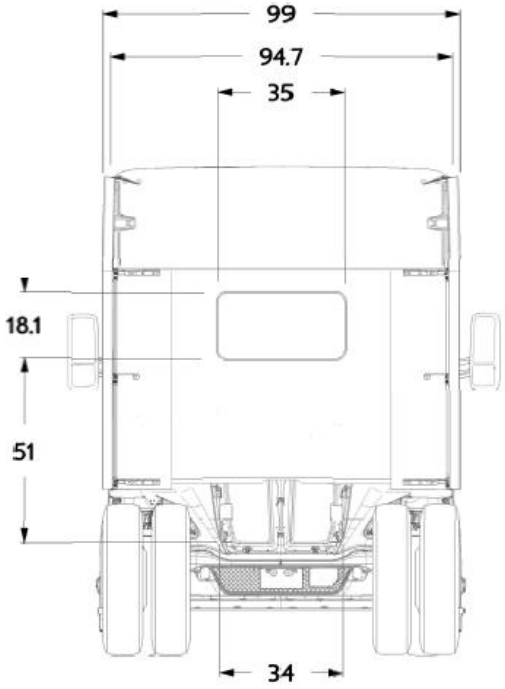


T680 MX OPTIMIZED HOOD WITH 76in MID-ROOF SLEEPER

The following drawings are of a standard T680 MX Optimized hood with 76un Mid-Roof Sleeper, shown with standard chassis components.



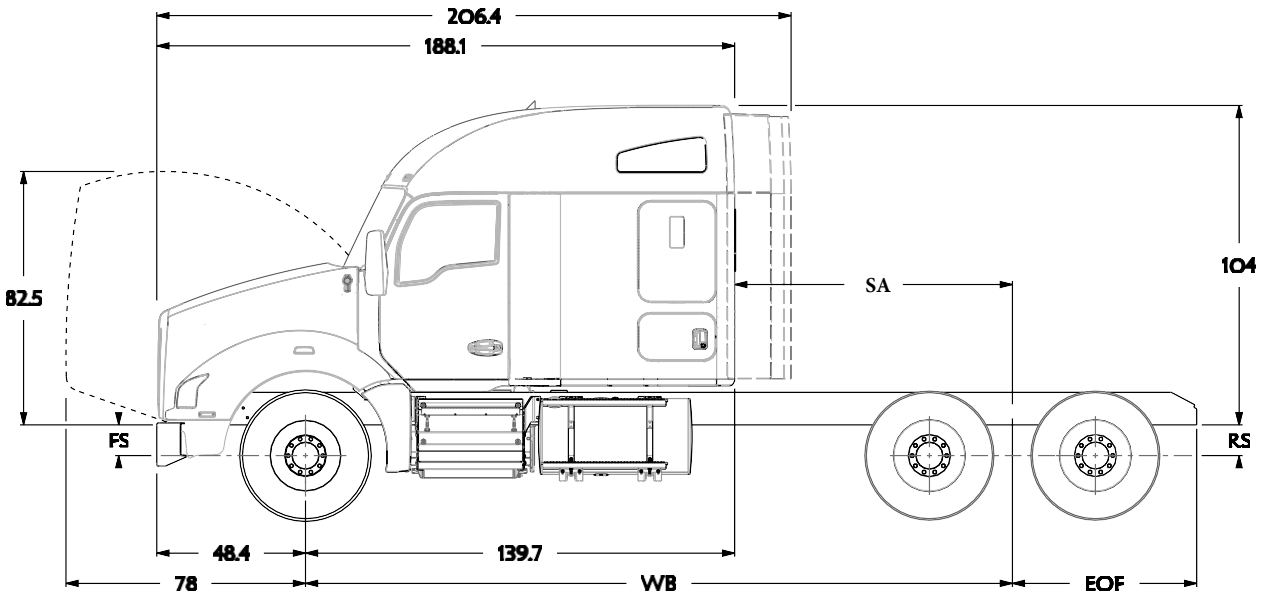


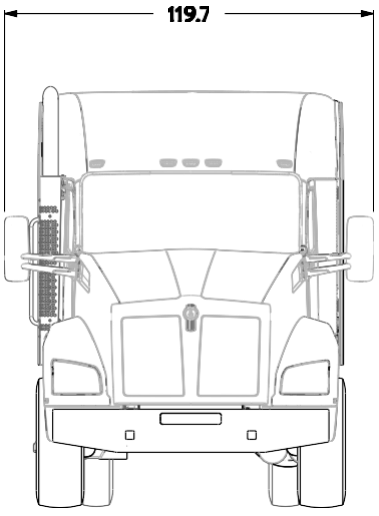


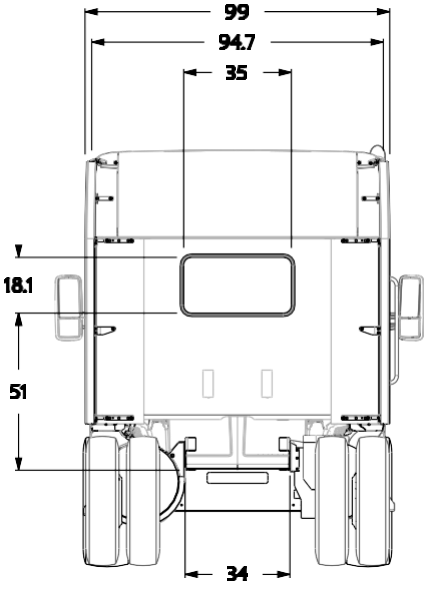
SECTION 3 - DIMENSIONS

T880 STANDARD HOOD WITH 76in MID-ROOF SLEEPER

The following drawings are of a standard T880 Standard Hood with 76in Mid-Roof Sleeper, shown with standard chassis components.

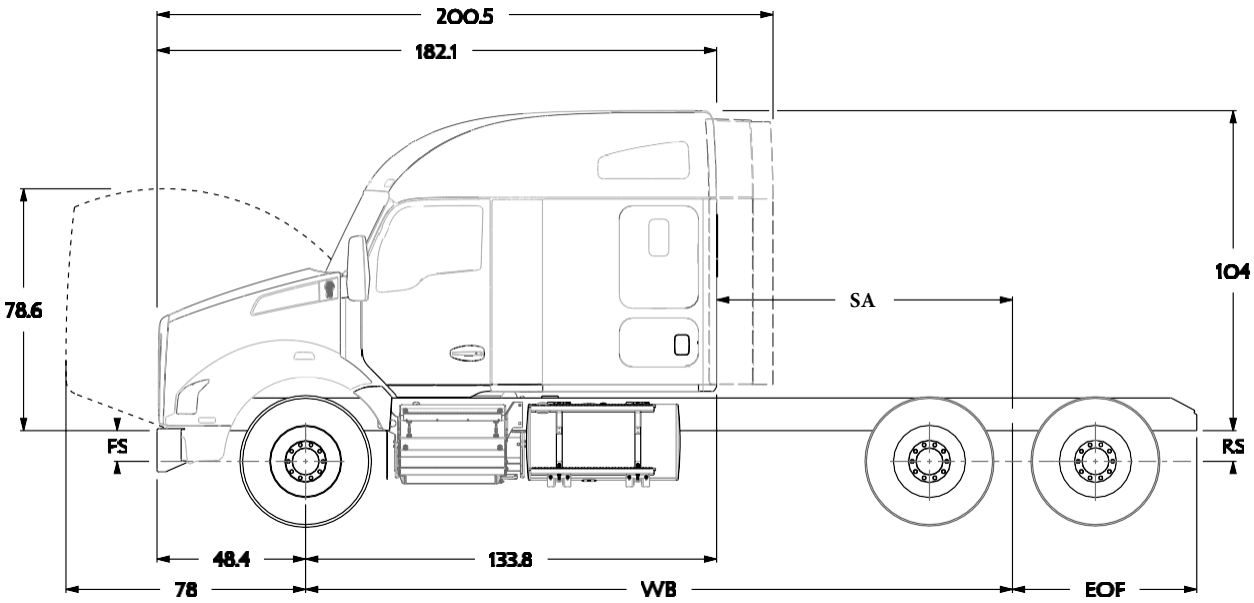


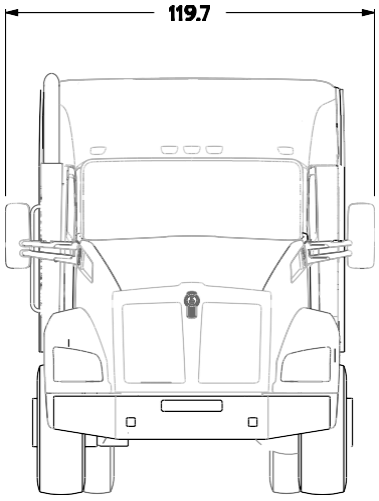


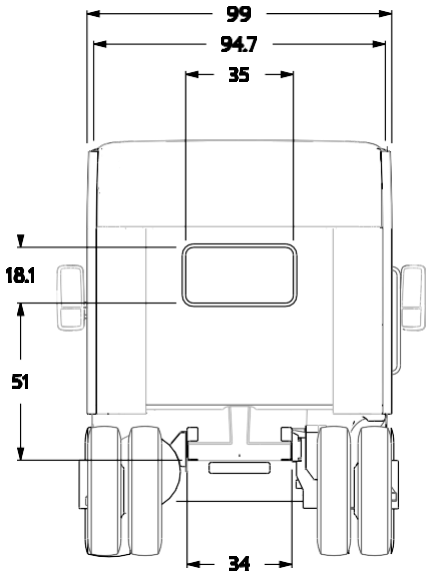


T880 MX OPTIMIZED HOOD WITH 76in MID-ROOF SLEEPER

The following drawings are of a standard T880 MX Optimized Hood with 76in Mid-Roof Sleeper, shown with standard chassis components.

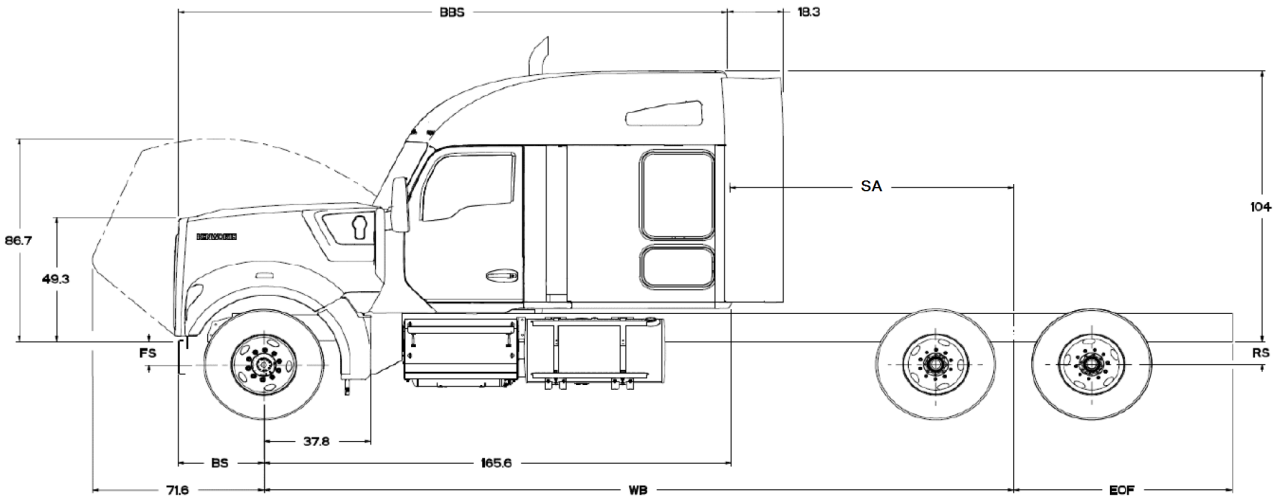


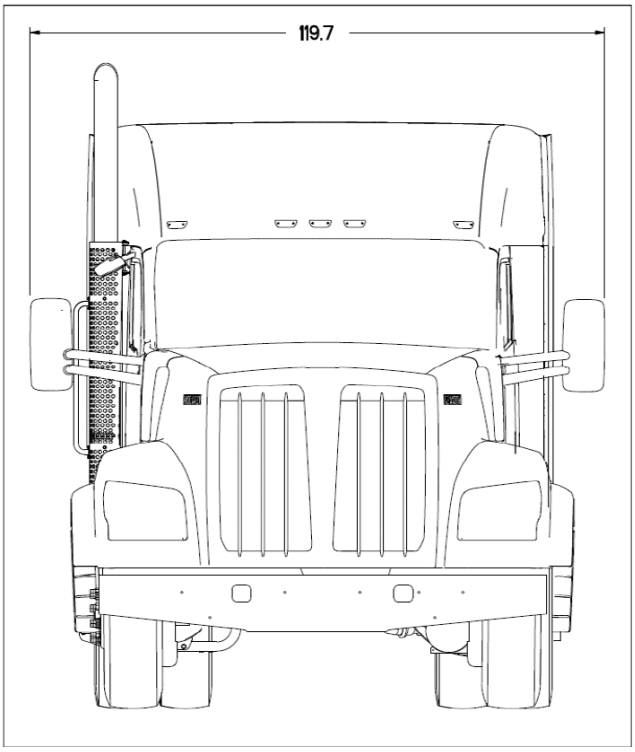


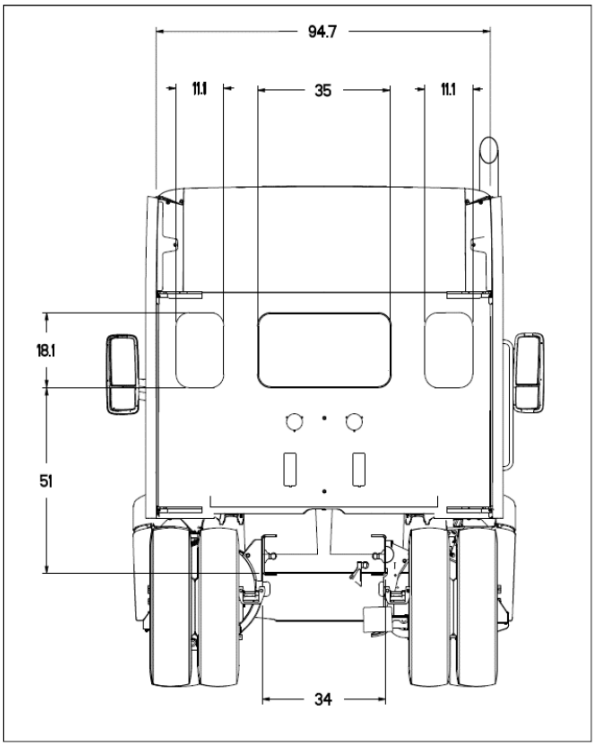


W990 WITH 76in MID-ROOF SLEEPER

The following drawings are of a standard W990 76in Mid-Roof Sleeper, shown with standard chassis components.

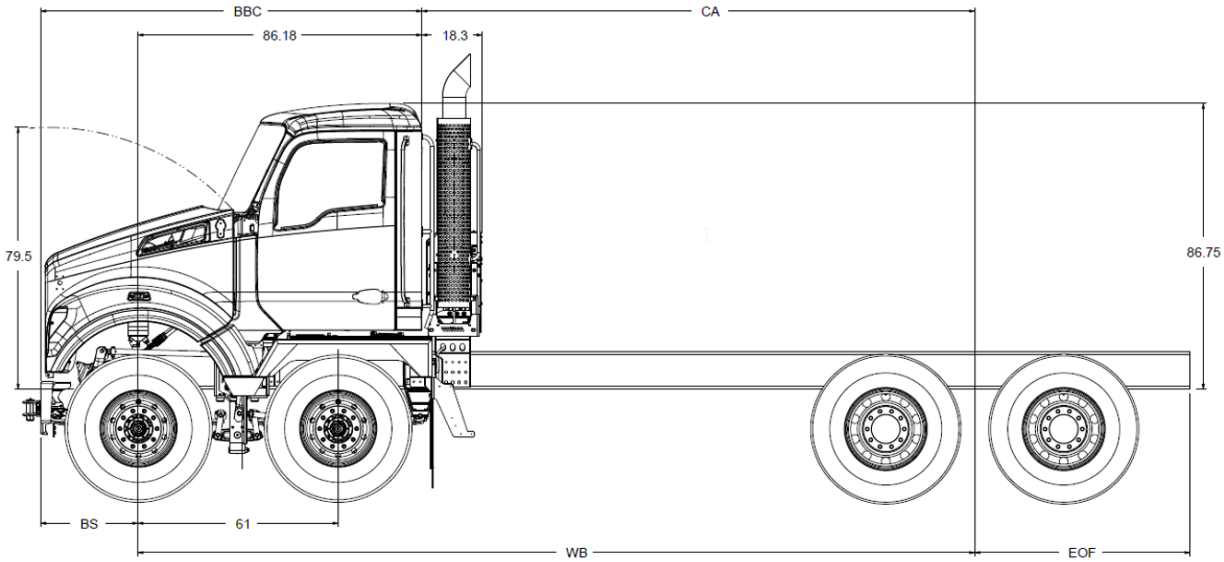






T880S TWIN STEER DAYCAB WITH 61in AXLE SPACING

The following drawings are of a standard T880S Twin Steer Daycab, shown with standard chassis components.



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RIDE HEIGHTS

The front (FS) and rear (RS) suspension ride heights are provided as a basic tool to determine the overall height of the cab, height of exhaust components, and frame heights. The heights are all calculated from the centerlines of the axles, please be sure to include the tire radius dimension to determine overall height. Note: the frame rail height itself will not affect the overall height as all components are located from the bottom of the frame rail.

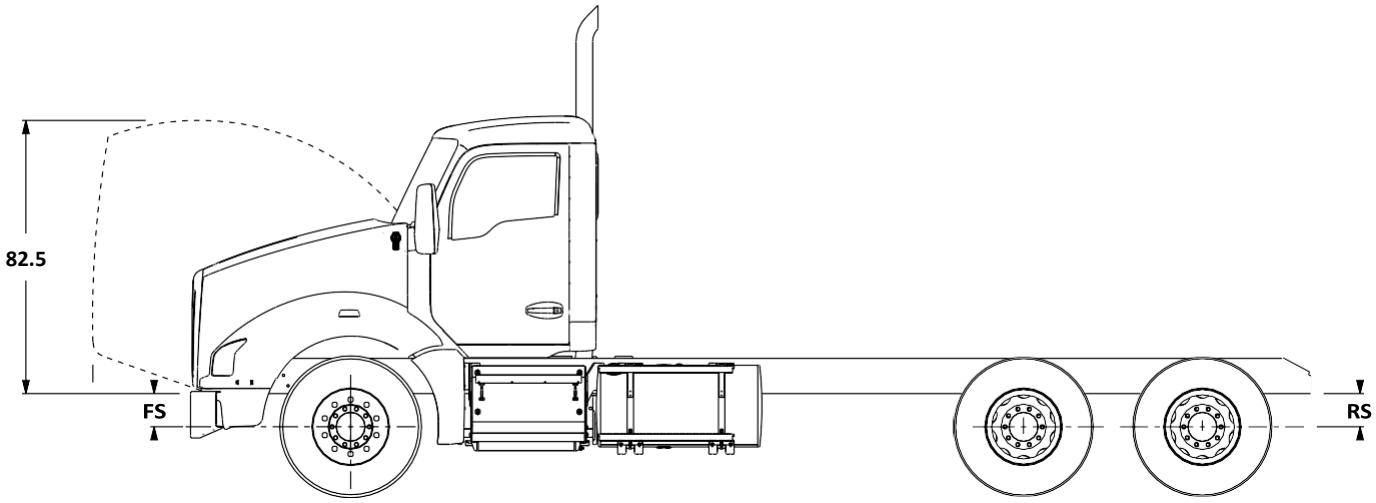


TABLE 3-2. Front Suspension Ride Heights

Front Suspension (FS)	Laden:	Unladen:
12K Taperleaf	10.3″	11.5″
13.2K Taperleaf	10.3″	11.5″
14.6K Taperleaf	10.3″	11.7″
16K Taperleaf	10.6″	12.3″
20K Taperleaf	10.4″	11.9″
22K Multi-stage Taperleaf	10.7″	12.7″

To calculate the frame height, use the following formulas:

Front Frame Height = FS + 1/2 Front Tire Diameter
Rear Frame Height = RS + 1/2 Rear Tire Diameter

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The table below provides laden and unladen heights for all Rear Suspensions offered on the Kenworth T680, T880, and W990 models. Common Rear Suspensions are shown here, for detailed suspensions please use the Rear suspension layouts on pages 43 to 58.

TABLE 3-3. Rear Suspension Ride Heights

Rear Suspension	Laden:	Unladen:
Kenworth AG400L	8.5″	8.5″
Kenworth AG400	9″	9″
Kenworth AG460	10.5″	10.5″
Kenworth AG690 Tridem	10.5″	10.5″
Reyco 79KB 23K Rating	8.3″	10.8″
Reyco 102 38K Rating	9.2″	10.8″
Chalmers 854-40-L-HS 40K Rating	9.6″	11″
Chalmers 854-46-H 46K Rating	10.1″	12.4″
Chalmers 854-50-H-HS 50K Rating	10.8″	12.5″
Chalmers 865-65-XL 65K Rating	13″	15.7″
Hendrickson HAULMAAX EX HMX400 15.5″ Saddle	8.5″	10.5″
Hendrickson HAULMAAX EX HMX400 16.5″ Saddle	9.5″	11.5″
Hendrickson HAULMAAX EX HMX400 17.5″ Saddle	10.5″	12.5″
Hendrickson HAULMAAX EX HMX460 15.5″ Saddle	8.5″	10.5″
Hendrickson HAULMAAX EX HMX460 16.5″ Saddle	9.5″	11.5″
Hendrickson HAULMAAX EX HMX460 17.5″ Saddle	10.5″	12.5″
Hendrickson HAULMAAX EX HMX460 18.5″ Saddle	11.5″	13.5″
Hendrickson HAULMAAX EX HMX520 16.5″ Saddle	9.5″	11.5″
Hendrickson HAULMAAX EX HMX520 17.5″ Saddle	10.5″	12.5″
Hendrickson HAULMAAX EX HMX520 18.5″ Saddle	11.5″	13.5″
Hendrickson Primaax EX 46K Rating	10″	10″
Hendrickson RT463 6″ Saddle 46K Rating	10″	11.1″
Hendrickson RT463 7.19″ Saddle 46K Rating	11.2″	12.5″
Hend RT523 52K 6″ Saddle	9.9″	11″
Neway ADZ246 46K Rating	10″ or 12″	10″ or 12″
Neway ADZ252 52K Rating	10″ or 12″	10″ or 12″
Neway ADZ369 69K Tridem	10″ or 12″	10″ or 12″
Neway ADZ378 78K Tridem	10″	10″

To calculate the frame height, use the following formulas:

Front Frame Height = FS + 1/2 Front Tire Diameter
Rear Frame Height = RS + 1/2 Rear Tire Diameter

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REAR SUSPENSION LAYOUTS

The rear suspension layouts are provided as a tool to help layout body installers prior to arrival. The applicable dimensions are shown. Be sure to check the axle spacing that is shown, as alternate spacings may exist and could change some of the dimensions. The dimensions shown below are the most typical installations. In special cases some hole locations will move. If you are planning on using the holes shown for your body installation, please confirm with your local KW dealer that the drawing below will be the installation used on your specific truck. Ensure that proper torque is used to reinstall any suspension components.

It would be a good idea in this case to order the frame layout of your chassis during the truck ordering process. This can be done on any Kenworth truck, and will be provided 4-6 weeks ahead of the build schedule.

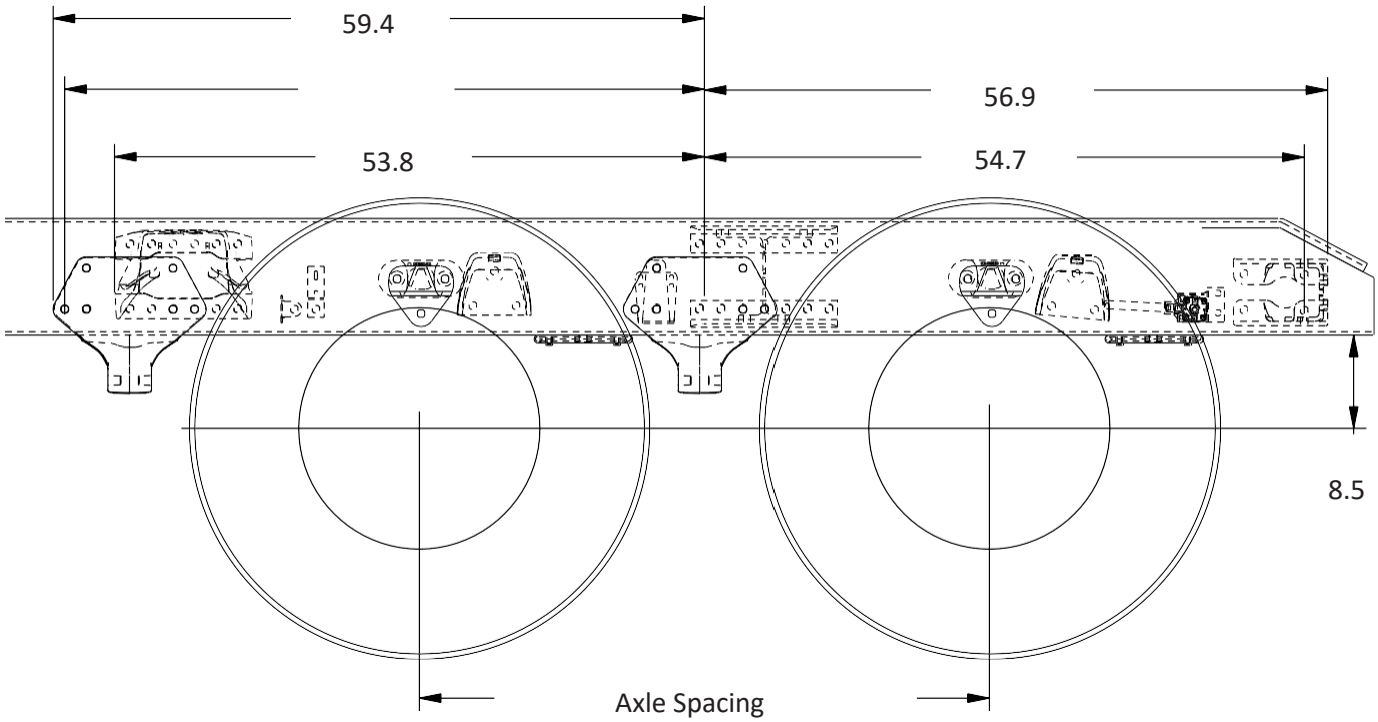
If there are hole locations that are not detailed, please work with your local Kenworth Dealer to request that information.

Additionally, optional axle spacings are shown in the charts below, if you would like details on the frame drilling with optional spacings, please contact your local Kenworth dealer.

NOTE: Actual axle spacing can depart from nominal due to axle slant requirements. Final axle spacing can vary by more than an inch from nominal in some cases. If precise axle spacing is critical due to body installation or state/local regulatory requirements, please contact Kenworth Applications/Technical Support for assistance.

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AG400L TANDEM



AG400L Suspensions

NOTE: 54” Axle Spacing dimensions shown

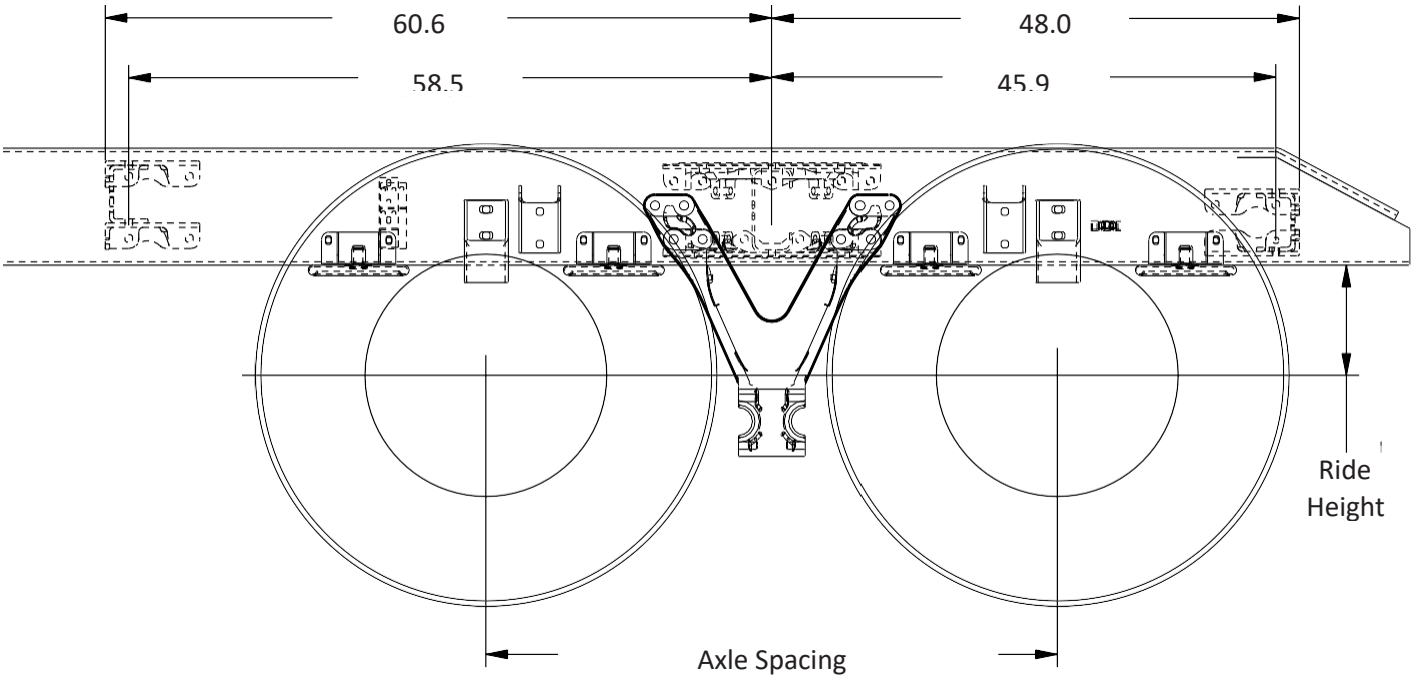
TABLE 3-4. AG400L Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden RideHeight	Unladen RideHeight
AG400L Tandem	40K	52"	8.5"	8.5"
AG400L Tandem	40K	54"	8.5"	8.5"

NOTE: Actual axle spacing can depart from nominal due to axle slant requirements. Final axle spacing can vary by more than an inch from nominal in some cases. If precise axle spacing is critical due to body installation or state/local regulatory requirements, please contact Kenworth Applications/technical Support for assistance.

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AG400 TANDEM



AG400 Suspensions

NOTE: 54" Axle Spacing dimensions shown

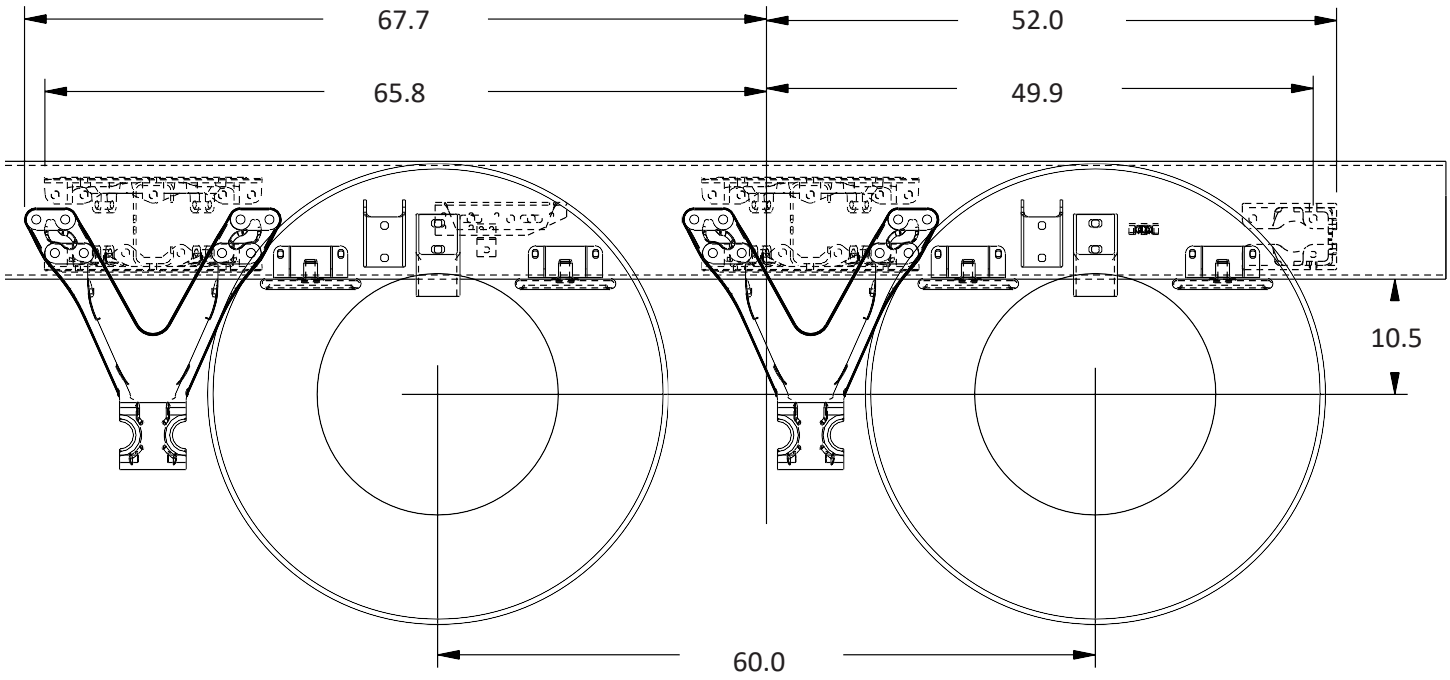
TABLE 3-5. AG400 Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden RideHeight	Unladen RideHeight
AG400 Tandem	40K	52"	9"	9"
AG400 Tandem	40K	54"	9"	9"

NOTE: Actual axle spacing can depart from nominal due to axle slant requirements. Final axle spacing can vary by more than an inch from nominal in some cases. If precise axle spacing is critical due to body installation or state/local regulatory requirements, please contact Kenworth Applications/technical Support for assistance.

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AG460 TANDEM



AG460 Suspensions

NOTE: 60" Axle Spacing dimensions shown

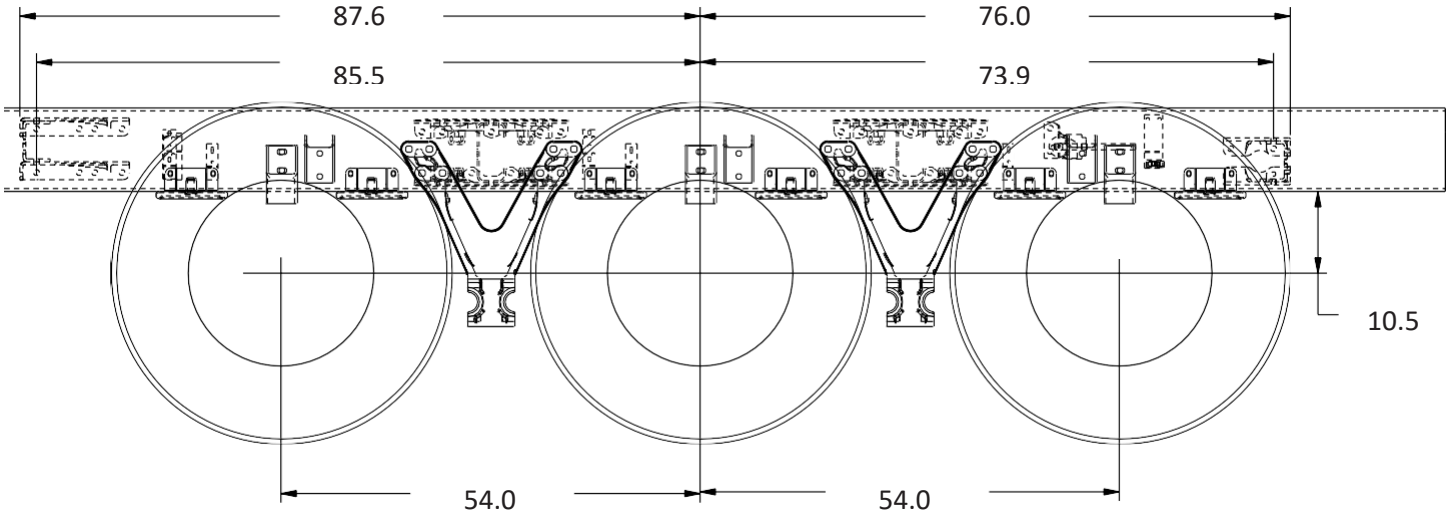
TABLE 3-6. AG460 Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden RideHeight	Unladen RideHeight
AG460 Tandem	46K	54"	10.5"	10.5"
AG460 Tandem	46K	60"	10.5"	10.5"

NOTE: Actual axle spacing can depart from nominal due to axle slant requirements. Final axle spacing can vary by more than an inch from nominal in some cases. If precise axle spacing is critical due to body installation or state/local regulatory requirements, please contact Kenworth Applications/technical Support for assistance.

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AG690 TRIDEM



AG690 Tridem Suspension

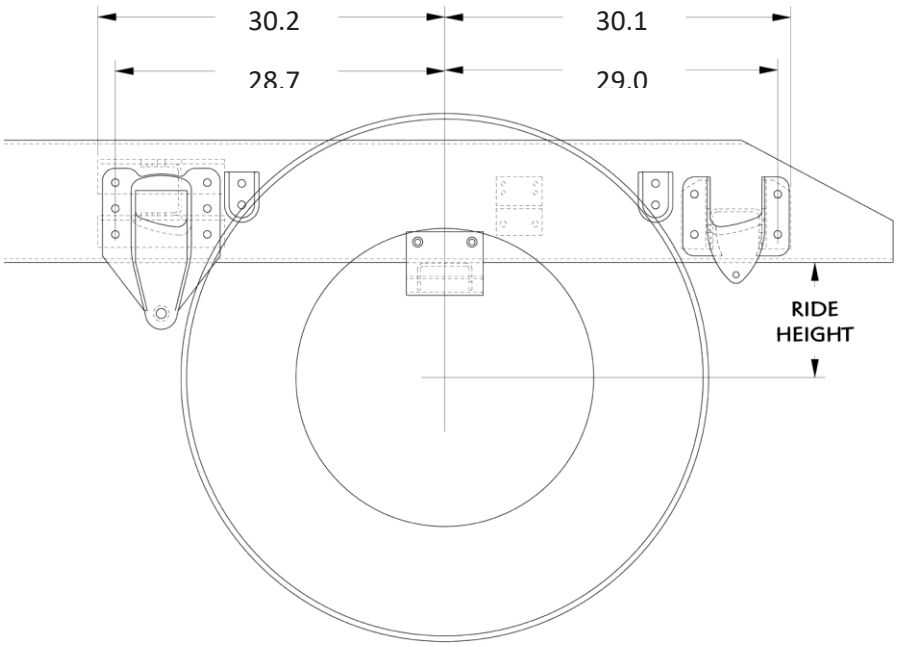
TABLE 3-7. AG690 Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden RideHeight	Unladen RideHeight
AG690 Tridem	69K	54″	10.5″	10.5″

NOTE: Actual axle spacing can depart from nominal due to axle slant requirements. Final axle spacing can vary by more than an inch from nominal in some cases. If precise axle spacing is critical due to body installation or state/local regulatory requirements, please contact Kenworth Applications/technical Support for assistance.

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REYCO 79KB SINGLE



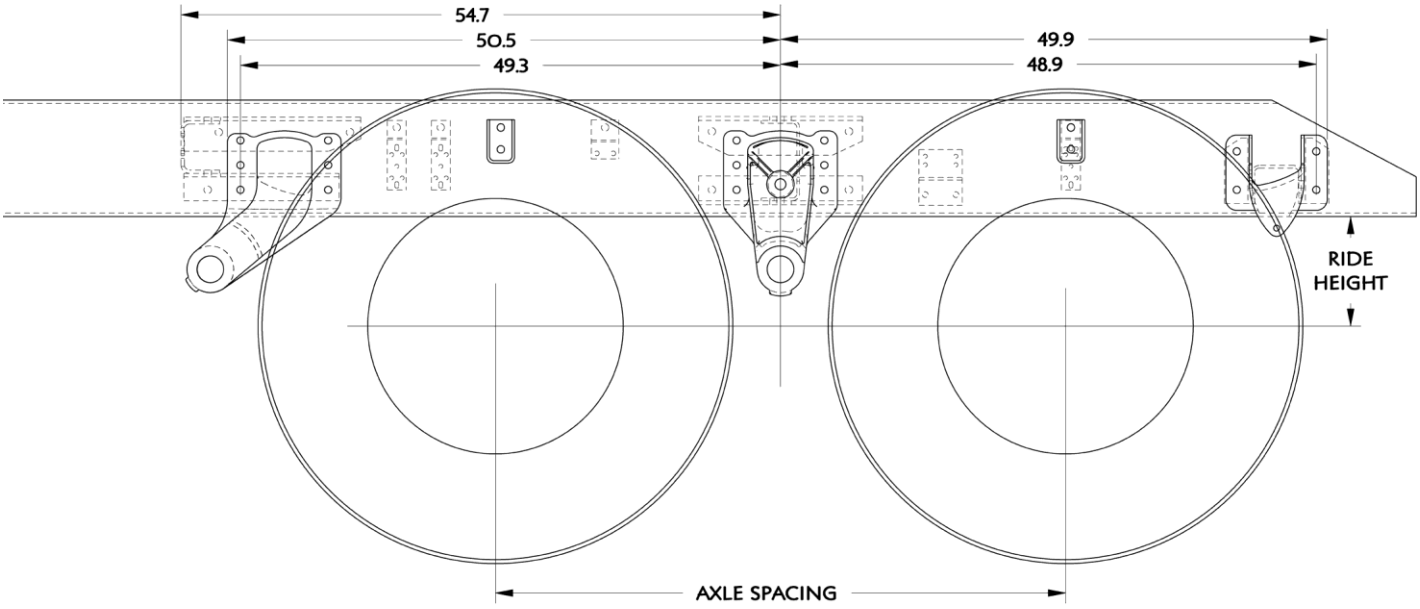
Reyco 79KB Suspensions

TABLE 3-8. Reyco 79KB Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden RideHeight	Unladen RideHeight
Reyco 79KB single	20K	-	8.3″	10.8″
Reyco 79KB single	23K	-	8.3″	10.8″
Reyco 79KB single	26K	-	8.2″	11.3″
Reyco 79KB single	31K	-	9.6″	12.2″

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REYCO 102 TANDEM



Reyco 102 Suspensions

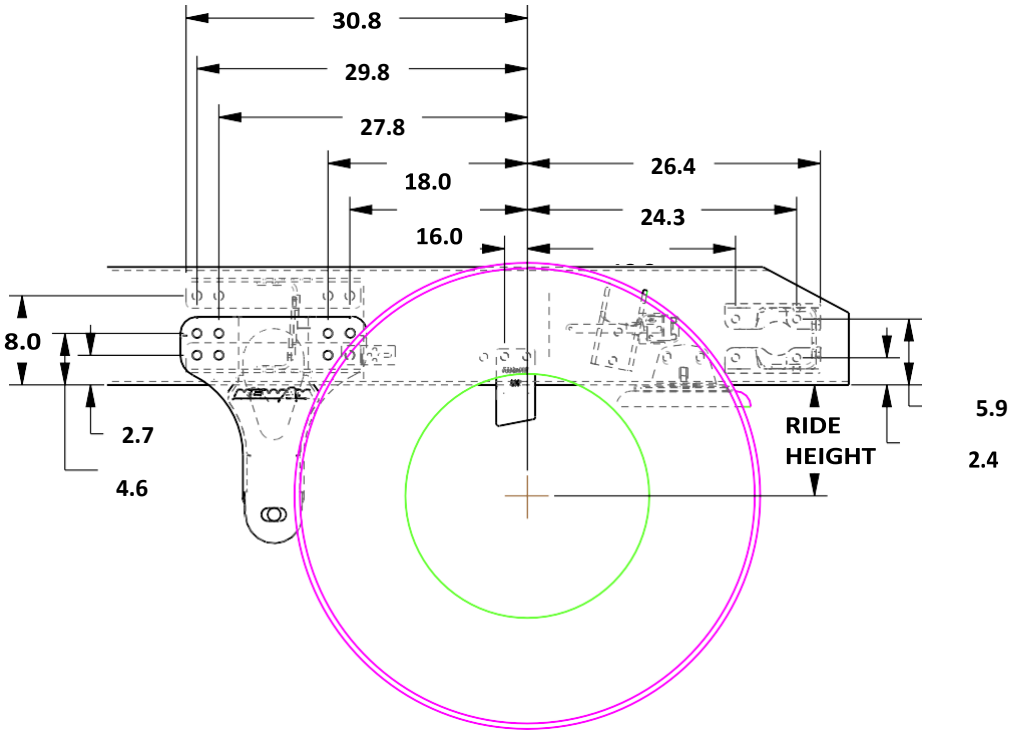
NOTE: 52" Axle Spacing dimensions shown

TABLE 3-9. Reyco 79KB Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden RideHeight	Unladen RideHeight
Reyco 102 Tandem	38K	52"	9.2"	10.8"

NOTE: Actual axle spacing can depart from nominal due to axle slant requirements. Final axle spacing can vary by more than an inch from nominal in some cases. If precise axle spacing is critical due to body installation or state/local regulatory requirements, please contact Kenworth Applications/technical Support for assistance.

NEWAY ADZ 123 SINGLE



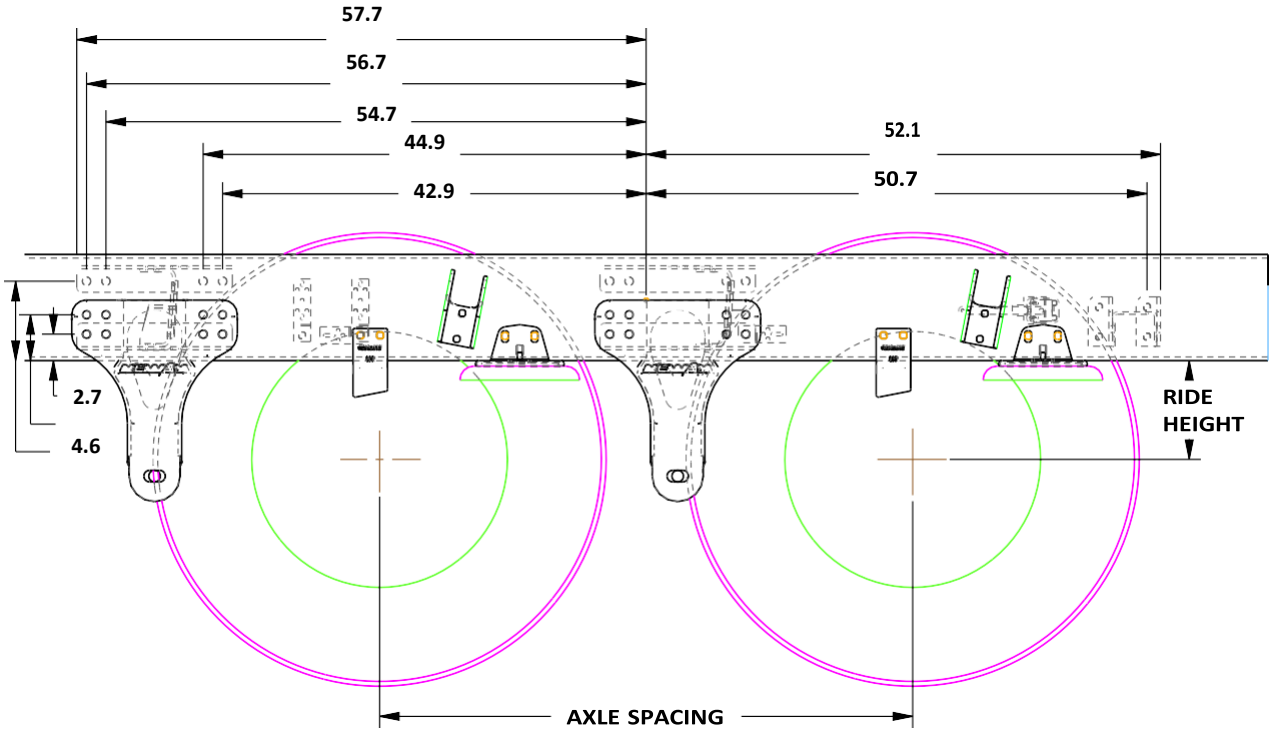
Neway ADZ Single Suspensions

TABLE 3-10. Neway ADZ Single Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden RideHeight	Unladen RideHeight
Neway ADZ123	23K	-	10″	10″
Neway ADZ126	26K	-	10″	10″

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NEWAY ADZ 246 TANDEM



Neway ADZ Tandem Suspensions

NOTE: 54″ Axle Spacing dimensions shown

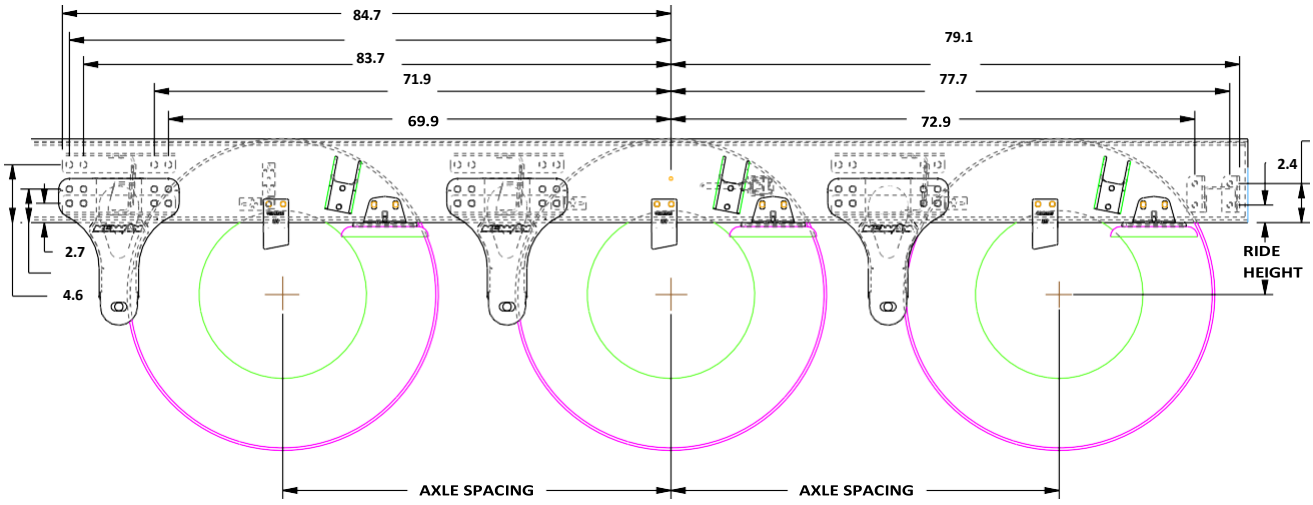
TABLE 3-11. Neway ADZ Tandem Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden RideHeight	Unladen RideHeight
Neway ADZ246	46K	54″	10″	10″
Neway ADZ246	46K	60″	10″	10″
Neway ADZ246	46K	72″	10″	10″
Neway ADZ246	52K	54″	10″	10″
Neway ADZ246	52K	54″	12″	12″
Neway ADZ246	52K	60″	10″	10″
Neway ADZ246	52K	60″	12″	12″

NOTE: Actual axle spacing can depart from nominal due to axle slant requirements. Final axle spacing can vary by more than an inch from nominal in some cases. If precise axle spacing is critical due to body installation or state/local regulatory requirements, please contact Kenworth Applications/technical Support for assistance.

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NEWAY ADZ 369 TRIDEM



Neway ADZ Tridem Suspensions

NOTE: 54" Axle Spacing dimensions shown

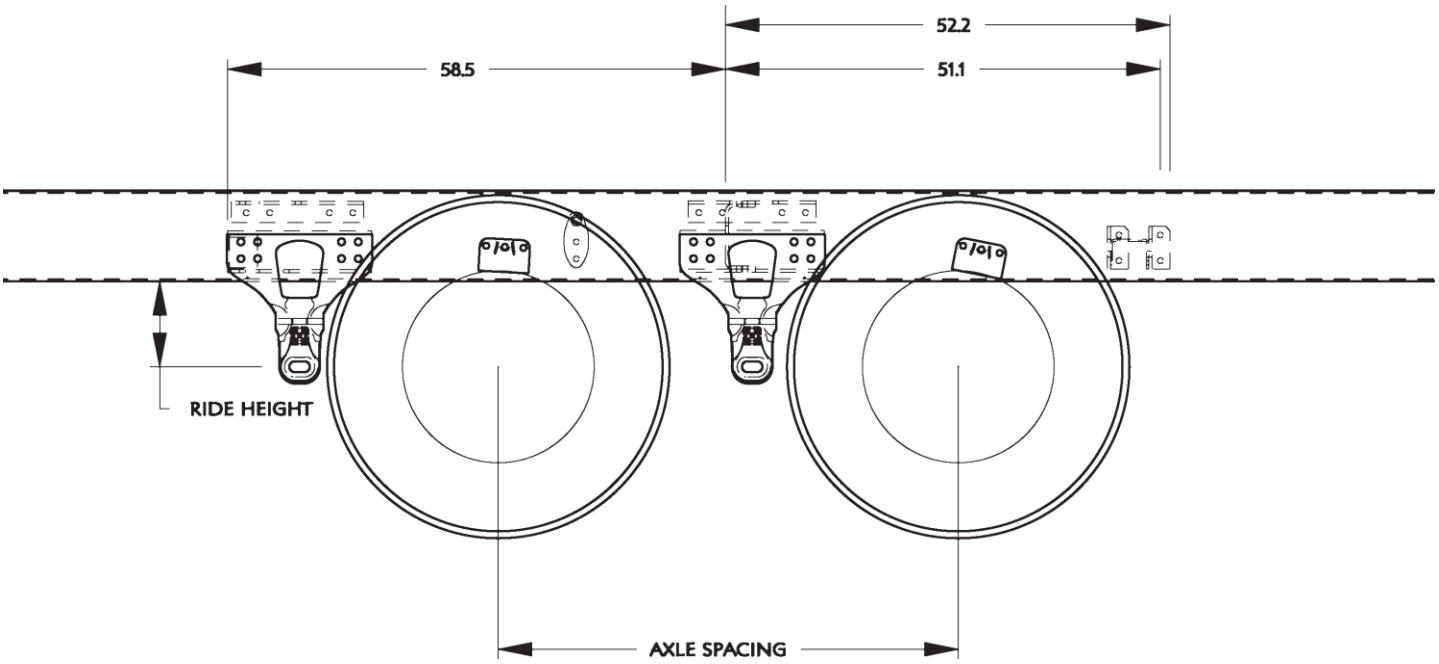
TABLE 3-12. Neway ADZ Tridem Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden RideHeight	Unladen RideHeight
Neway ADZ369	69K	54"	10"	10"
Neway ADZ369	69K	54"	12"	12"
Neway ADZ369	69K	60"	12"	12"
Neway ADZ369	78K	54"	10"	10"
Neway ADZ369	78K	60"	10"	10"

NOTE: Actual axle spacing can depart from nominal due to axle slant requirements. Final axle spacing can vary by more than an inch from nominal in some cases. If precise axle spacing is critical due to body installation or state/local regulatory requirements, please contact Kenworth Applications/technical Support for assistance.

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HENDRICKSON PRIMAAX EX TANDEM



Hendrickson Primaax EX Tandem Suspensions

NOTE: 54" Axle Spacing dimensions shown

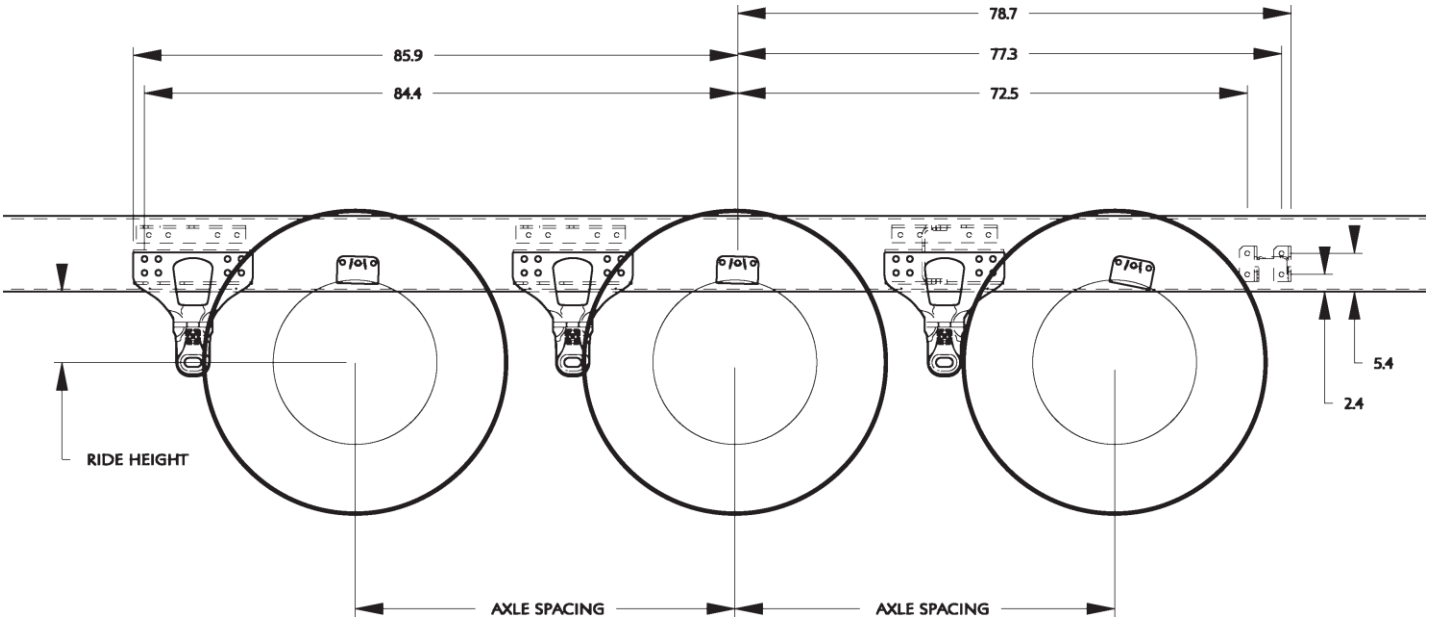
TABLE 3-13. Hendrickson Primaax EX Tandem Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden RideHeight	Unladen RideHeight
Hendrickson Primaax	46K	54"	10"	10"
Hendrickson Primaax	46K	60"	10"	10"
Hendrickson Primaax	46K	72"	10"	10"

NOTE: Actual axle spacing can depart from nominal due to axle slant requirements. Final axle spacing can vary by more than an inch from nominal in some cases. If precise axle spacing is critical due to body installation or state/local regulatory requirements, please contact Kenworth Applications/technical Support for assistance.

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HENDRICKSON PRIMAAX EX TRIDEM



Hendrickson Primaax EX Tridem Suspensions

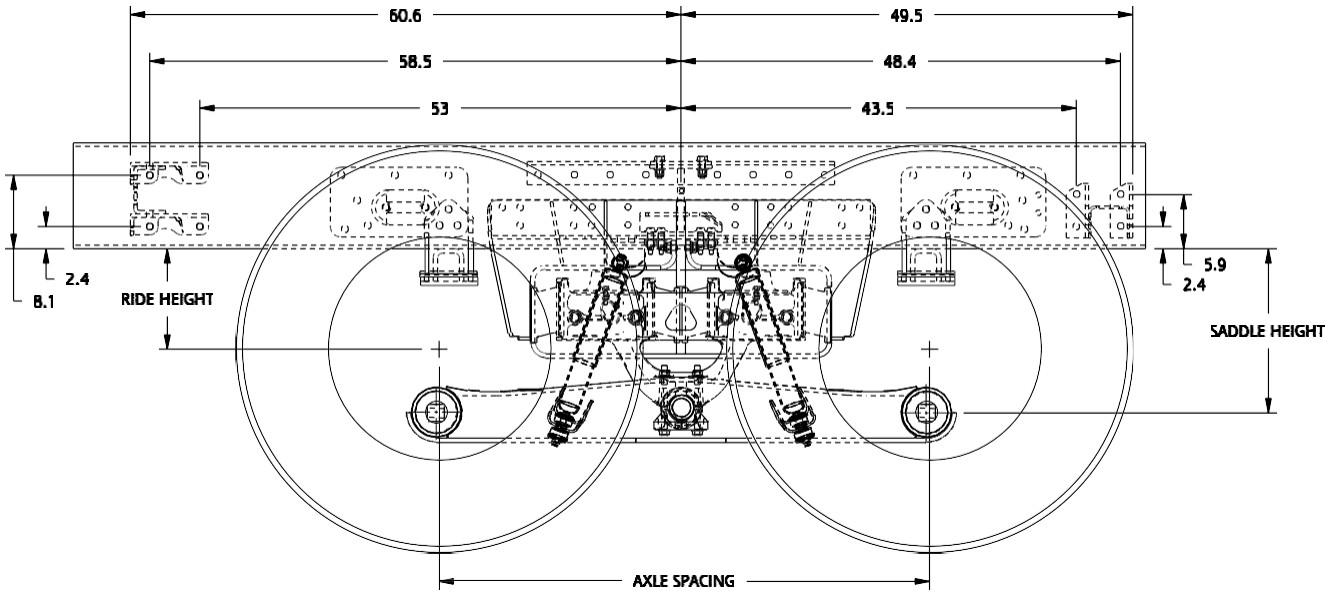
NOTE: 54" Axle Spacing dimensions shown

TABLE 3-14. Hendrickson Primaax EX Tridem Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden RideHeight	Unladen RideHeight
Hendrickson Primaax	69K	54"	10"	10"
Hendrickson Primaax	69K	60"	10"	10"

NOTE: Actual axle spacing can depart from nominal due to axle slant requirements. Final axle spacing can vary by more than an inch from nominal in some cases. If precise axle spacing is critical due to body installation or state/local regulatory requirements, please contact Kenworth Applications/technical Support for assistance.

HENDRICKSON ULTIMAAX TANDEM



Hendrickson ULTIMAAX Tandem Suspensions

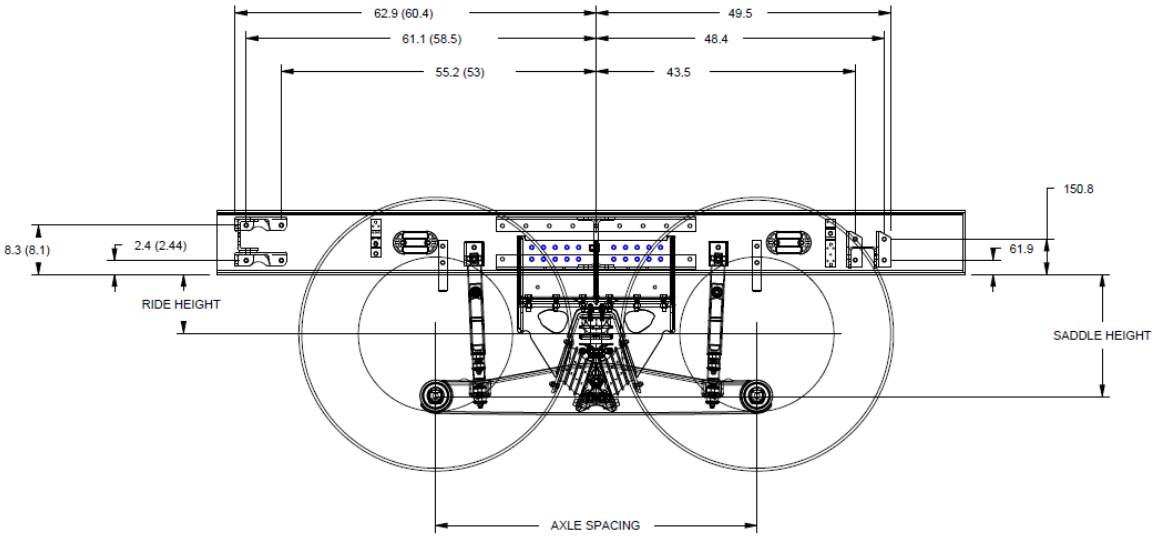
NOTE: 54″ Axle Spacing dimensions shown

TABLE 3-15. Hendrickson Ultimaax Tandem Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden Ride Height	Unladen Ride Height
Hendrickson ULTIMAAX 460 17.5″	46K	54″	11″	12.5″
Hendrickson ULTIMAAX 460 18.25″	46K	54″	11″	12.5″
Hendrickson ULTIMAAX 460 17.5″	46K	60″	11″	12.5″
Hendrickson ULTIMAAX 460 18.25″	46K	60″	11″	12.5″
Hendrickson ULTIMAAX 520 17.5″	52K	54″	11″	12.5″
Hendrickson ULTIMAAX 520 18.25″	52K	54″	11″	12.5″
Hendrickson ULTIMAAX 520 17.5″	52K	60″	11″	12.5″
Hendrickson ULTIMAAX 520 18.25″	52K	60″	11″	12.5″
Hendrickson ULTIMAAX 460 17.5″	46K	54″	11″	12.5″
Hendrickson ULTIMAAX 460 18.25″	46K	54″	11″	12.5″

NOTE: Actual axle spacing can depart from nominal due to axle slant requirements. Final axle spacing can vary by more than an inch from nominal in some cases. If precise axle spacing is critical due to body installation or state/local regulatory requirements, please contact Kenworth Applications/technical Support for assistance.

HENDRICKSON HAULMAAX HMX EX TANDEM



Hendrickson HAULMAAX HMX EX Tandem Suspensions

NOTE: 54” Axle Spacing dimensions shown

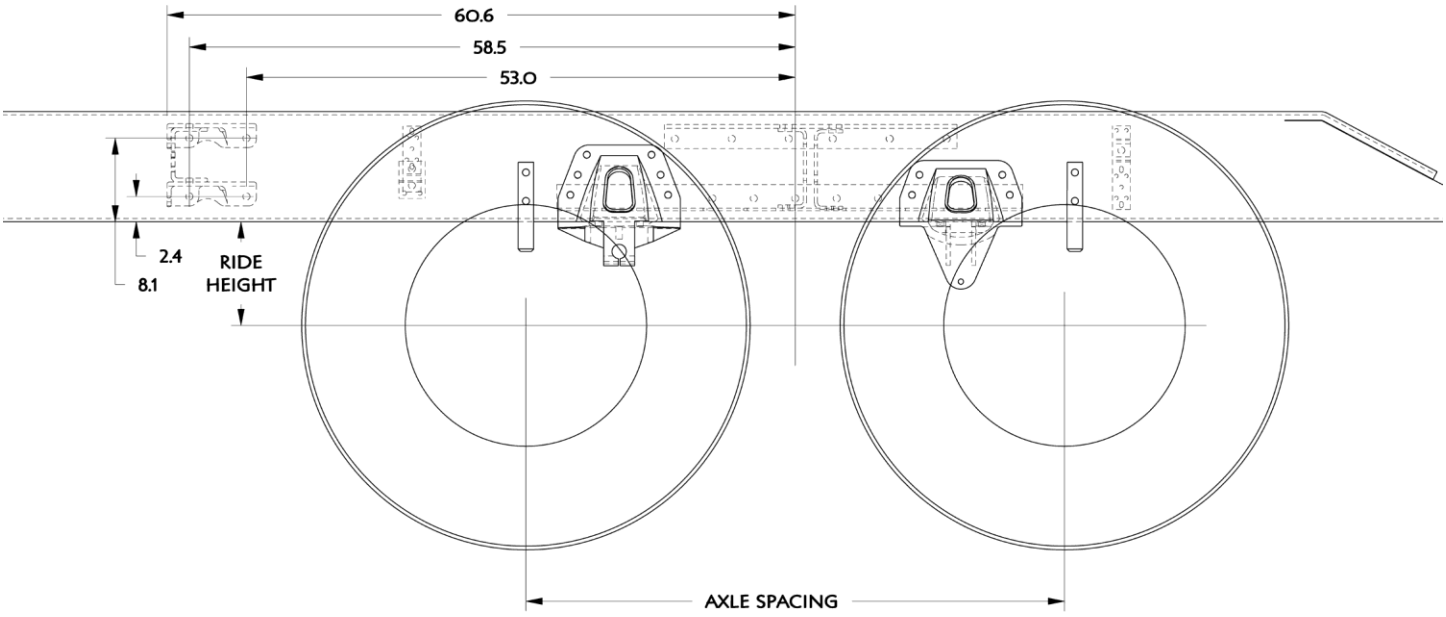
TABLE 3-16. Hendrickson HAULMAAX HMX EX Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden Ride Height	Unladen Ride Height
Hendrickson Haulmaax EX 400 16.5"	40K	54"	9.5"	11.5"
Hendrickson Haulmaax EX 400 17.5"	40K	54"	10.5"	12.5"
Hendrickson Haulmaax EX 460 16.5"	46K	54"	9.5"	11.5"
Hendrickson Haulmaax EX 460 17.5"	46K	54"	10.5"	12.5"
Hendrickson Haulmaax EX 460 18.5"	46K	54"	11.5"	13.5"
Hendrickson Haulmaax EX 460 17.5"	46K	60"	10.5"	12.5"
Hendrickson Haulmaax EX 460 18.5"	46K	60"	11.5"	13.5"
Hendrickson Haulmaax EX 520 16.5"	52K	54"	9.5"	11.5"
Hendrickson Haulmaax EX 520 17.5"	52K	54"	10.5"	12.5"
Hendrickson Haulmaax EX 520 18.5"	52K	54"	11.5"	13.5"

NOTE: Actual axle spacing can depart from nominal due to axle slant requirements. Final axle spacing can vary by more than an inch from nominal in some cases. If precise axle spacing is critical due to body installation or state/local regulatory requirements, please contact Kenworth Applications/technical Support for assistance.

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HENDRICKSON RT TANDEM



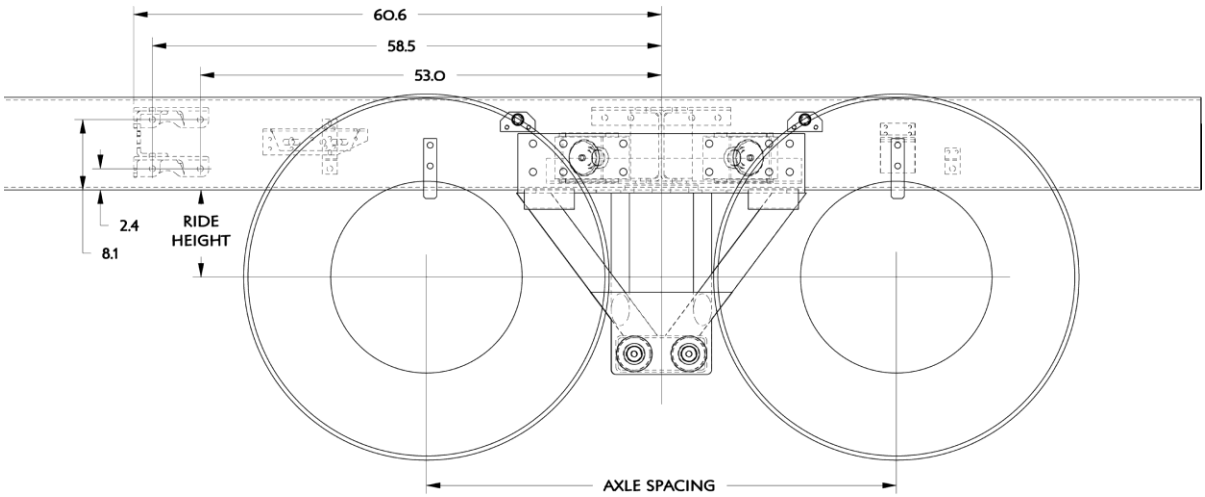
Hendrickson HAULMAAX RT Tandem Suspensions

NOTE: 54" Axle Spacing dimensions shown

TABLE 3-17. Hendrickson RT Tandem Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden Ride Height	Unladen Ride Height
Hendrickson RT463 6" saddle	46K	52"	10.0"	11.1"
Hendrickson RT463 6" saddle	46K	54"	10.0"	11.1"
Hendrickson RT463 7.19" saddle	46K	54"	11.2"	12.5"
Hendrickson RT463 7.94" saddle	46K	54"	11.9"	13.3"
Hendrickson RT463 6" saddle	46K	60"	10.0"	11.1"
Hendrickson RT463 7.94" saddle	46K	60"	11.9"	13.0"
Hendrickson RTE463 7.19" saddle	46K	52"	10.5"	11.6"
Hendrickson RT523 6" saddle	52K	52"	9.9"	11.0"
Hendrickson RT523 6" saddle	52K	54"	9.9"	11.0"
Hendrickson RT523 7.19" saddle	52K	54"	11.1"	12.2"
Hendrickson RT523 11" saddle	52K	54"	14.9"	16.0"
Hendrickson RT523 6" saddle	52K	60"	9.9"	11.0"
Hendrickson RT523 7.19" saddle	52K	60"	11.1"	12.2"

CHALMERS 856-46 TANDEM



Chalmers Tandem Suspensions

NOTE: 54" Axle Spacing dimensions shown

TABLE 3-18. Chalmers Tandem Rear Suspension Options

Suspension Type	Rating	Axle Spacing	Laden Ride Height	Unladen Ride Height
Chalmers 854-40-L	40K	54"	8.9"	11.1"
Chalmers 854-40-L-HS	40K	54"	9.6"	11.1"
Chalmers 854-40-H	40K	54"	10.2"	12.4"
Chalmers 854-40-H-HS	40K	54"	10.9"	12.4"
Chalmers 854-46-L	46K	54"	8.9"	11.3"
Chalmers 854-46-L-HS	46K	54"	9.6"	11.3"
Chalmers 854-46-H	46K	54"	10.1"	12.5"
Chalmers 854-46-H-HS	46K	54"	10.9"	12.5"
Chalmers 854-50-L	50K	54"	8.9"	11.3"
Chalmers 854-50-L-HS	50K	54"	9.6"	11.3"
Chalmers 854-50-H	50K	54"	10.1"	12.5"
Chalmers 854-50-H-HS	50K	54"	10.9"	12.5"
Chalmers 854-52-L-HS	52K	54"	9.6"	11.3"
Chalmers 854-52-H-HS	52K	54"	10.9"	12.5"
Chalmers 860-40-L	40K	60"	8.9"	11.1"
Chalmers 860-46-L	46K	60"	8.9"	11.3"
Chalmers 860-46-L-HS	46K	60"	9.6"	11.3"
Chalmers 860-46-H	46K	60"	10.1"	12.5"
Chalmers 860-46-H-HS	46K	60"	10.9"	12.5"
Chalmers 860-52-H	52K	60"	10.9"	12.5"
Chalmers 872-46-H-HS	46K	72"	11.0"	12.5"

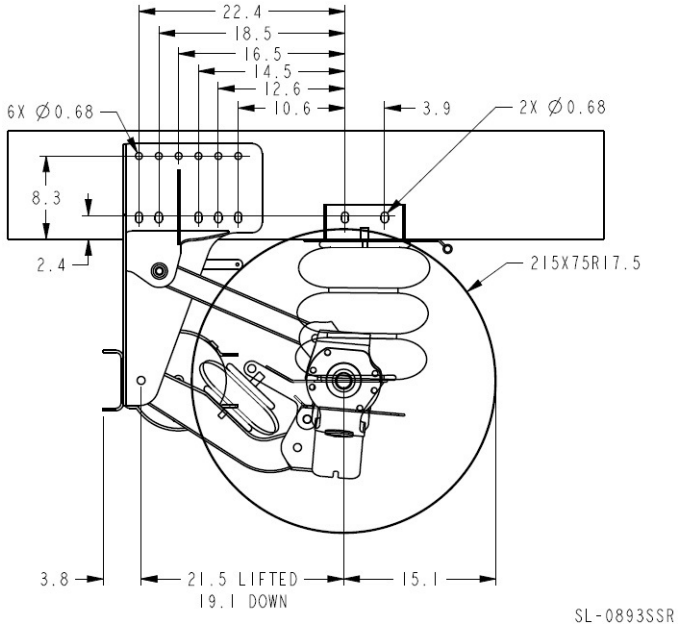
SECTION 3 - DIMENSIONS 01/2022

LIFT AXLES (PUSHERS AND TAGS)

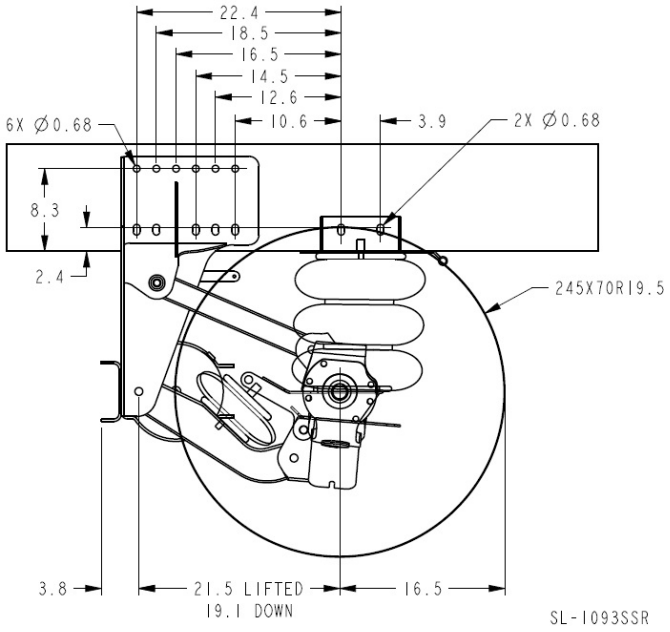
The lift axle layouts are provided as a tool to help layout bodies prior to arrival. The applicable dimensions are shown. When using the lift axle layouts to determine available frame space please be aware that required clearances are not shown. For information that may not be detailed in these drawings, please work with your local Kenworth Dealer to request that information.

Kenworth will automatically install the highest lift axle kit as applicable based on chassis frame height and loading conditions. Installing the highest lift axle kit will maximize ground clearance when the axle is in lifted state. If needed, kit may be lowered to clear driveline when in lifted state.

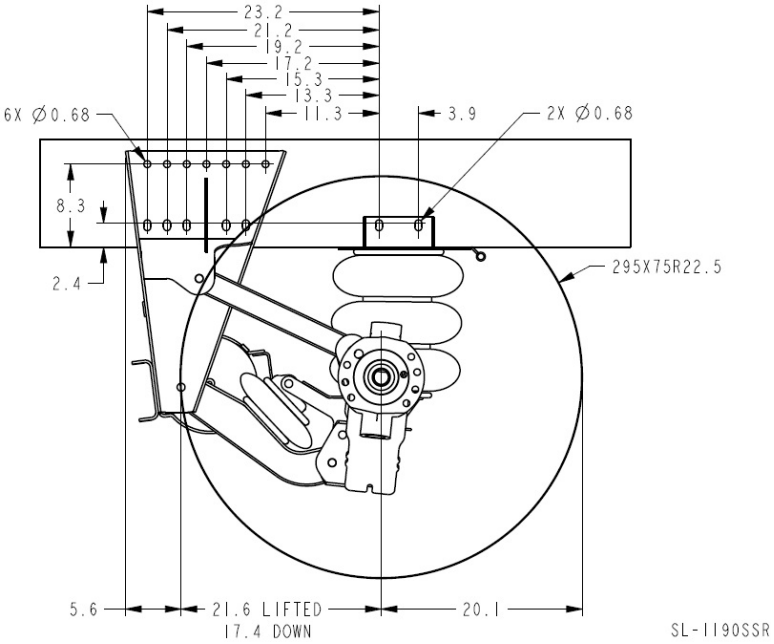
Watson & Chalin 8K Steerable (SL0893SSR)



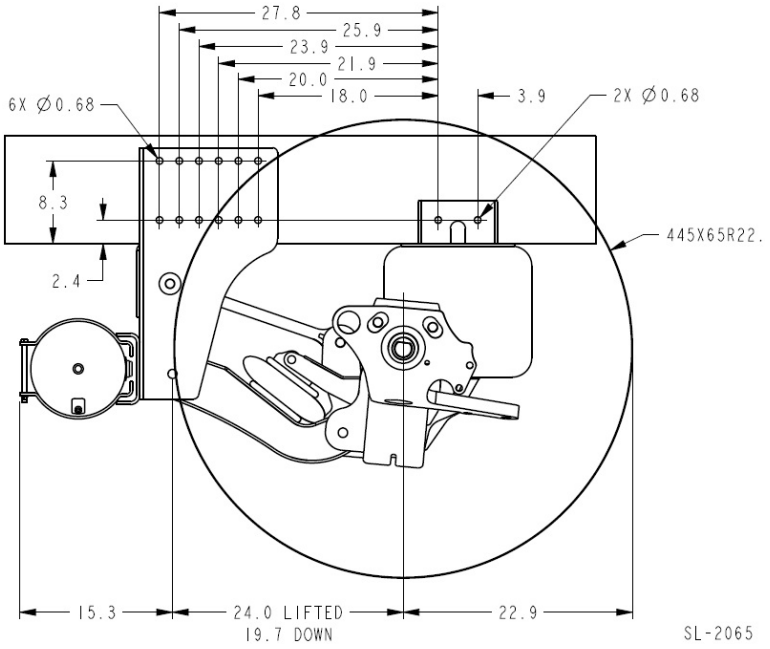
Watson & Chalin 10K Steerable (SL1093SSR)



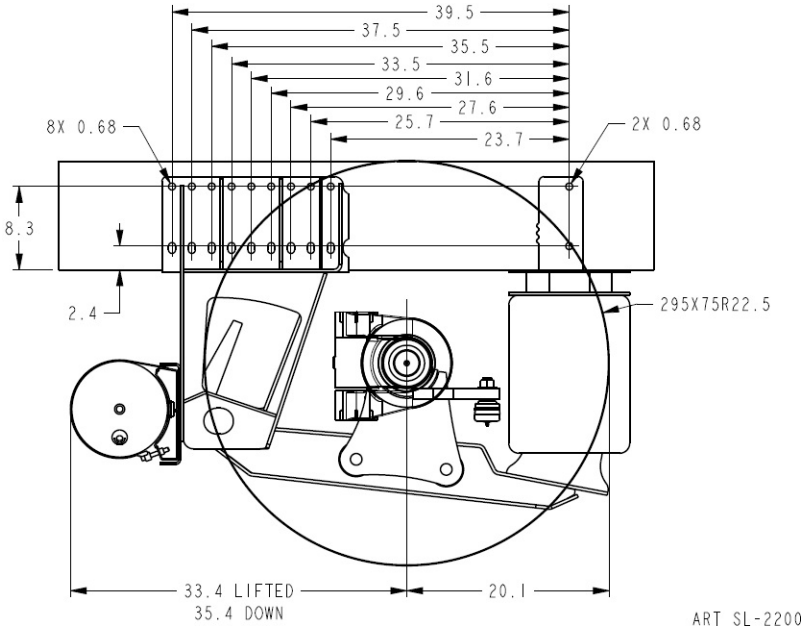
Watson & Chalin Tru Track Alumilite 13.5K Steerable (SL1190SSR)



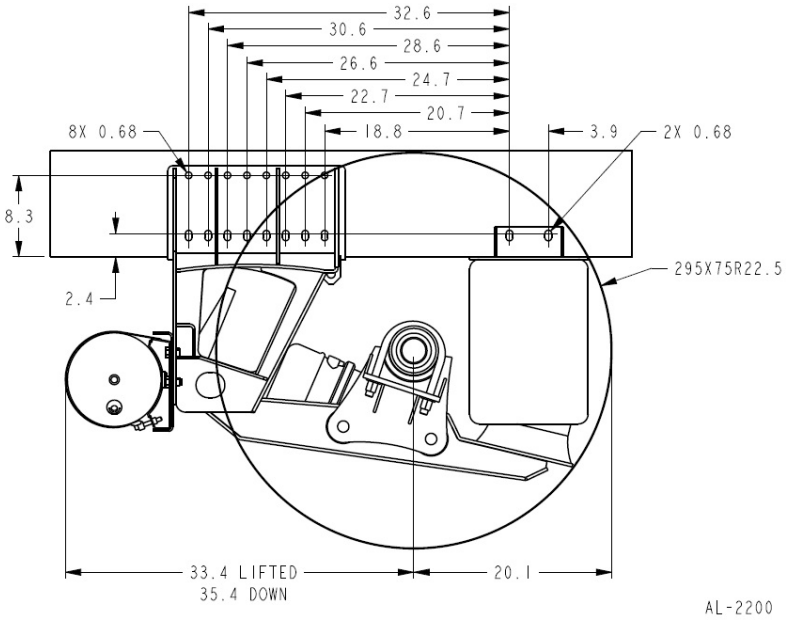
Watson & Chalin Tru Track 20K Steerable (SL2065)



Watson & Chalin 23K Steerable (SL2200) *Use with Duals Only*



Watson & Chalin 23K Non-Steerable (AL2200)



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AXLE TRACK AND TIRE WIDTH

The dimensions provided in this section are representative of some typical product combinations. The purpose this section is to demonstrate some of the typical dimensions.

- Axle Track: The distance between the dual tire centerlines on a dual tire arrangement or the distance between the tire centerlines on a single tire arrangement.
- Width: The distance over the outermost tire sidewall to sidewall.

These dimensions may be significant to the following:

- Appearance relative to other tires and chassis mounted equipment.
- Load carrying capacity. Different wheel disc offset can have a positive or negative impact on the axle carrying capacity of the axle.

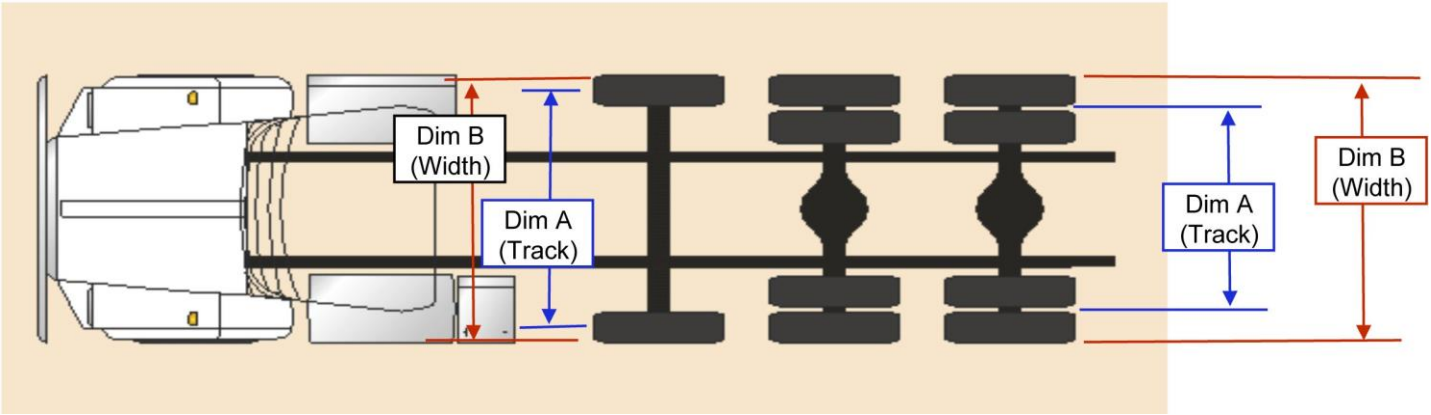


TABLE 3-19. Drive Axle Width Calculation.

Axle - Drive	Wheel	Tire	Configuration	Track Dim "A"	Overall Width Dim "B:
Meritor RT46-160(P)(EH) 46K Dual Dana Spicer D46-170(H)(P) 46K Dual	Alcoa 88367 22.5X8.25	11R22.5	4-4	73.3"	97.8"
Meritor RT46-160(P)(EH) 46K Dual Dana Spicer D46-170(H)(P) 46K Dual	Alcoa 98363 24.5X8.25	11R24.5	4-4	73.6"	98.0"
Meritor RT46-160WT(P)(EH) 46K Dual Wide Track Dana Spicer D46-170W(H)(P) 46K Dual Wide Track	Alcoa 88367 22.5X8.25	11R22.5	4-4	79.2"	103.7"
Meritor RT46-160WT(P)(EH) 46K Dual Wide Track Dana Spicer D46-170W(H)(P) 46K Dual Wide Track	Alcoa 98363 24.5X8.25	11R24.5	4-4	79.5"	103.9"
Dana Spicer D46-170(H)(P) 46K Dual Meritor RT46-160(P)(EH) 46K Dual	Alcoa 82262 22.5X12.25	425/65R22.5	2-4	72.7	88.9"
Meritor RT46-160WT(P)(EH) 46K Dual Wide Track Dana Spicer D46-170W(H)(P) 46K Dual Wide Track	Alcoa 82262 22.5X12.25	425/65R22.5	2-4	78.7"	94.9"

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TABLE 3-20. Steer Axle Width Calculation.

Axle - Steer	Wheel	Tire	Brake Drum Type	Track Dim "A"	Overall Width Dim "B:
Meritor MFS13 Std Track Dana Spicer E-1322I 13.2K	Alcoa 98363 24.5X8.25	11R24.5	CAST	80.2"	91.0"
Meritor MFS13 Wide Track Dana Spicer E-1322W 13.2K	Alcoa 98363 24.5X8.25	11R24.5	CAST	82.2"	93.0"
Meritor MFS20 Std Track Dana Spicer D2000 20K	Alcoa 82362 22.5X12.25	425/65R22.5	CAST	86.5"	102.7"
Meritor MFS20 Std Track Dana Spicer D2000 20K	Alcoa 82462 22.5X12.25	425/65R22.5	CAST	82.6"	98.8"

TABLE 3-21. Lift Axle Width Calculation.

Lift Axle Model	Wheel	Tire	Wheel Orientation	Track Dim "A"	Overall Width Dim "B"
W&C SL0893SSR 8K Steerable	Alcoa 66480 17.5x6	215/75R17.5	Same as FR	77.3"	85.8"
W&C SL1093SSR Steerable 10K	Alcoa 77349 19.5x7.5	265/70R19.5	Same as FR	78.5"	88.5"
W&C SL1190SSR Steerable 13.5K	Alcoa 88367 22.5x8.25	255/70R22.5	Same as FR	80.4"	90.7"
W&C SL2065 Steerable 20K	Alcoa 82362 22.5x12.25	425/65R22.5	Same as FR	83.6"	99.8"
W&C SL2200 Steerable 23K	Alcoa 88367 22.5x8.25	295/75R22.5	Same as RR,dual	78.2"	102.8"
W&C AL2200-STD Track Non-Steerable 23K	Alcoa 88367 22.5x8.25	11R22.5	Same as RR,dual	72.2"	96.6"
W&C AL2200-STD Track Non-Steerable 23K	Alcoa 82362 22.5x12.25	425/65R22.5	Same as RR,single	78.4"	94.7"
W&C AL2200-Wide TrackNon-Steerable 23K	Alcoa 89465 22.5x9	315/80R22.5	Same as FR,single	64.7"	77.3"
W&C AL2200-Wide TrackNon-Steerable 23K	Alcoa 84362 22.5x14	445/50R22.5	Same as RR,single	80.6"	97.7"

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GROUND CLEARANCE

This information is provided as a reference, not all optional equipment is included. To calculate the height on your specific chassis, please use the ride height information provided on page 41. For comparison the FS value shown is 12.5" unladen and 10.5" laden.

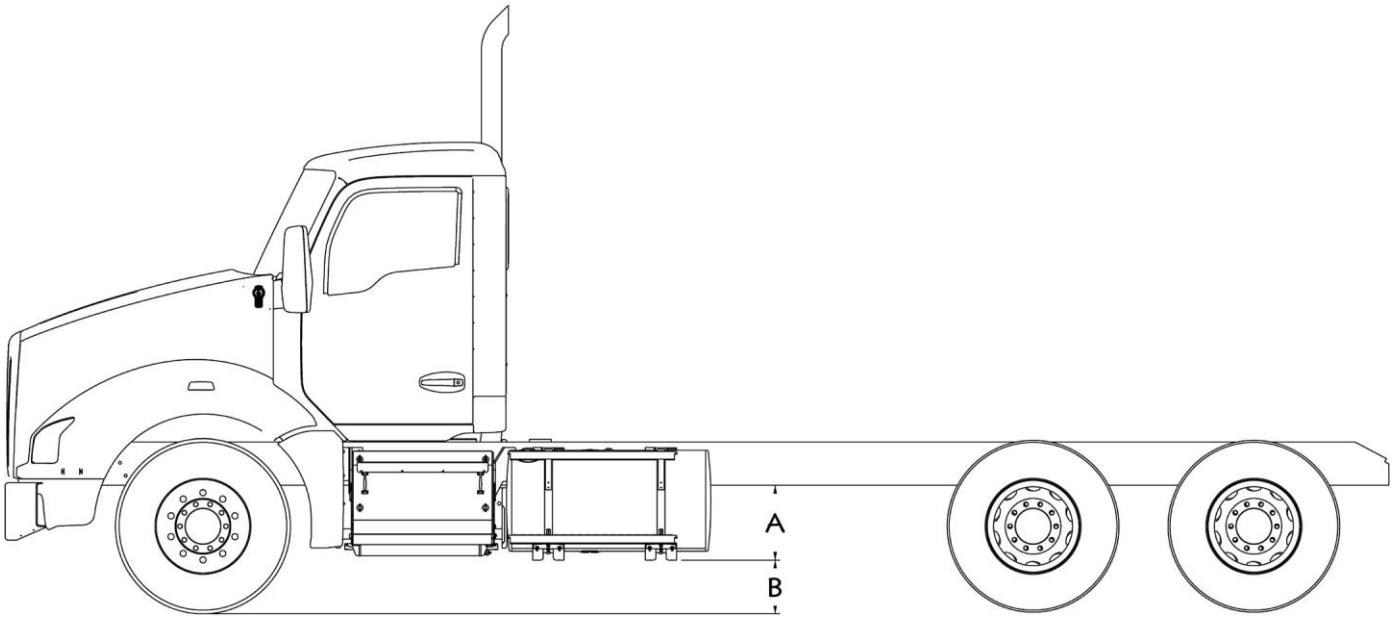


TABLE 3-22. Ground Clearance for Fuel Tanks and DEF Tanks

Front Suspension	Front Tires	Rear Suspension	Rear Tires	Fuel Tank Size	Component	Dimension "A" Distance from Bottom of Frame Rail (in)	Dimension "B" Ground Clearance (in)	
							Unladen	Laden
20K Taperleaf Spring	425/65R22.5	Hendrickson HMX 460 17.5" SaddleHeight	11R24.5	22" Diameter	Fuel Tank	16.3	17.2	14.9
					DEF Tank	15.3	18.2	15.9
				24.5" Diameter	Fuel Tank	18.2	15.3	13
					DEF Tank	15.8	17.7	15.4
				28.5" Diameter	Fuel Tank	21.4	12	9.7
					DEF Tank	17.2	16.2	13.9

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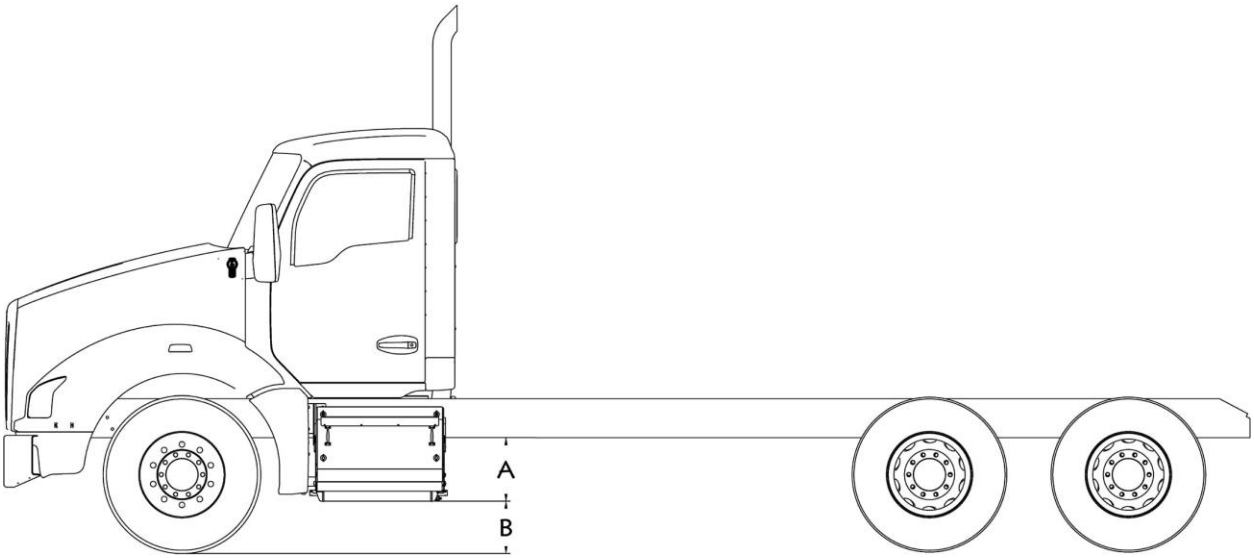


TABLE 3-23. Ground Clearance for Bottom of Rail and Cab Step

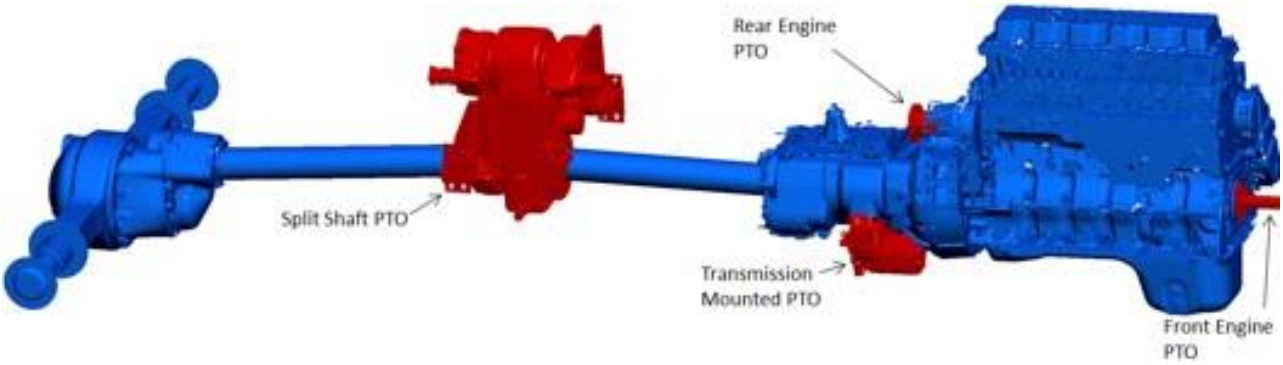
Front Suspension	Front Tires	Rear Suspension	Rear Tires	FuelTank Size	Component	Dimension "A" Distance from Bottom of Frame Rail (in)	Dimension "B" Ground Clearance (in)	
							Unladen	Laden
20K Taperleaf Spring	425/65R22.5	Hendrickson HMX 460 17.5" SaddleHeight	11R24.5	22" Diameter	Battery Box with Air Tanks	17.3	16.2	13.9
				24.5" Diameter	Vocational Battery Box with Air Tanks	17.8	15.7	13.4
				28.5" Diameter	DPF[1] Box	15.6	17.8	15.5

[1] Dimensions shown are for daycabs with high route exhaust. Sleeper ground clearance is reduced by 1.3 inches.

SECTION 4 – PTO MOUNTING & PROGRAM 01/2022

INTRODUCTION

A Power Take Off (PTO) provides a way to divert some or all the truck's engine power to another component. There are a wide variety of PTO options available.



PTO ACRONYM LIBRARY

Acronym	Definition
ABS	Anti-Lock Braking System
CAN	Controller Area Network
CC	Cruise Control
CECU	Cab Electrical Control Unit
DEF	Diesel Exhaust Fluid
DTC	Diagnostics Trouble Code
ECM	Engine Control Module
ECU	Electrical Control Unit
EIST	Engine Idle Shutdown Timer
EOA	Electric Over Air
EOH	Electric Over Hydraulic
FIC	Fast Idle Control
J-1939	SAE CAN Communication Standard
LIN	Local Interconnect Network
MSB	Master Solenoid Bank
MSM	Master Switch Module
MUX	Multiplex
OBD	On Board Diagnostics
OCM	Optional Control Module
OEM	Original Equipment Manufacture
PCC	Predictive Cruise Control
PDC	Power Distribution Center
PGN	Parameter Group Number
PMC	PTO Mode Control
PSC	PTO Speed Control
PTO	Power Take Off
PVP	PACCAR Vehicle Pro
RP1226	TMS Messaging Standard
SCM	Standard Control Module
SCR	Selective Catalyst Reduction
SPN	Suspect Parameter Number
TCM	Transmission Control Module
TSC1	Torque Speed Control (request)
VECU	Vehicle Electrical Control Unit

TRANSMISSION MOUNTED PTO

This is the most common type of PTO that is used. On a manual transmission there are two locations for PTO's.On medium duty transmissions there are 6 bolt PTO locations on the right and left. On heavy duty manual transmissions there is a 6 bolt PTO on the right and an 8 bolt PTO on the bottom left. There are also some options for a thru shaft or extended countershaft PTO. On a thru shaft PTO, the counter shaft extends out throughthe back of the transmission which can be used to power a PTO. When using a thru shaft PTO the vehicle mustbe spec'd with the correct option as not all transmissions will be set up for use with thru shaft PTO's. For more information go to www.roadranger.com and enter "PTO Installation Guide" in the search bar in the upper right corner.

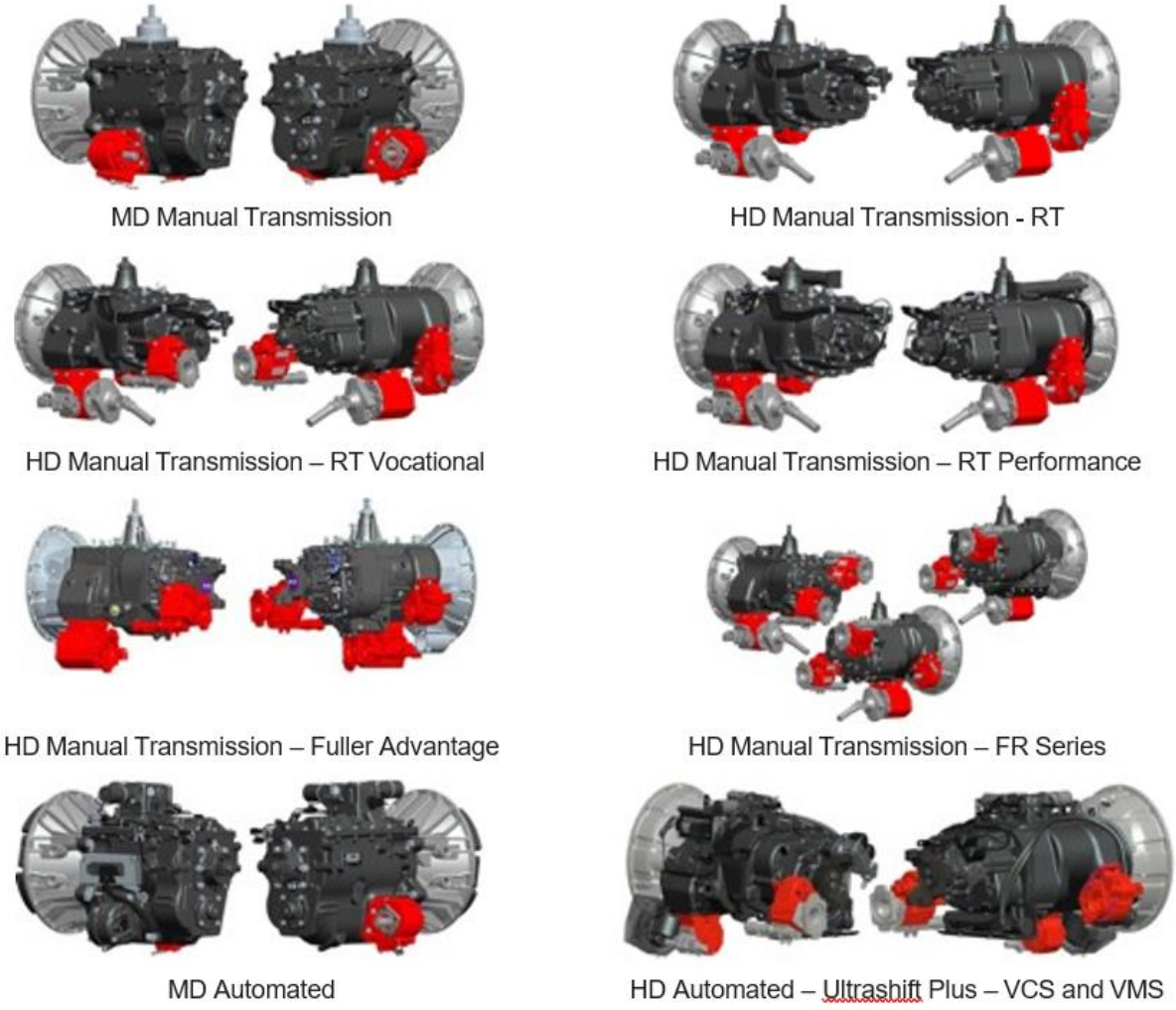


Figure 4-1. PTO Mounting – Manual/AMT Transmission

AUTOMATIC TRANSMISSIONS

On Allison transmissions there are two locations for PTO's. The Allison 4000 series has PTO locations at 1 and 8 o'clock viewed from the back of the transmission. The 4000HS transmission does not have any PTO locations. The 3000 series Allison transmissions do have PTO locations at 4 and 8 o'clock. For more information on using PTOs with an Allison transmission go to www.allisontransmission.com and refer to the "Rugged Duty Series Brochure" and "PTO Request Flyer" which is available in a 1000/2000 version and a 3000/4000 version.

Some PTO configurations will have clearance issues with other components on the truck. With manual transmissions, a 6-bolt PTO on the right will typically clear most components when the DPF and SCR are under the cab. This is also true when 30 and 45-degree adapters are used. The 8-bolt bottom mount PTO will not have any issues unless you are running a driveshaft back to another component and the truck has a crossover style exhaust. In this case, the DPF and SCR would block any routing for the driveshaft. If a wet kit is used in this scenario there is enough room to mount the PTO and the hydraulic pump without interfering with the exhaust. On Allison 4000 series transmissions, most PTO's will fit in the 1 o'clock position without interfering with the cab. If a wet kit is used here, the dipstick housing will most likely need to be modified as it runs over the top of the transmission to the driver side of the vehicle. The PTO in the 8 o'clock position is typically ok. The same issue with crossover exhaust would apply here as well. There are some scenarios where the PTO will be very close to or could interfere with the rear spring shackle on the front suspension. This problem can occur on vehicles with a set-back front axle and the problem is amplified on the short hood models.

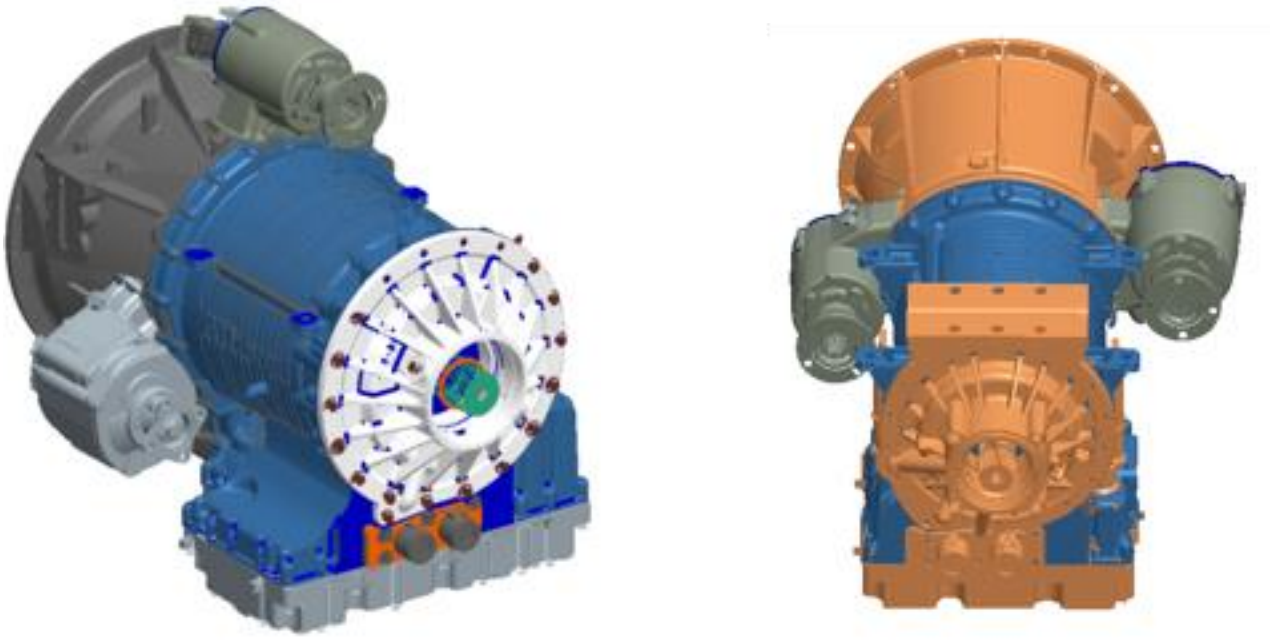


Figure 4-2. PTO Mounting – Allison Transmission (L: 4000 Series / R: 3000 Series)

REAR ENGINE PTO

Rear Engine PTO (REPTO) is commonly used in cement mixer and feed lot applications. The REPTO is driven off the rear gear train on the engine. There is a 1350/1410 flange on the bell housing in the 1 o'clock position that can be used to at- tach a hydraulic pump or driveshaft. The REPTO flange will always be turning when the engine is running, and the output rotation is the same as the engine. The Cummins ISL9 and PX-9 REPTO turns at a rate of 1.15:1. The Paccar MX-13 REPTO turns at a rate of 1.2:1. The Paccar MX-11 REPTO turns at a rate of 1.3:1.



Figure 4-3. REPTO Flywheel Housing

PTO TELLTALE

With key switch turned to “RUN” position, all the telltale icons will turn on briefly. PTO icon below will be illuminated green within the 15in Digital Display.



Figure 4-4. PTO Icon



Figure 4-5. PTO Telltale Location (15in Digital Display)

PTO CLEARANCES

The following visuals are provided to help aid in determining PTO locations and clearances. For specific dimensions please work through your local Kenworth dealer.

NOTE: Installations depict multiple PTOs.

To ensure the PTO area remains clear of air equipment, electrical and emissions equipment, Kenworth recommends always ordering PTO controls, even when installing the PTO aftermarket. Kenworth does offer a variety of factory installed PTOs. Contact your local dealer for assistance.

Manual Transmission:

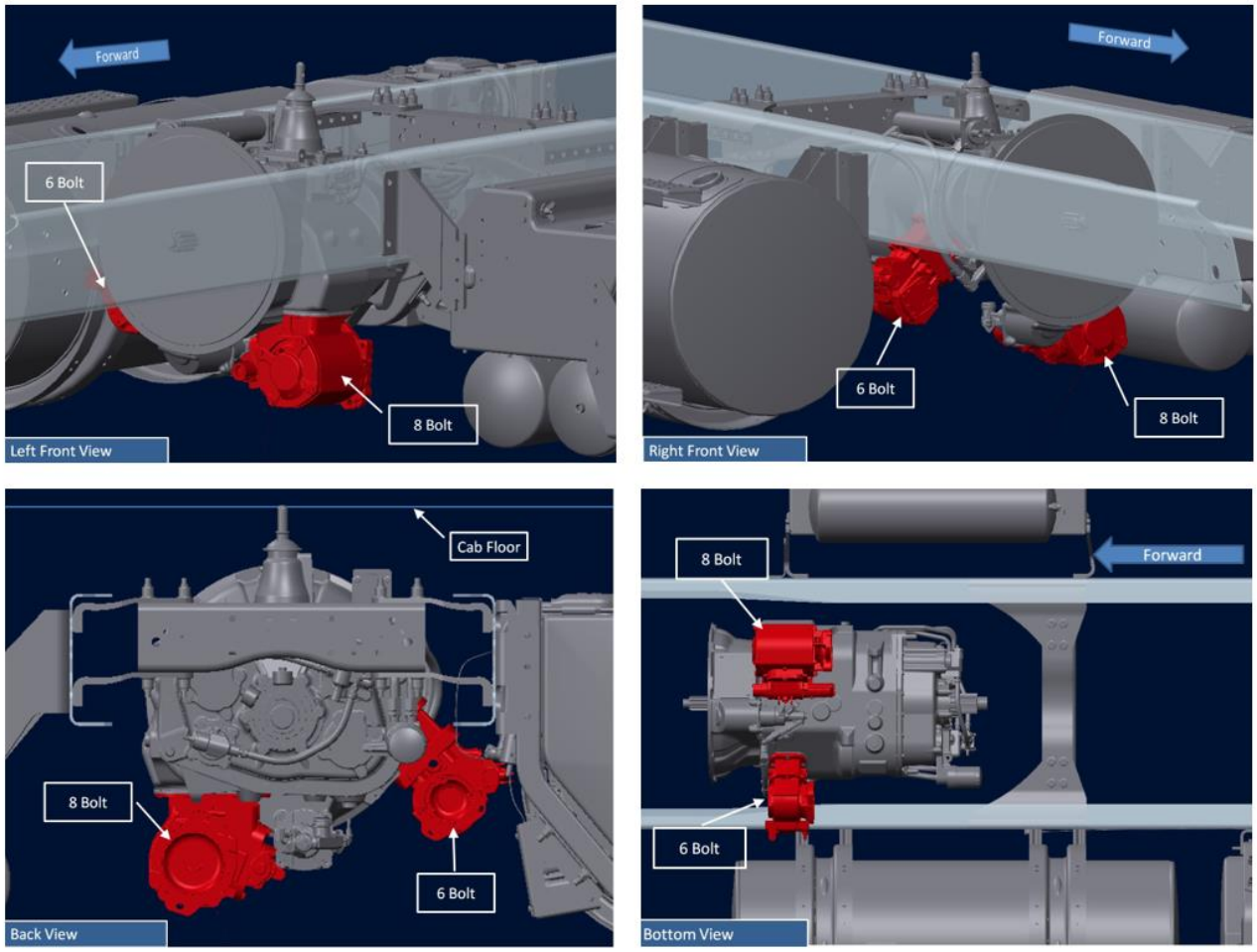


Figure 4-6. PTO Clearance – Manual Transmission

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Allison Transmission:

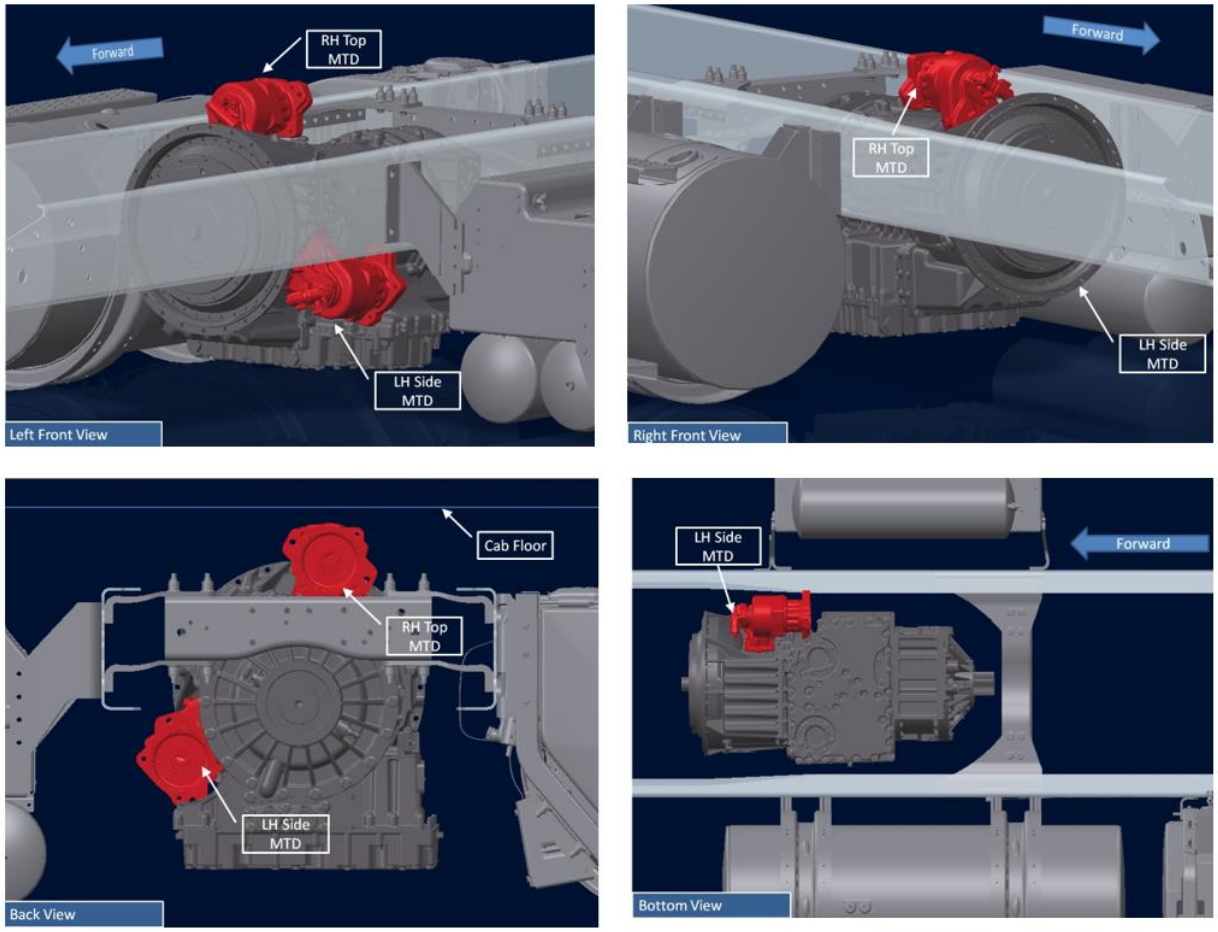


Figure 4-7. PTO Clearance – Allison Transmission

PTO MOUNTING CLEARANCE

This application guide indicates if a PTO has sufficient clearance to truck components in various mounting configurations. A green “ok” indicates that there is sufficient clearance to other truck components. A red “x” indicates that there minimal orno clearance and the application is not recommended. The truck components investigated in this guide include frame rails,Set Back Front Axle (SBFA) rear shackle, SBFA Front Air Suspension (FAS) rear shackle, over-bell frame brace, coolant return manifold, transmission clutch actuator, and exhaust system components.

Usage Notes:

1. This application guide is only applicable to 2.1M trucks.
2. Only the specified PTO configurations have been analyzed.
3. Horizontal crossover exhaust limits access behind PTOs for shaft drives and other PTO attachments.
4. Eaton FR transmissions require the use of a 30° adapter when installing Chelsea or Muncie transmission PTOs in the right-hand position.
5. Eaton RT & Ultrashift Plus transmissions require the use of a 49° adapter when installing Chelsea transmission PTOs in the right-hand position.
6. Eaton RT & Ultrashift Plus transmissions require the use of a 55° adapter when installing Muncie transmission PTOs in the right-hand position.
7. Eaton transmissions require the use of a 6 to 8 Bolt adapter when installing a 6 bolt PTO in the bottom position.

2.1M PTO MOUNTING CLEARANCE CHARTS

TABLE 4-1. 10-Bolt PTOs for Allison Transmissions

10-Bolt PTO's for Allison Transmissions			4000 series		3000 Series - 1 & 8 Housing		3000 Series - 4 & 8 Housing	
Brand	PTO	Truck Model	1 o'clock	8 o'clock	1 o'clock	8 o'clock	4 o'clock	8 o'clock
Chelsea	267-M3XK	All	x	x	ok	x	x	x
	267-M5XK	All	ok	ok	ok	x	ok	ok
	280-B5RK	T680 MH/T880 MH	ok	ok	ok	x	ok	ok
		T680 / T880	ok	x	ok	x	ok	ok
	870X-B3RS	All	ok	x	ok	x	x	x
	870X-B5RS	All	ok	x	ok	x	x	x
	890-B5XS	All	ok	x	ok	x	x	ok
Muncie	CD05-M3CX	All	ok	ok	ok	ok	ok	ok
	CD10-M1CX	T680 MH/T880 MH	ok	x	ok	x	ok	ok
		T680 / T880	ok	x	ok	x	x	ok
	CD10-M3CX	T680 MH/T880 MH	ok	x	ok	x	ok	ok
		T680 / T880	ok	x	ok	x	x	ok
	CS10-H1CX	All	x	x	x	x	x	x
	CS10-H3CX	All	x	x	x	x	x	x
	CS24-H1KX	All	ok	x	ok	x	x	x
	CS24-H3BX, KX	T680 MH/T880 MH	ok	ok	ok	x	ok	ok
		T680 / T880	ok	ok	ok	x	x	ok
	CS24X1BX	All	ok	x	ok	x	x	ok
	CS41-H1EX, CX	All	ok	x	x	x	x	x
	CS41-H3CX, EX	All	ok	x	x	x	x	x
	HS24-H1BX, KX	T680 MH/T880 MH	ok	x	x	x	ok	x
		T680 / T880	ok	x	x	x	ok	ok
	HS24-H3BX, KX	All	ok	ok	ok	x	x	ok

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TABLE 4-2. 6 and 8-Bolt PTOs for EATON Transmissions

6 & 8 Bolt PTO's for Eaton Transmissions

			FR		RT		Ultrashift Plus	
Brand	**Style**	**PTO**	**Bottom**	**Right**	**Bottom**	**Right**	**Bottom**	**Right**
Chelsea	6-Bolt	230-V3XD/XK	ok	ok[1,2,3]	ok	ok[1,2,3]	ok	ok[1,2,3]
		236-V3XD/XK	Recomend 238	ok[1,2,3]	Recomend 238	ok[1,2,3]	Recomend 238	ok[1,2,3]
		270-B3XD/XK	ok	ok[1,2,3]	ok	ok[1,2,3]	ok	ok[1,2,3]
		340-V5XD	ok	ok[1,2,3]	ok	ok[1,2,3]	ok	ok[1,2,3]
		442-V3XK	Recomend 489	ok[1,2,3]	Recomend 489	ok[1,2,3]	Recomend 489	ok[1,2,3]
		660-V3XK	Recomend 680	ok[1,2,3]	Recomend 680	ok[1,2,3]	Recomend 680	ok[1,2,3]
	8-Bolt	238-V3XD/XK	ok	n/a	ok	n/a	ok	n/a
		489-V3XK	ok	n/a	ok	n/a	ok	n/a
		680-V3XK	ok	n/a	ok	n/a	ok	n/a
		823-V3XS	ok	n/a	ok	n/a	ok	n/a
		880-V3XS/XV[4]	ok	n/a	ok	n/a	ok	n/a
		885-V3XS[4]	ok	n/a	ok	n/a	ok	n/a
Muncie	6-Bolt	CS6-P1BX/KX	Recomend CS8	ok[1,2,3]	Recomend CS8	ok[1,2,3]	x	ok[1,2,3]
		SH6-P1BX/KX	Recomend SH8	ok[1,2,3]	Recomend SH8	ok[1,2,3]	x	ok[1,2,3]
		TG6-P1BX/KX	Recomend TG8	ok[1,2,3]	Recomend TG8	ok[1,2,3]	Recomend TG8	ok[1,2,3]
	8-Bolt	828S-U1CX/EG	ok	n/a	ok	n/a	x	n/a
		CS8-P1BX/KX	ok	n/a	ok	n/a	ok	n/a
		SH8-P1BX/KX	ok	n/a	ok	n/a	ok	n/a
		TG8S-P1BX/KX	ok	n/a	ok	n/a	ok	n/a

NOTE:

1. Not available with Front Air Leaf Suspension.
2. Not available with Horizontal Crossover or Right Hand behind Fairing Exhaust Systems.
3. Restricted PTO access with RH Cab Step Assembly DPF-SCR exhaust systems with Vertical BOS tailpipes or RH Horizontal Tailpipe below rail.
4. The Optional Hydraulic Clutch Orientation must be used with this PTO.

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TABLE 4-3. Dual PTO Compatibility for EATON Transmissions

Dual PTO Compatibility for Eaton Transmissions

		Chelsea								Muncie						
		RH (6-Bolt) PTO's														
		RT			FR			Ultrashift+			RT		FR		Ultrashift+	
	Model	230/236-V3	340X-A5	442/660-V3	230/236-V3	340X-A5	442/660-V3	340X-A5	442/660-V3	Model	CS/SH6-A1	TG6-A1	CS/SH6-A1	TG6-A1	CS/SH6-A1	TG6-A1
LH (6 & 8-Bolt) PTO's	230/236-V3	S	S	S	S	S	S	ok	ok	828S-Q1	S	S	S	S	ok	ok
	238-V3	S	S	S	S	S	S	ok	ok	CS/SH8-A1	S	S	S	S	ok	ok
	340X-A5	S	S	S	S	S	S	ok	ok	TG8S-A1	S	S	S	S	ok	ok
	442/660-V3	S	S	S	S	S	S	ok	ok							
	489/680-V3	S	S	S	S	S	S	ok	ok							
	823-V3	S	S	S	S	S	S	ok	ok							
	880-V3	x	x	O	x	O	x	ok	ok							
	885-V3	x	x	O	x	O	x	ok	ok							

S = Standard Hydraulic Clutch Actuator Configuration
O = Optional Hydraulic Clutch Actuator Configuration

Note:
The actuator should not be flipped upside down to achieve PTO clearance.

1. Bleed nipple should always be above centerline.
2. Drain should always be below centerline.

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HYDRAULIC CLUTCH ACTUATOR CONFIGURATIONS

(Only used with 2.1M models with Eaton FR or RT transmissions)

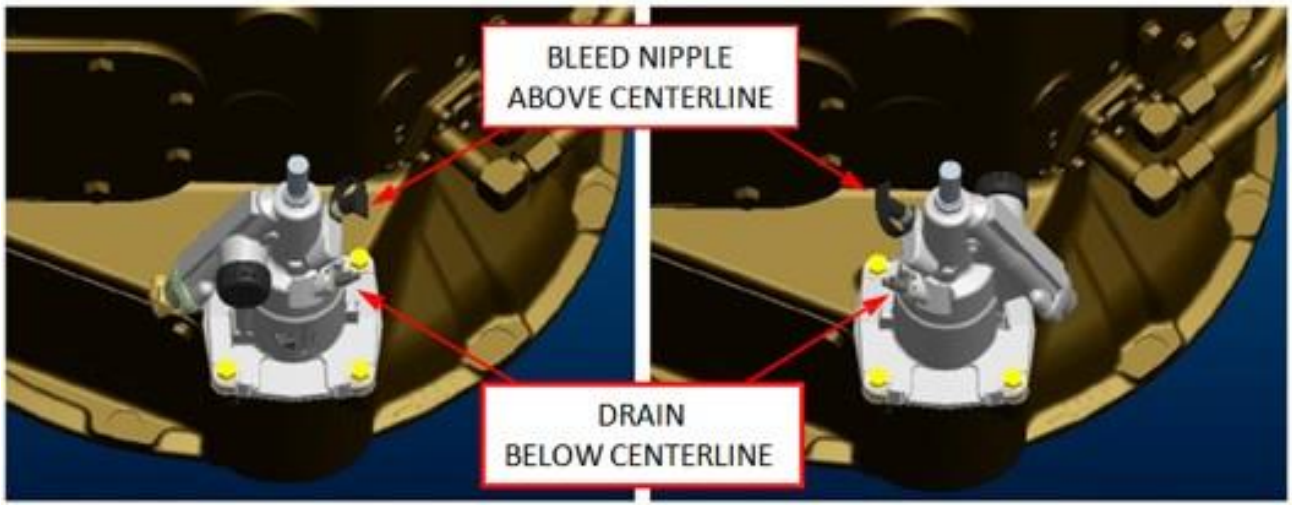


Figure 4-8. Hydraulic Clutch Actuator Configurations

Left: Standard Configuration – Air assist connection faces the driver's side. Used with all but Chelsea 880 and 885 PTOs.
Right: Bottom Mount PTO – Air assist connection faces the passenger's side. Used with all but Chelsea 880 and 885 PTOs.

MX PTO MODE CONTROL (PMC)

MX PTO Mode Control (PMC) includes features, limits, and protections that are active in PTO Mode. It also includes PTO Speed Control (PSC) functionality that includes a variety of useful ways to control engine speed during PTO operation.

Reference the VECU Programming Guide for detailed information on PTO Mode Control configuration, functionality, and usage.

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MX PTO MODE ACTIVATION

There are three ways to activate PTO Mode. PMC parameter(s) must be enabled on the vehicle for PTO Mode to activate.

- Active feedback of physical PTO engagement
  - Trucks with factory installed PTOs or that are coded for Customer Installed PTOs will come prewired to receive the PTO engaged signal.
- Active PTO Mode Switch
  - The PTO Mode Switch can be configured at the time of order or in the aftermarket. The PTO Mode switch can be used to activate PTO Mode independent of PTO engagement and may be useful for trucks with FEPTOs or REPTOs that need the ability to use PMC features.
- PTO Mode Request over the CAN bus.



Figure 4-9. PTO Mode Switch

MX PTO MODE CONTROL LOCATION

Vehicles can be configured to control PTO functionality from a cab location and/or a remote location (outside the cab). Most PTO Mode Features and Interlocks have a cab station option and a remote station option. This allows a vehicle to be configured for two unique jobs. For example, a vehicle could be configured for mobile cab station operation with one set of limits and stationary remote station operation with a different set of limits.

If a vehicle is configured for both cab and remote PTO control, a PMC Location Switch must be installed on the dash. This switch will determine which set of PTO Mode Features to apply and which control location to use.



Figure 4-10. PMC Location Switch

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MX PTO MODE FEATURES

The following features and configurations are available when PTO Mode is active.

- Cab Accelerator Configurations
- Disable in PTO Mode
- Torque Control (Automotive Style)
- Speed Control
- Enable in Remote PTO Mode
- Log Time and Fuel in PTO Mode
- Disable Engine Idle Shutdown Timer (EIST) in PTO Mode
- PTO Mode Specific Engine Idle Shutdown Timer (EIST)
- Fan-On in PTO Mode
- Adjustable PTO Engine Speed Governor Responsiveness (for light or heavy varying loads)

MX PTO MODE PROTECTIONS AND LIMITS

The following protections and limits are available when PTO Mode is active. Protections and limits are active when PTO Mode is active and will continue to be active until PTO Mode is no longer active.

- Max Vehicle Speed
- Max Engine Torque
- Max Engine Speed – Accelerator Controlled
- Max Engine Speed – Switch Controlled
- Min Engine Speed
- Max Rate of Engine Speed Change

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MX PTO SPEED CONTROL (PSC) FEATURES

PTO Mode must be active prior to using PTO Speed Control (PSC) to control engine speed. PSC is available from both the cab station and remote station (see PTO Mode Control Location Section above). In the cab location, cruise control switches and PSC specific switches are used to control engine speed. Equivalent remote station inputs are available (Reference Remote PMC Connections section below).

Steering Wheel Buttons

- Set / Res
  - Bump RPM Up / Down (Short Press)
  - Ramp RPM Up / Down (Long Press)



Figure 4-11. Steering Wheel Buttons

Dash Switches

- + / -
  - Configurable to either command one unique preset when "+" is pressed and a second unique preset when "-" is pressed OR toggle through 1 to 6 presets.



Figure 4-12. Dash Switches (+/-)

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Preset Switches

- 3 Dedicated Presets with the following configuration options.
  - Latch: Hold Preset Speed When Switch is Released
  - Cancel: Cancel PSC When Switch is Released
- The Remote PTO Inputs for Presets 1, 2 & 3 can be configured to function when Cab PTO Mode is active
- In some applications, it may be useful to connect the Remote PTO Inputs for Presets 1, 2 & 3 to something other than a hand-operated switch. For example, the inputs can be configured to activate based off PTO engagement, hydraulic pressure, or equipment movement.



Figure 4-13. Preset Switches (1, 2, and 3)

MX PTO SPEED CONTROL INTERLOCKS

PTO Speed Control Interlocks cancel PSC when active. There is an option to disable the accelerator when a PSC interlock is active. When a PSC interlock is active the engine speed will return to the Minimum Engine Speed in PTO Mode or the engine speed commanded by the accelerator if applicable. An active PSC interlock does not disable PMC protections and limits.

The configurable PSC interlocks are listed below.

- Clutch Pressed
- Park Brake NOT Set
- Transmission NOT in Neutral
- Service Brake (Configurable for Pressed or NOT Pressed)
- Custom Hardwired Interlock (Configurable Polarity)

A custom hardwired interlock input is available that will allow a body builder to create a customized interlock for their specific application. This interlock functions for both Cab and Remote Station PSC. Many types of switches such as hand operated switches, hydraulic pressure switches, equipment position switches, or pressure plate switches can activate the interlock. The switch polarity is configurable which allows the body builder to choose the interlock state if the circuit fails.

PTO SPEED CONTROL ICONS

During PSC operation there will be icons on the driver information display that indicate:

- PSC Enabled (white icon) or Active (green icon)
- PSC Control Location (designed by “Cab” or “Remote”)
- PSC target engine speed when active

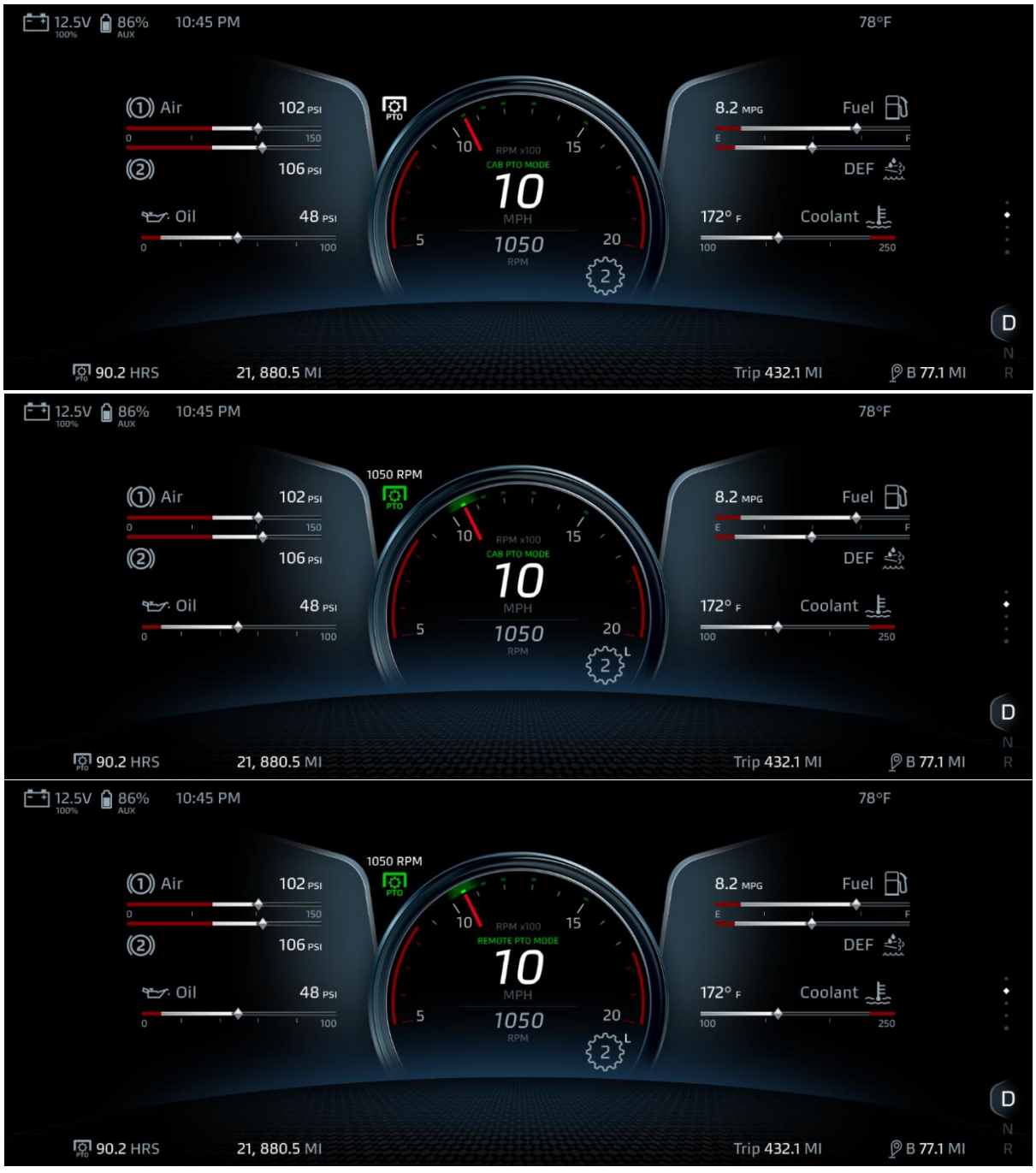


Figure 4-14. PTO Speed Control Icons

REMOTE PMC CONNECTIONS

There are options to control PTO functionality from the following locations.

- Engine Bay – Hardwired option only
- RP1226 Connection in the Cab – CAN bus connection only
- BOC/BOS – Hardwired and CAN bus connections
- EOF – Hardwired and CAN bus connections

There are options available for the body builder to specify controller speeds of 250 or 500 kbps.



Figure 4-15. Standard RP1226 Location (Driver's Side Kick Panel)

MX PTO CAN functionality may be accessed in the cab through the RP1226 connector and remotely through the body connectors K-CAN (E-3375-021) and B-CAN (DTM06-2S-EP10) Connectors. MX PTO hardwired functionality may be accessed in the engine bay or on the frame through optional 12-Way and 8-Way connectors.



Figure 4-16. PMC Connectors (Left to Right: 12 Way Deutsch, 8 Way Deutsch, RP1226 Deplhi)

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PTO MODE CONTROL FLOW CHARTS

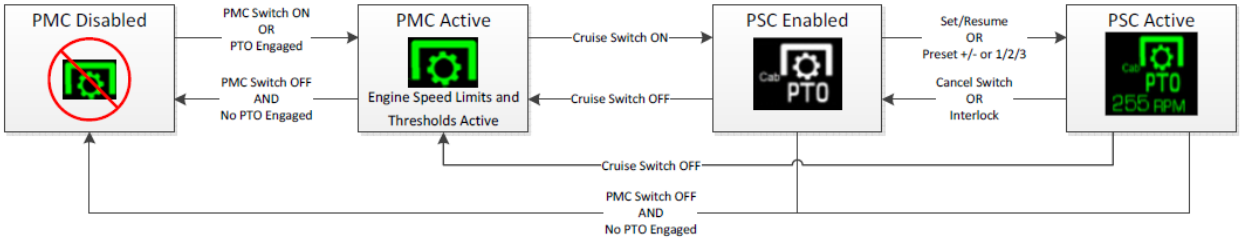


Figure 4-17. PTO Mode Control – Cab

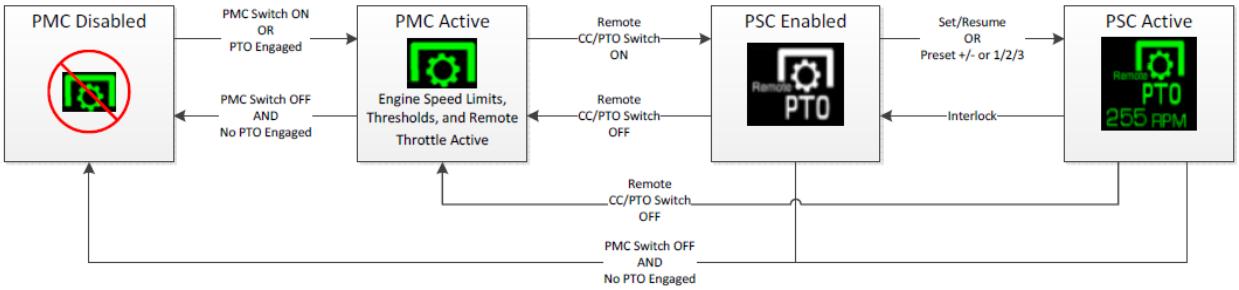


Figure 4-18. PTO Mode Control – Remote Hardwired

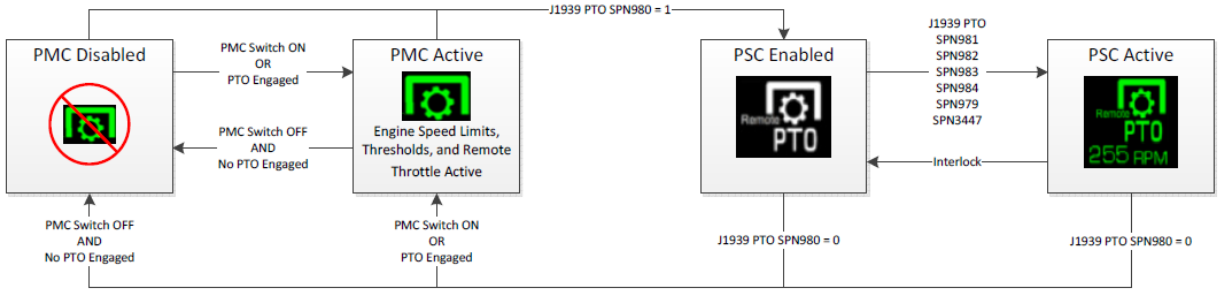


Figure 4-19. PTO Mode Control – Remote CAN Controls

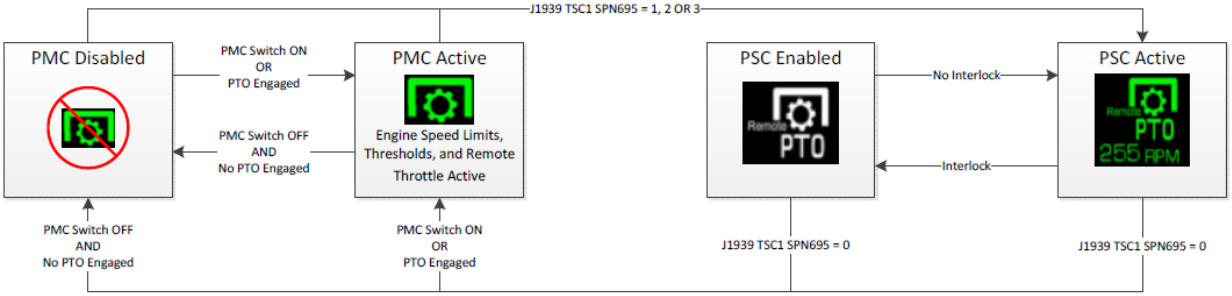


Figure 4-20. PTO Mode Control – Remote TSC1 CAN Controls

EXHAUST AND AFTER-TREATMENT INFORMATION

The following section is designed to give you information regarding the exhaust and aftertreatment systems on Kenworth chassis.

All Kenworth's equipped with 2021 emission level engines will utilize Selective Catalyst Reduction (SCR). SCR is a process in which Diesel Exhaust Fluid (DEF) is injected into the exhaust downstream of the engine. DEF is converted to ammonia by the heat of the exhaust system. Inside of the SCR canister a catalyst causes a chemical reaction to occur between the ammonia and NOx, turning it into water and nitrogen. For more information on the specific details of how SCR works, please contact your local Kenworth dealer.

DEF System Schematic:

On most Kenworth chassis the DEF Supply Module (or pump) is integrated into the DEF tank. Kenworth does not allow relocation of this pump. The following schematic details how the DEF lines route to the after-treatment system.

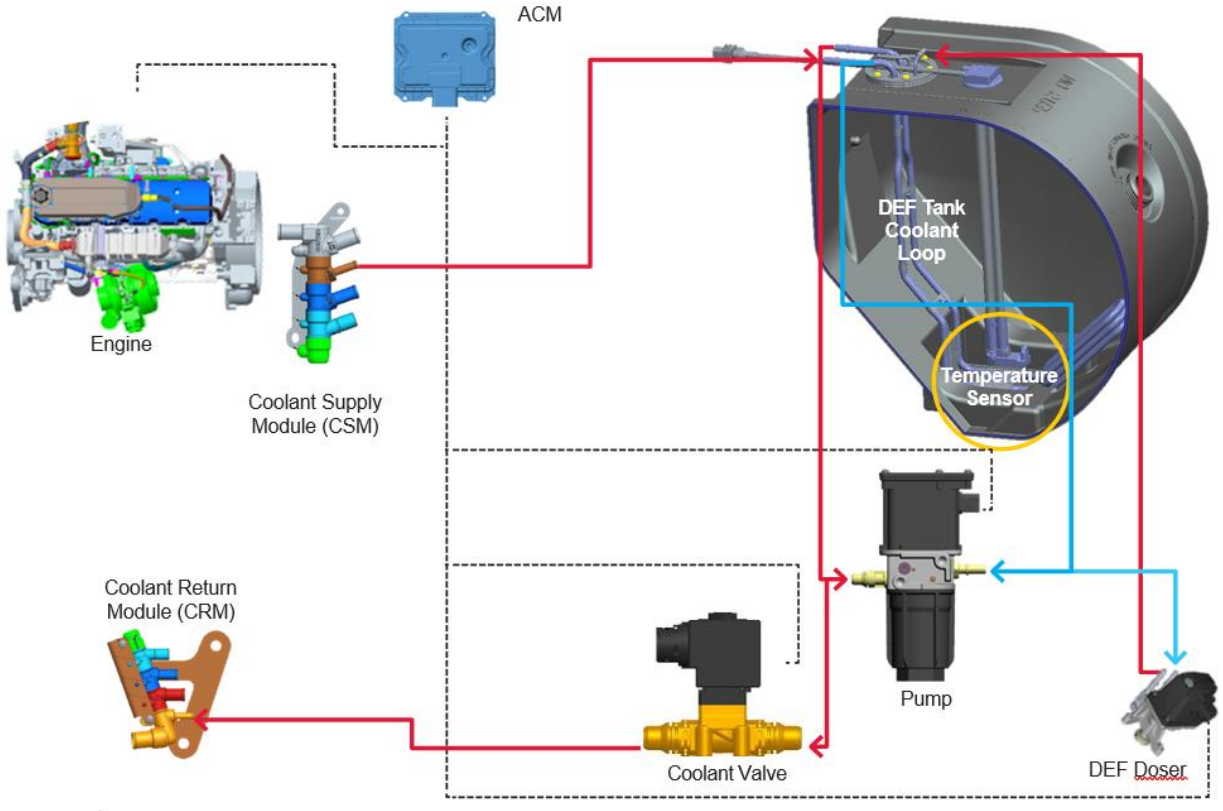


FIGURE 5-1. DEF System Schematic

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DEF will freeze at approximately 11° F. To keep DEF from freezing all tanks will be heated with engine coolant. The following schematic shows the routing of these lines. It is critical that the system is not compromised in any manner. The numbers below denote the order of the components in the flow.

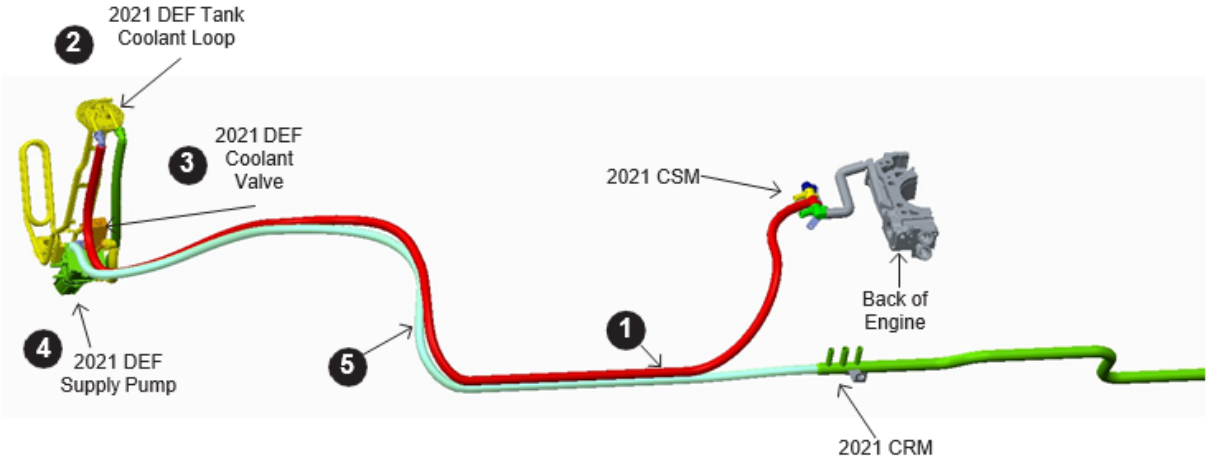


FIGURE 5-2. DEF System Component Flow

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GENERAL GUIDELINES FOR DEF SYSTEM

The installation of the DEF tank is a critical component of the aftertreatment system. While Kenworth does not recommend relocating the DEF tank, there are applications and body installations that will require it. The guidelines below must be strictly followed by any entity relocating the tank. Failure to follow the guidelines completely and accurately may result in engine shut-down situations.

PACCAR-approved DEF hoses are required when retrofitting for the system to properly function. The use of unapproved hoses for DEF lines will void warranty and may cause engine shut-down situations. The DEF pump (or Supply Module) cannot be relocated from the DEF tank.

Kenworth offers a variety of DEF tank sizes to meet every application. The DEF tank volume is regulated by the E.P.A. Kenworth advises against modifying the tank volume after the truck has been delivered from the factory. These are estimated nominal (published) maximum fuel capacities for various DEF tanks, engines, and fill ratios. Dosing rates for these calculations are also shown.

TABLE 5-1. Nominal Allowable Fuel (Gallons) per DEF Tank

DEF Tank	Standard DEF Fuel Ratio (2:1)		Minimum Recommended DEF Fuel Ratio (1:25-1:99)		Minimum Required DEF Fuel Ratio (1:1)	
	X15	*MX13/MX11/PX9*	*X15*	*MX13/MX11/PX9*	*X15*	*MX13/MX11/PX9*
Small	121	145	150	180	206	248
Medium	203	244	250	300	345	414
Large	257	308	317	380	436	524
Medium Aero	172	207	213	256	293	352
Large Aero	230	276	285	340	388	466
Rectangular	68	82	85	102	166	140
Clear BOC	62	74	0	0	98	118

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INSTALLATION REQUIREMENTS AND DIMENSIONS FOR DEF SYSTEM

When relocating any DEF system components, the locations must meet the guidelines below. Failure to comply may result in non-conformance to EPA standards and engine shutdown.

With all relocating procedures, general clearances and routing guidelines must be followed. See Section 9 of this manual for general routing guidelines.

When relocating the components, the maximum pressure DEF hose length, from Supply module to Dosing Module, is 5.5 meters (216.5").

Maintain a minimum of 3" clearance to shielded exhaust components when routing DEF lines to prevent possible melting.

If the DEF tank is relocated, the coolant lines will need to be modified. During this process if the tank is moved forward on the chassis (i.e. closer to the engine) it is necessary to remove excess coolant lines and maintain the original routing path. If the tank is moved rearward on the chassis the additional length of cooling line required to complete the installation must be installed in a straight section of the existing coolant routing lines. This process minimizes the change in coolant flow by mitigating changes in restrictions. Changes in restriction are added with excessive line length and bends. Work with your local Kenworth dealer if you are unsure about the coolant line modifications.

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Routing to the Dosing Module (Injector)

A DEF pressure line "trap" is no longer required after EPA 2013 emissions level engine. The dosing module (injector) no longer needs to be purged and relative heights of components is no longer critical. See Figure 5-3 below for typical routing with RHUC exhaust and LH DEF tank shown. Also shown in this figure is the coolant line routing for T680, T880, and W990 models.

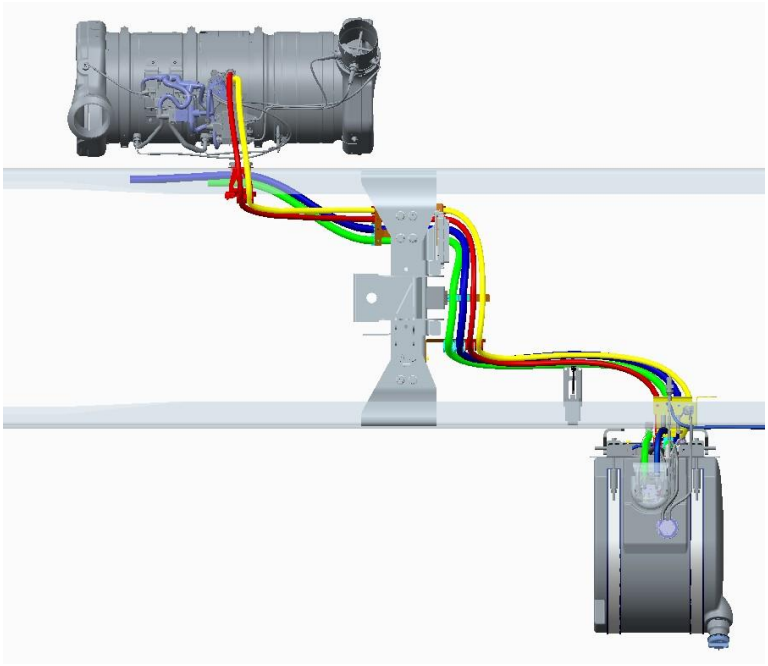


FIGURE 5-3. DEF and Coolant Line Routings

DEF Supply Module Mounting Requirements

The Supply Module (or Pump) standard mounting location is on the DEF tank assembly. Body builders may need to relocate this component and should follow the location and length restrictions above. Additionally, the mounting and the orientation of the Supply Module must not exceed 45° from vertical in any direction.

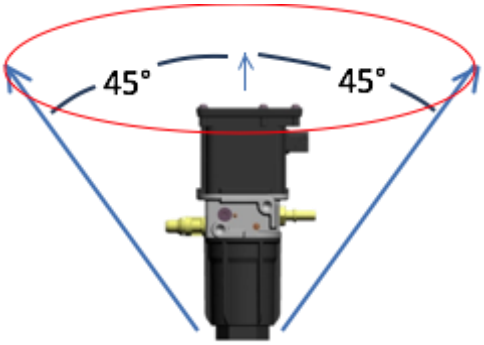
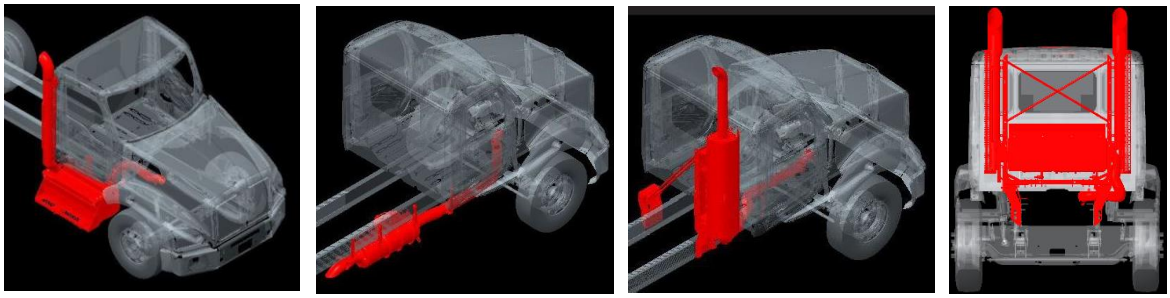


FIGURE 5-4. DEF Supply Module Allowed Clocking Angle Limit

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GENERAL EXHAUST INFORMATION

Kenworth will offer three main DPF and SCR exhaust systems on heavy duty chassis in 2021. A Right Hand Under DPF and SCR system, in which both canisters are located underneath the cab access step. A horizontal system with both the DPF and SCR located horizontally with a cross over pipe in the frame, and an Independent/Transverse DPF and SCR located vertically back of cab on stanchion brackets.



Left to Right: RHUC DPF/SCR, RH UNDER FRAME, INDEPENDENT BOC, TRANSVERSE BOC

FIGURE 5-5. Exhaust DPF/SCR Options

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Right Hand Under DPF/SCR on Daycab with Single Side of Cab Tailpipe

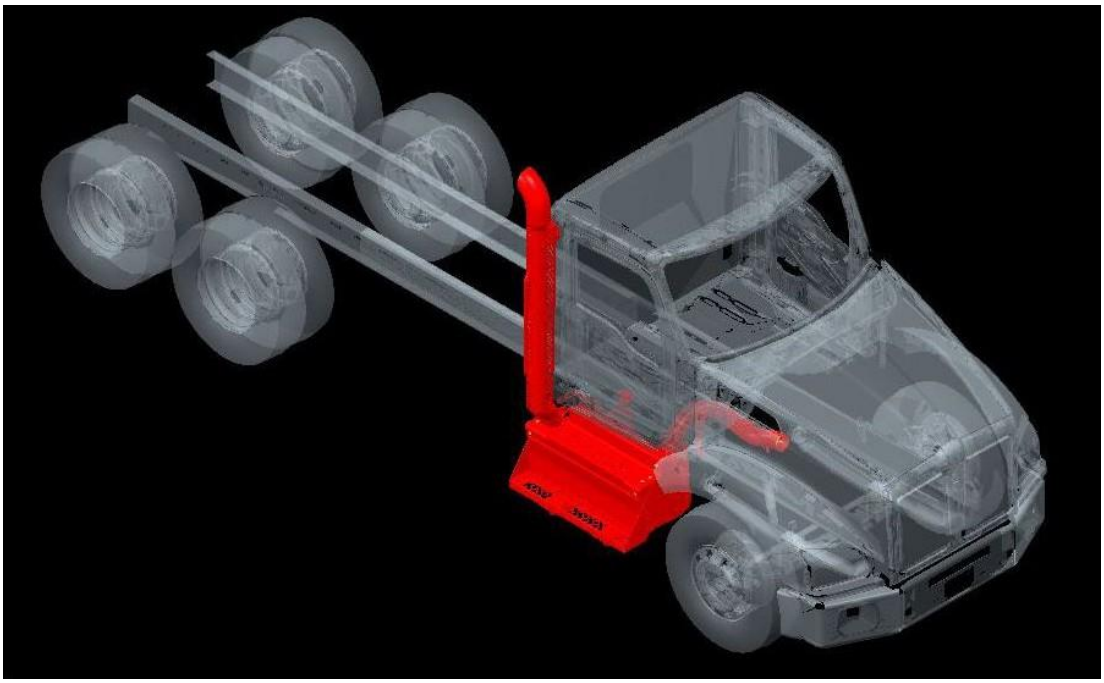


FIGURE 5-6. RHUC DPF/SCR SOC Tailpipe – Front ISO View

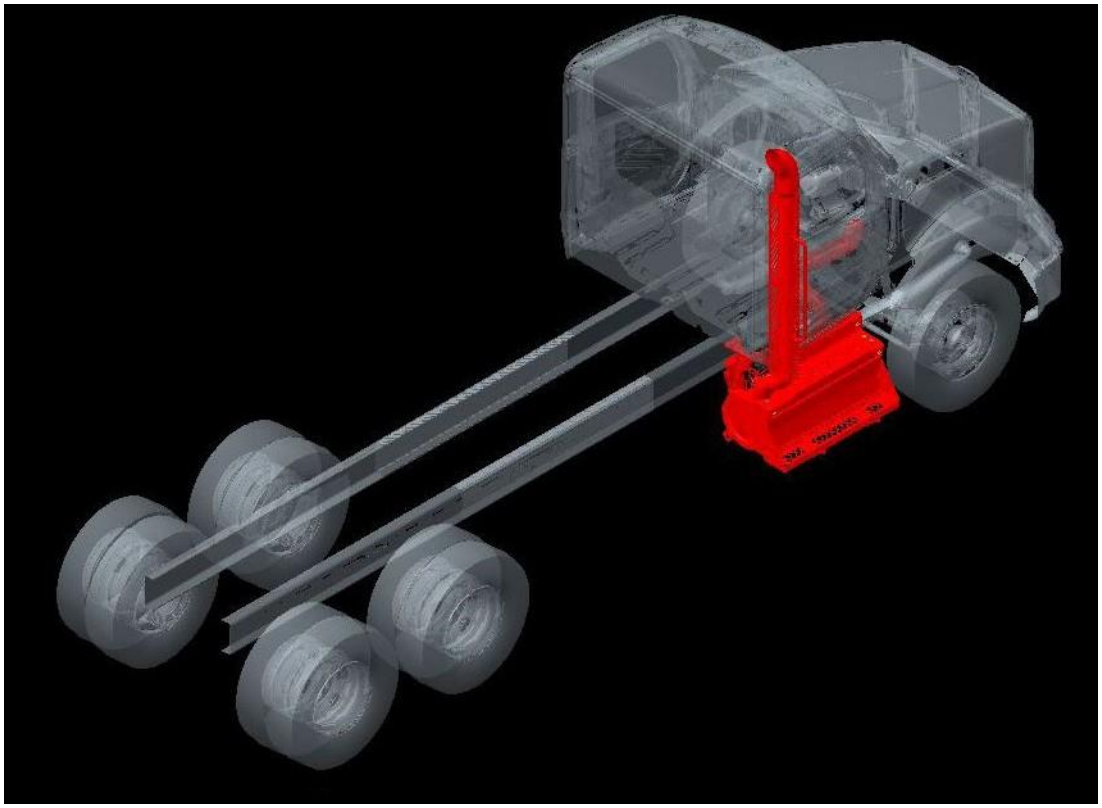


FIGURE 5-7. RHUC DPF/SCR SOC Tailpipe – Rear ISO View

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FIGURE 5-8. RHUC DPF/SCR SOC Tailpipe – RH View

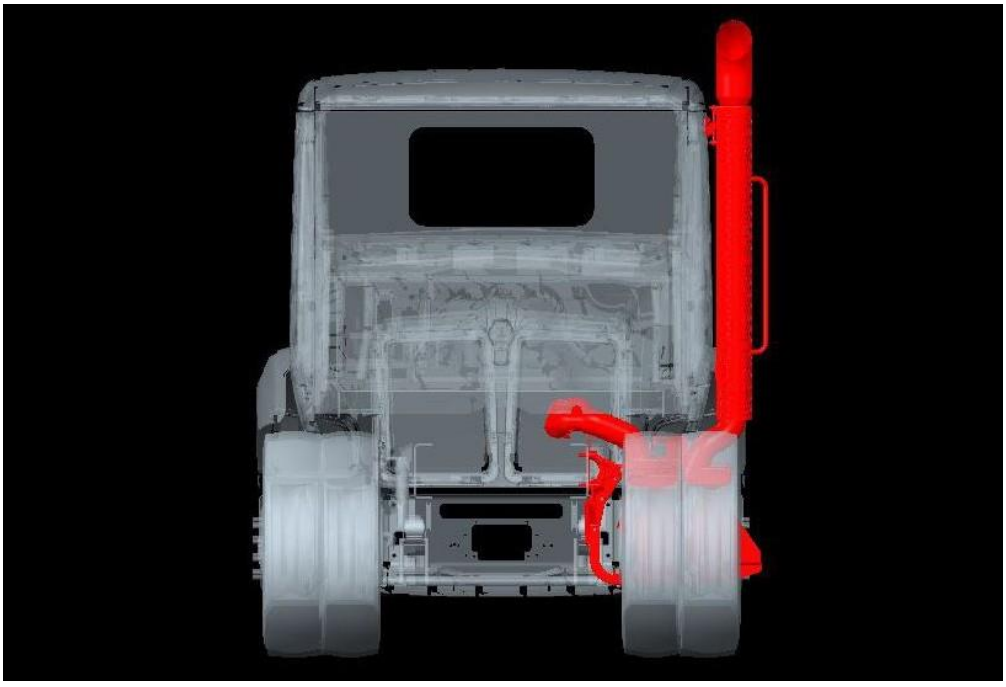


FIGURE 5-9. RHUC DPF/SCR SOC Tailpipe – Rear View

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Right Hand Under DPF/SCR on Daycab with Dual Side of Cab Tailpipes

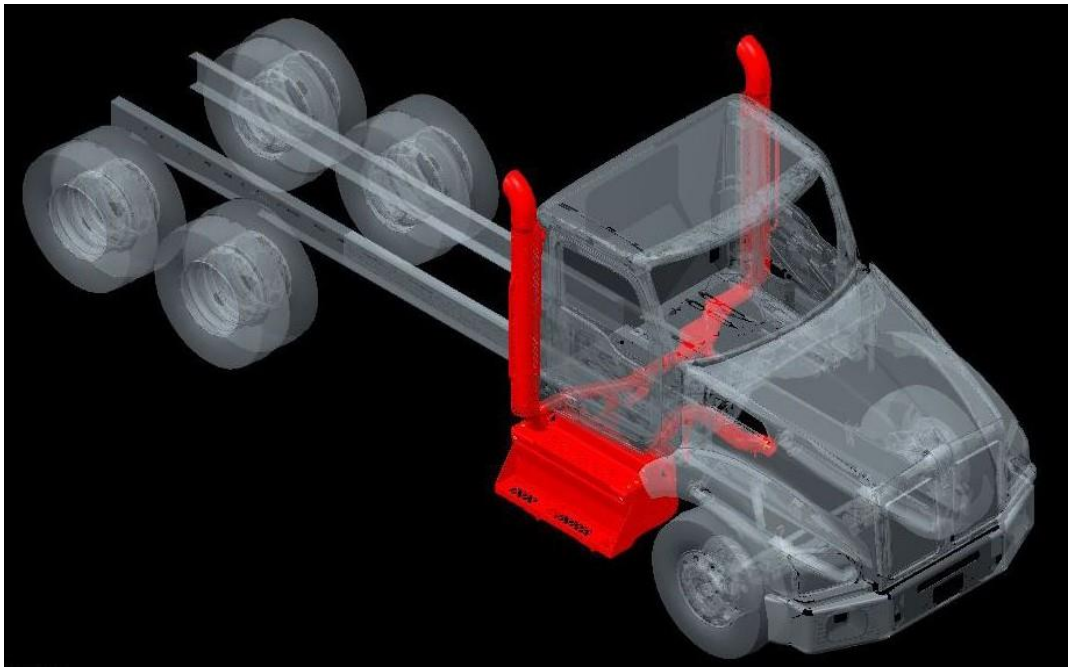


FIGURE 5-10. RHUC DPF/SCR Dual SOC Tailpipes – Front ISO View

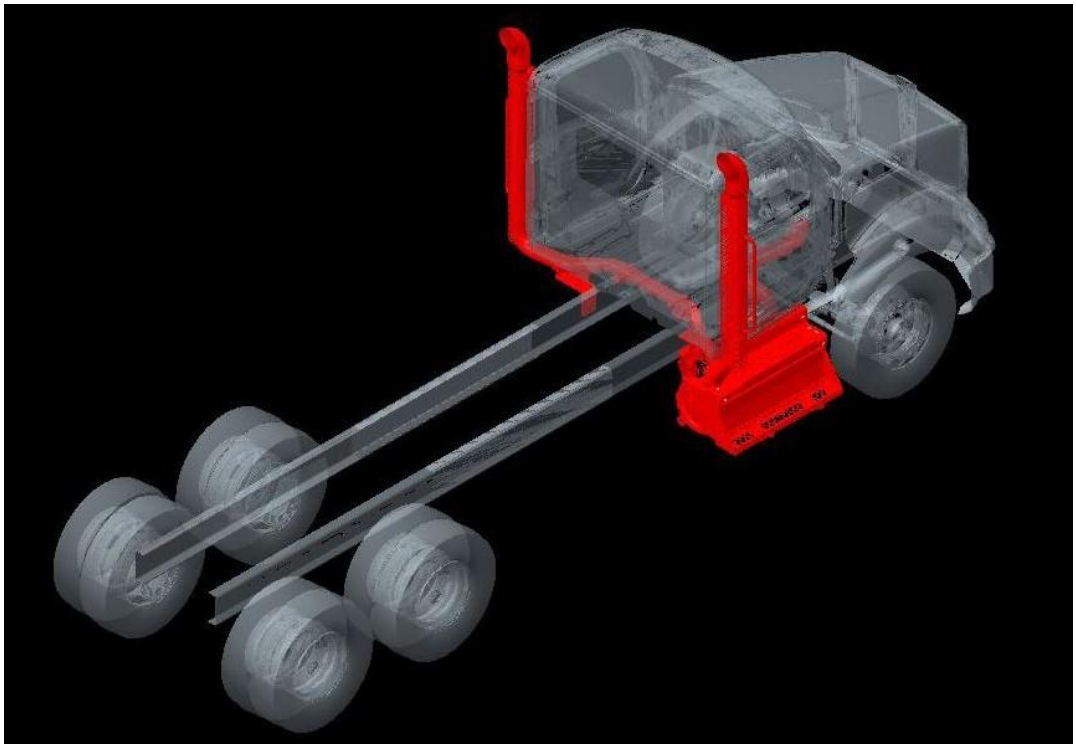


FIGURE 5-11. RHUC DPF/SCR Dual SOC Tailpipes – Rear ISO View

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FIGURE 5-12. RHUC DPF/SCR Dual SOC Tailpipes – RH View

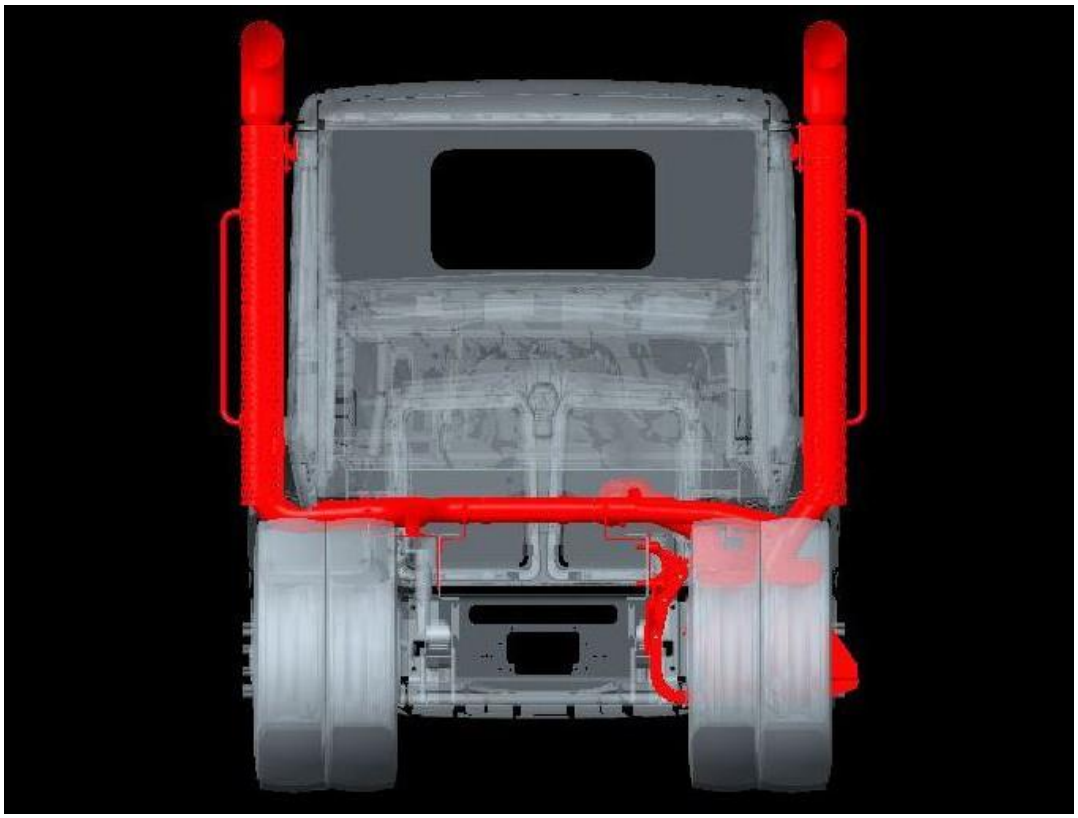


FIGURE 5-13. RHUC DPF/SCR Dual SOC Tailpipes – Rear View

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Right Hand Under DPF/SCR on Daycab with Back of Cab Tailpipe

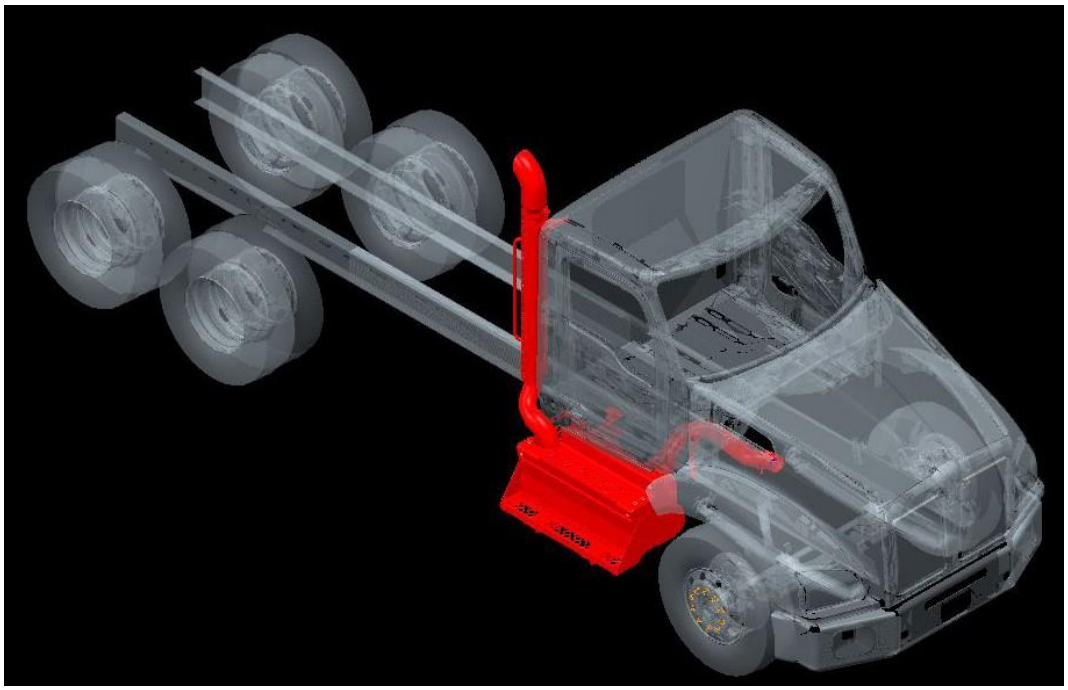


FIGURE 5-14. RHUC DPF/SCR BOC Tailpipe – Front ISO View

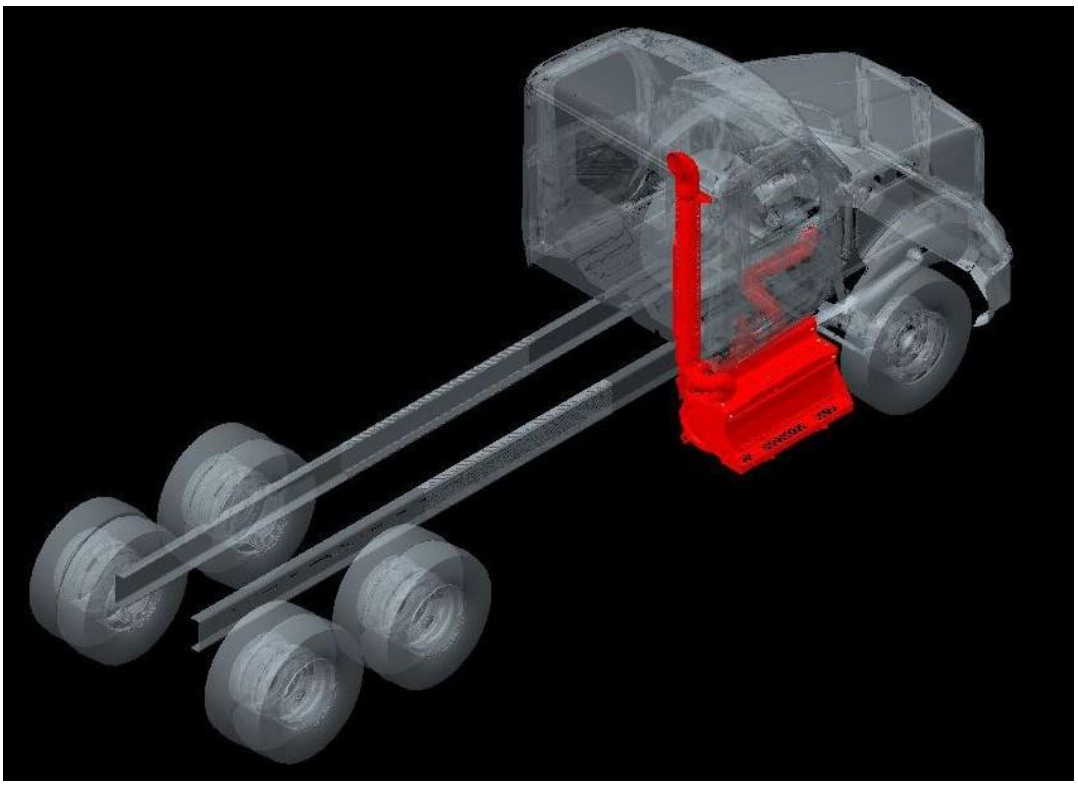


FIGURE 5-15. RHUC DPF/SCR BOC Tailpipe – Rear ISO View

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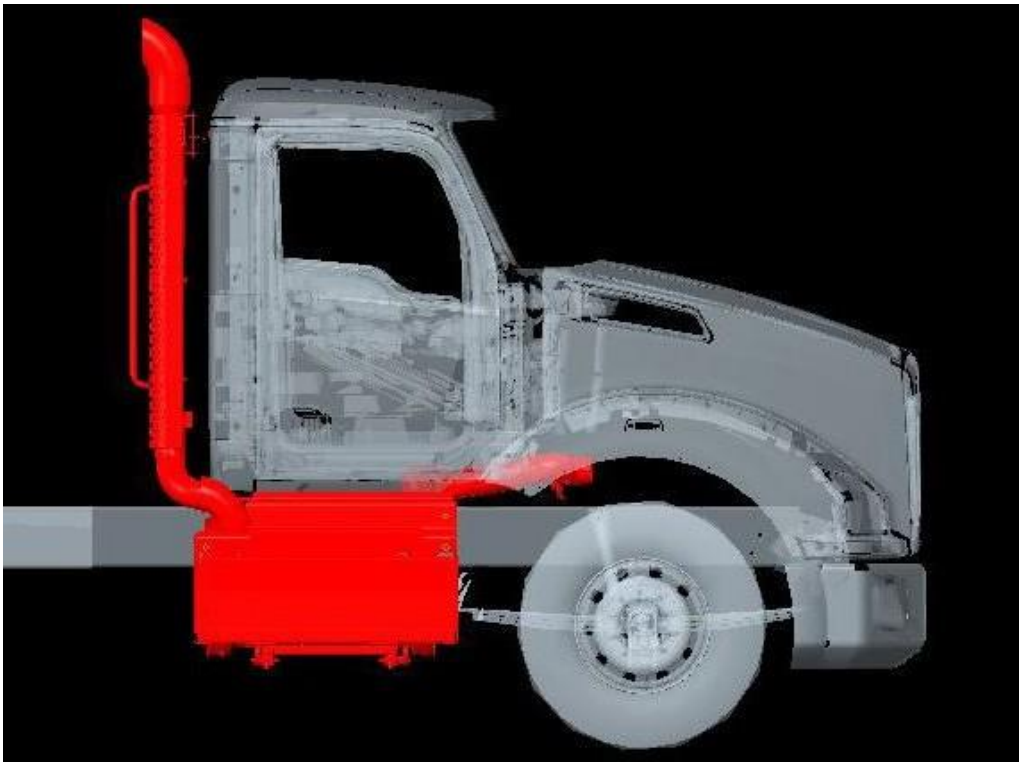


FIGURE 5-16. RHUC DPF/SCR BOC Tailpipe – RH View

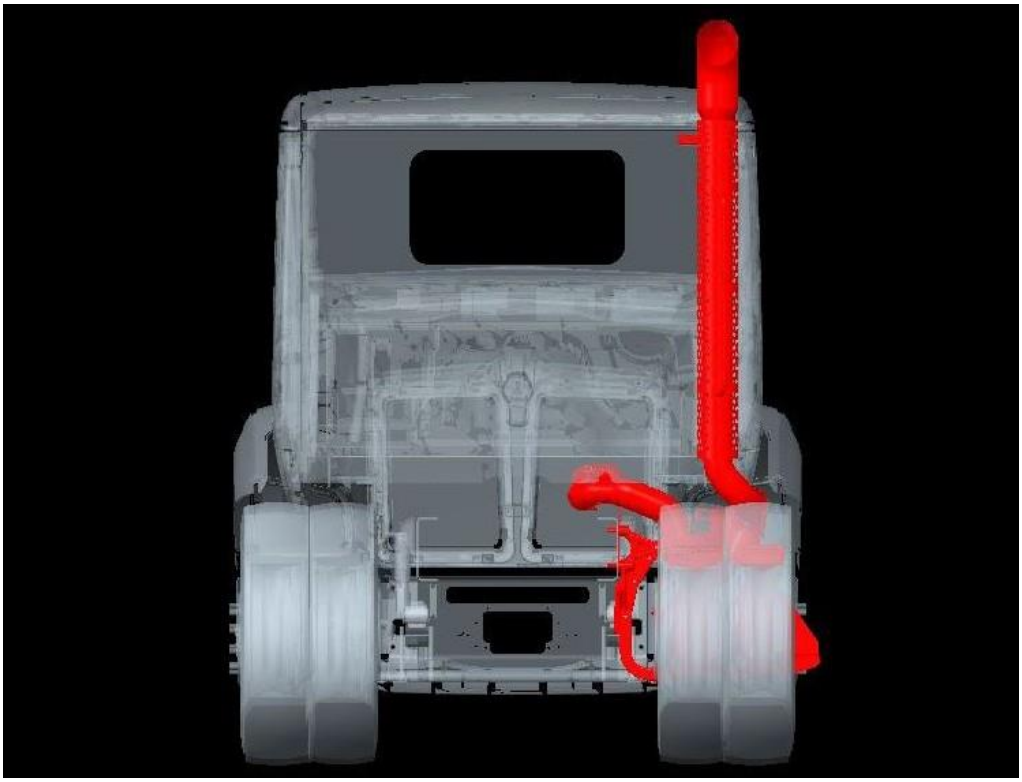


FIGURE 5-17. RHUC DPF/SCR BOC Tailpipe – Rear View

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Right Hand Under DPF/SCR on Daycab with Ground-Dump Tailpipe

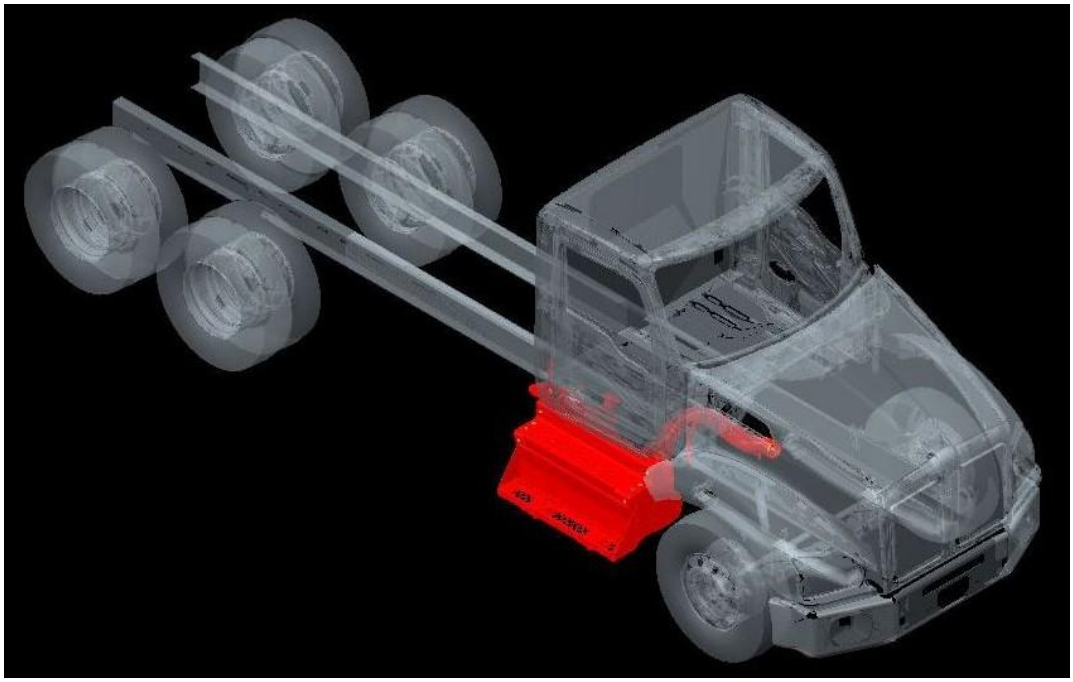


FIGURE 5-18. RHUC DPF/SCR Horizontal Tailpipe – Front ISO View

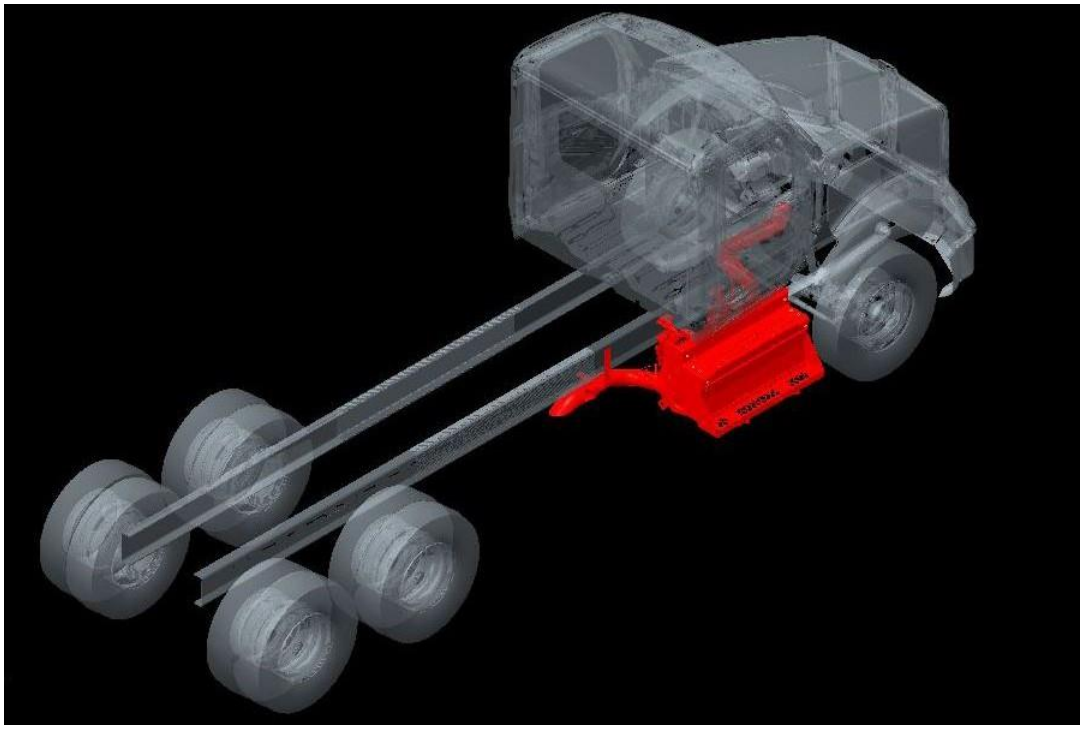


FIGURE 5-19. RHUC DPF/SCR Horizontal Tailpipe – Rear ISO View

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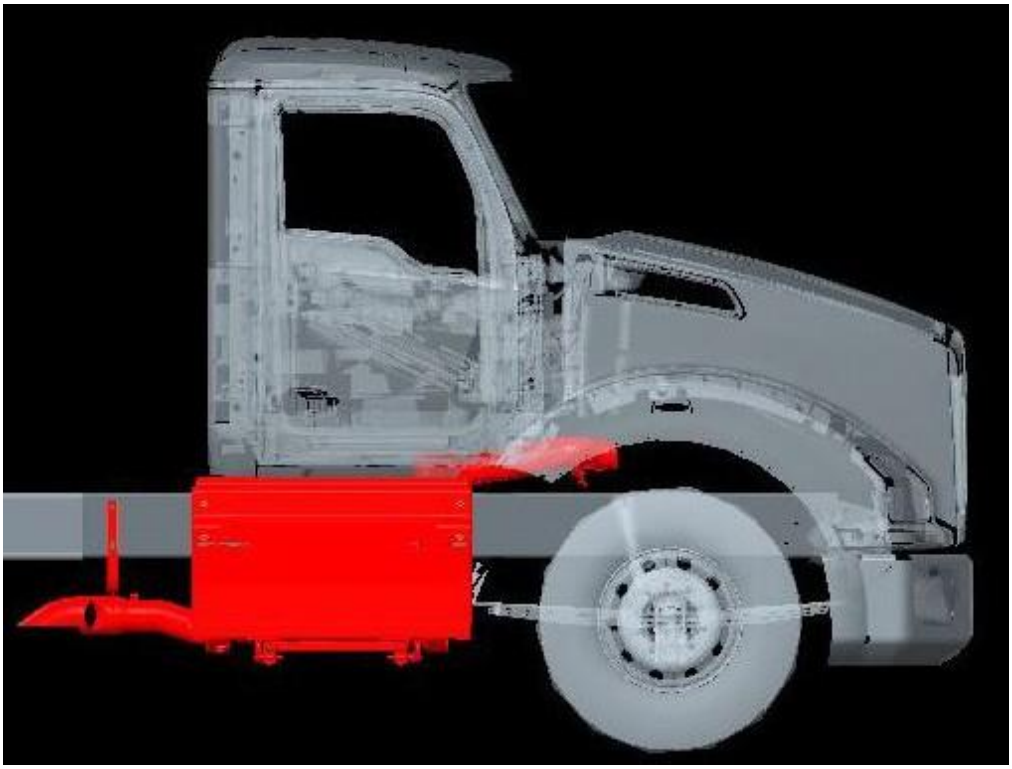


FIGURE 5-20. RHUC DPF/SCR Horizontal Tailpipe – RH View

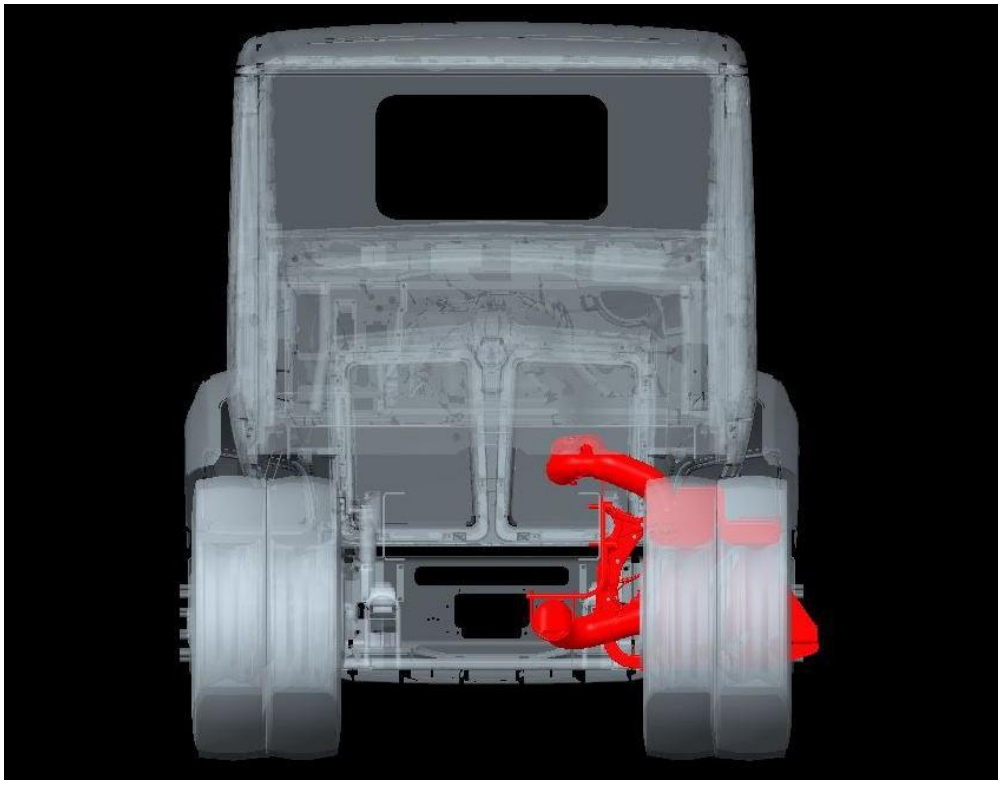


FIGURE 5-21. RHUC DPF/SCR Horizontal Tailpipe – Rear View

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Independent Back of Cab DPF/SCR on Daycab with Back of Cab Tailpipe

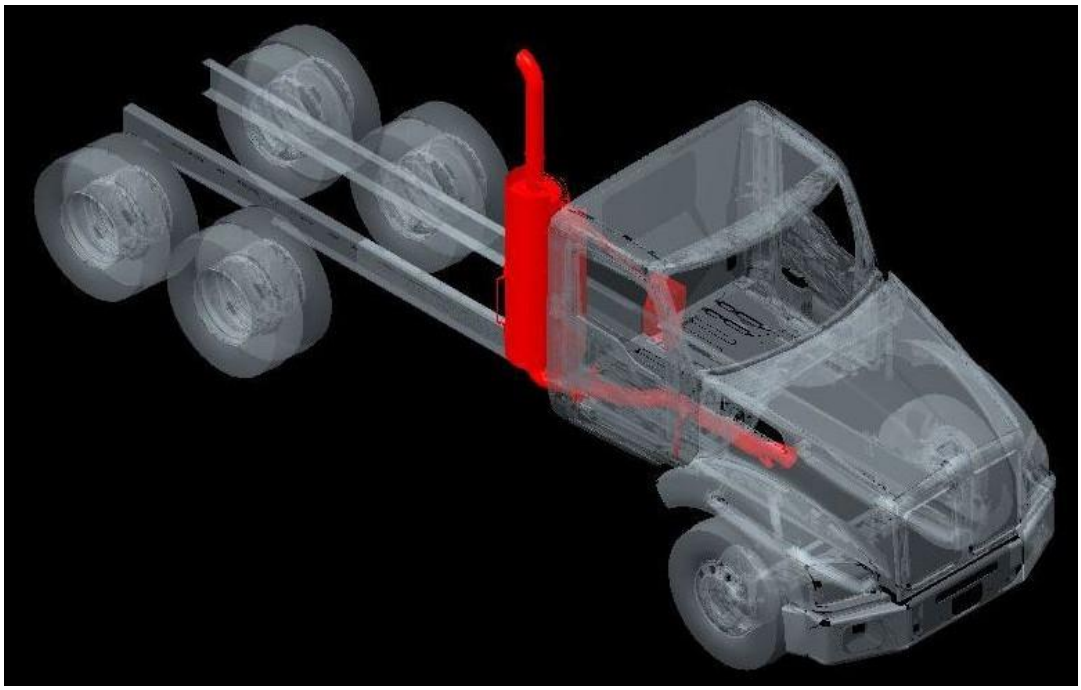


FIGURE 5-22. Independent BOC DPF/SCR w/BOC Tailpipe – Front ISO View

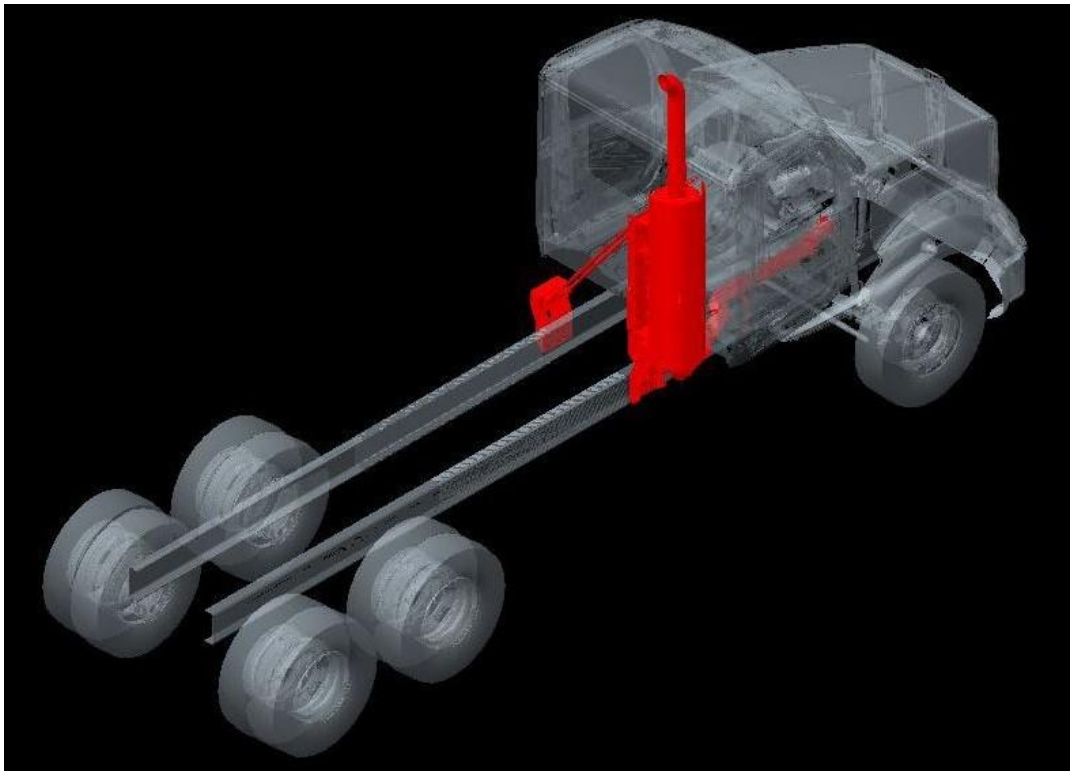


FIGURE 5-23. Independent BOC DPF/SCR w/BOC Tailpipe – Rear ISO View

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FIGURE 5-24. Independent BOC DPF/SCR w/BOC Tailpipe – RH View

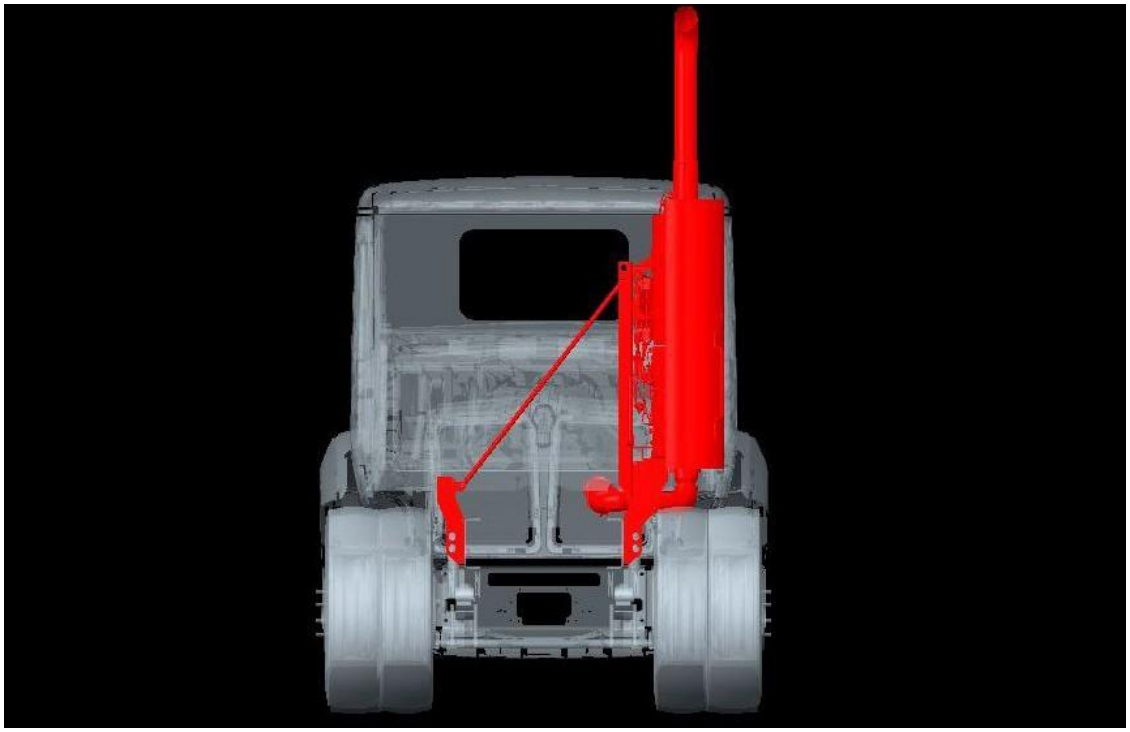


FIGURE 5-25. Independent BOC DPF/SCR w/BOC Tailpipe – Rear View

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Horizontal DPF/SCR on Daycab with Ground-Dump Tailpipe

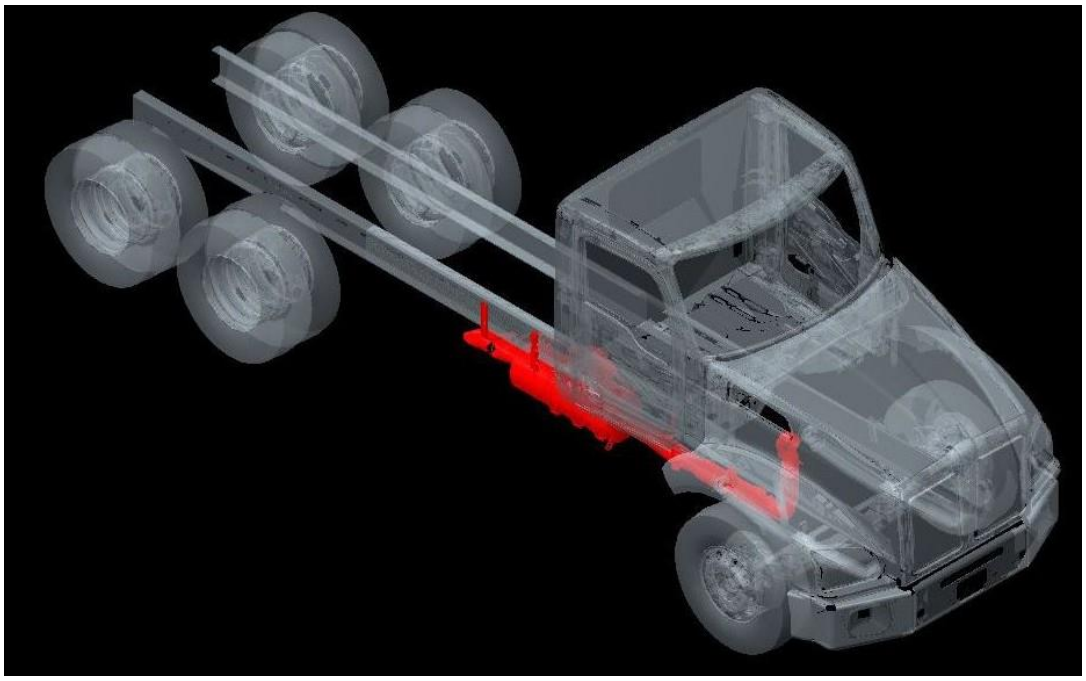


FIGURE 5-26. Horizontal DPF/SCR w/Horizontal Tailpipe – Front ISO View

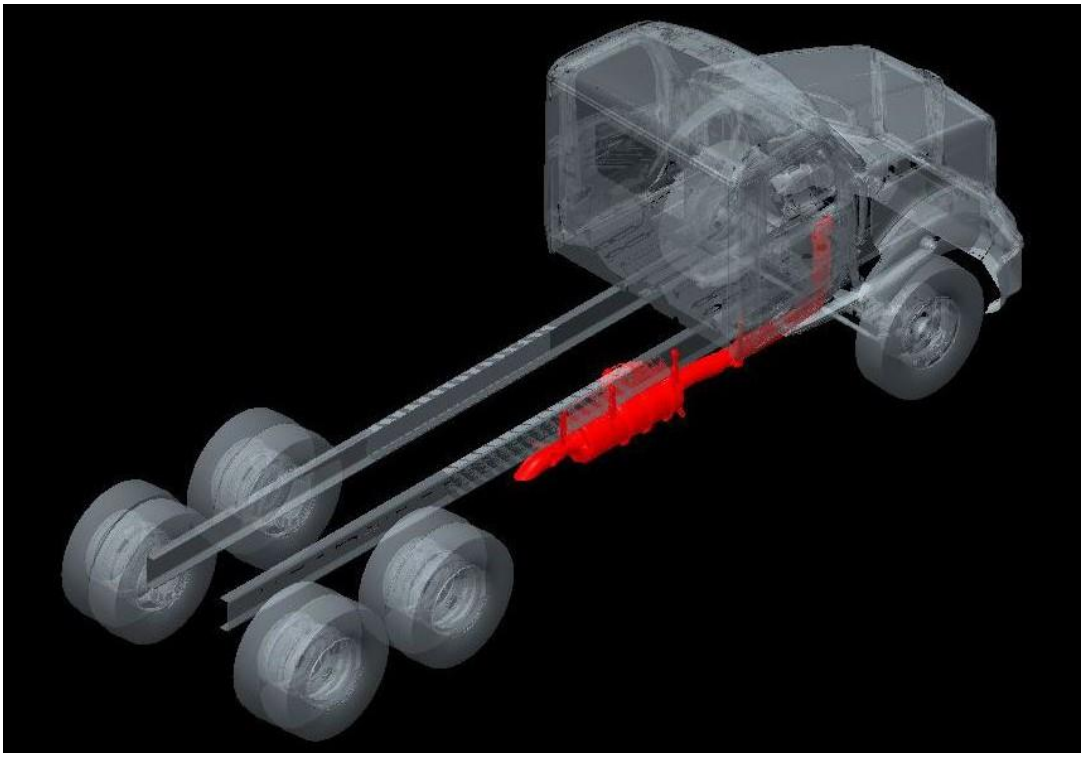


FIGURE 5-27. Horizontal DPF/SCR w/Horizontal Tailpipe – Rear ISO View

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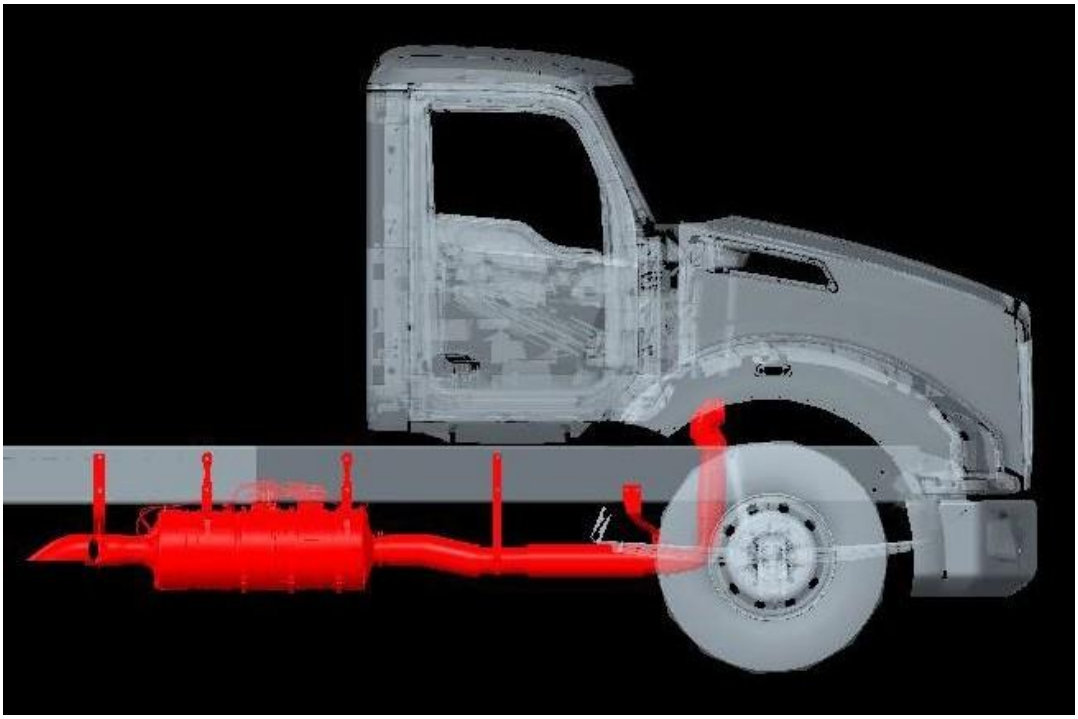


FIGURE 5-28. Horizontal DPF/SCR w/Horizontal Tailpipe – RH View

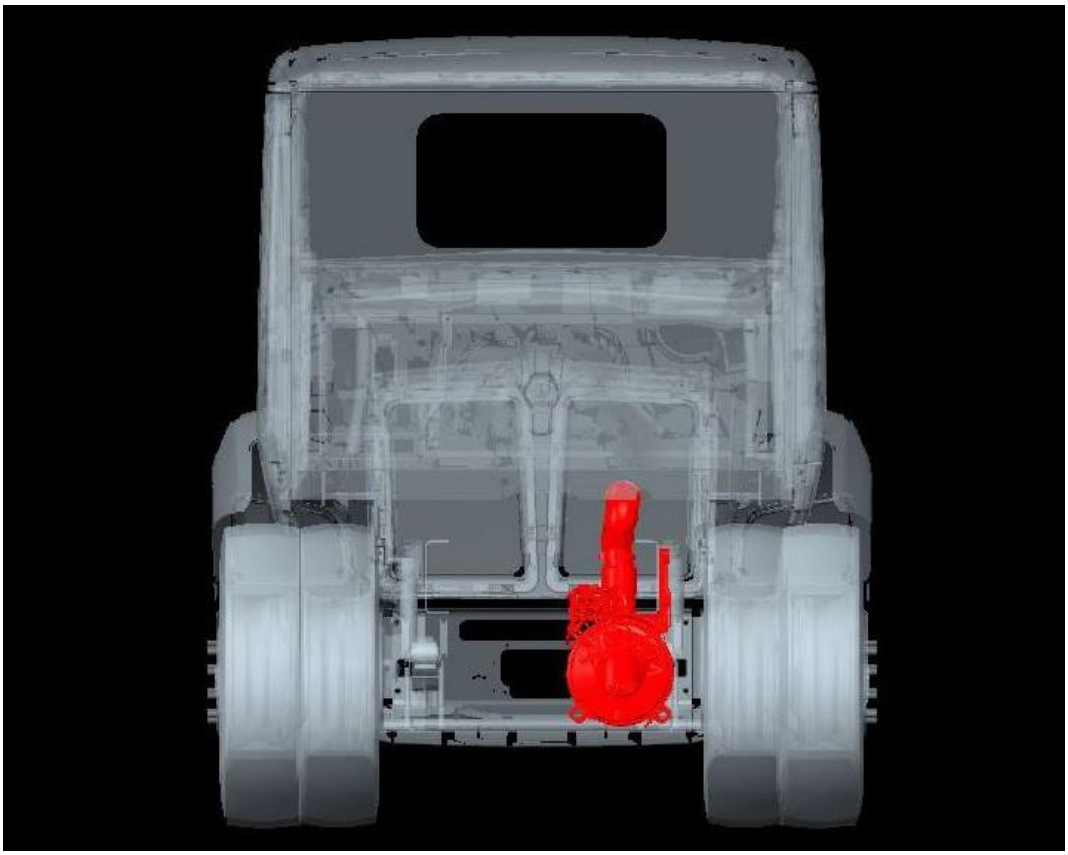


FIGURE 5-29. Horizontal DPF/SCR w/Horizontal Tailpipe – Rear View

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Transverse Back of Cab DPF/SCR on Daycab with Back of Cab Tailpipe

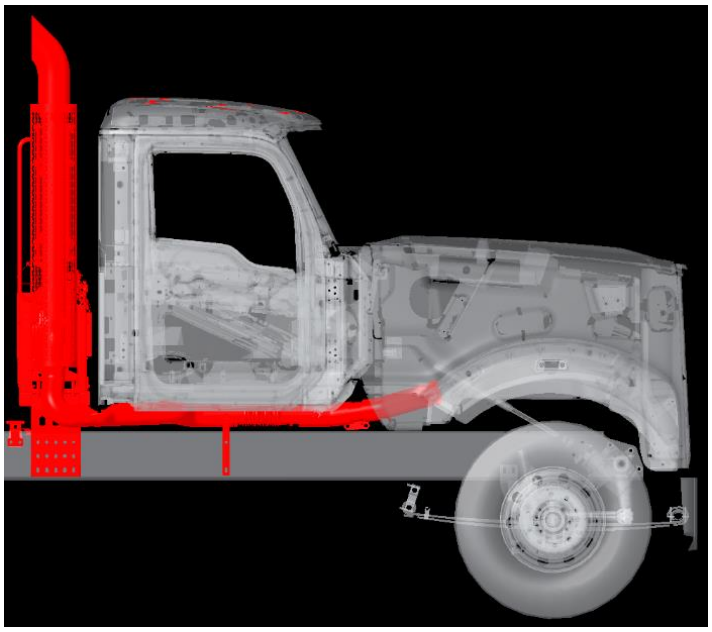


FIGURE 5-30. Transverse BOC DPF/SCR w/BOC Tailpipe – RH View

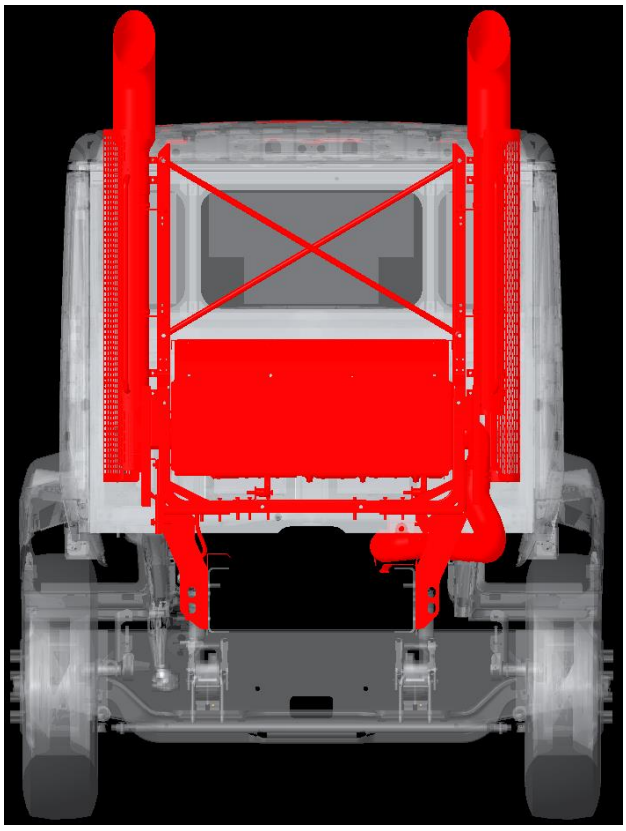


FIGURE 5-31. Transverse BOC DPF/SCR w/BOC Tailpipe – Rear View

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EXHAUST INFORMATION

This section includes information on how to calculate tailpipe heights.

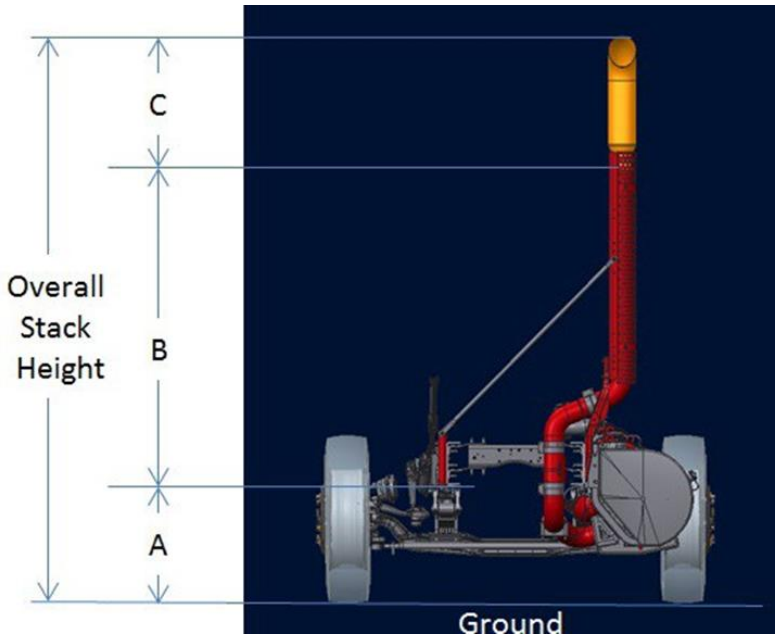


FIGURE 5-32. Exhaust Height Calculation Diagram

TABLE 5-2. Exhaust Height Calculation

	Dimension B		Min. Tailpipe Length Dimension "C" (Daycab)	Min. Tailpipe Length Dimension "C" (40" Sleeper)	Min. Tailpipe Length Dimension "C" (52" Sleeper)
Diesel	Tailpipes Side of Cab (RHUC DPF/SCR)	69.2″	18"	N/A	N/A
	Tailpipes Side of Sleeper (RHUC DPF/SCR)	69.2″	N/A	30"	42"
	Tailpipes Back of Cab (RHUC DPF/SCR)	70.3″	24″	N/A	N/A
	Tailpipes Back of Sleeper (RHUC DPF/SCR)	86″	N/A	24″	36″
	Tailpipes Back of Cab (Independent DPF/SCR Back of Cab)	77.5″	24″	N/A	N/A
Natural Gas	Tailpipes Side of Cab (RHUC DPF/SCR)	69.2″	18″	N/A	N/A
	Tailpipes Back of Cab (Independent DPF/SCR Back of Cab)	74″	24″	N/A	N/A

Utilize PremierSpec frame heights (or calculated knowing tire size and suspension height) to accurately calculate Dimension "A" from ground to the bottom of the frame rail.

When utilizing PremierSpec, remember that heights shown are calculated to top of frame rail, and frame section height needs to be subtracted from PremierSpec height to get overall frame height from ground to bottom of frame flange Dimension A).

FRAME RAKE



The listed heights should be considered approximations due to variations which may occur in component manufacturing processes, spring set, and the way in which the vehicle is loaded.

Component	Sales Code	Description	Laden	Unladen
Frame	6056400	Frame Rails: 10-3/4 x 3-1/2 x 3/8in. Steel 285in.	10.8	10.8
Front Spring	2864019	Front Springs: Taperleaf 14.6K w/shock absorbers	10.5	12.0
Front Axle Drop 3.5"	2513025	Meritor MFS14 14.6K 5in. drop wide track.	-1.5	-1.5
Height Adj.	2790015	Front End Lowered: 1 in. Not available W9B/L.	-1.0	-1.0
Front Tires	4070008	Front tires: Bridgestone R268 ECOPIA 295/80R22.5	19.4	20.0
		Front Frame Height	**38.2**	**40.2**
Frame	6056400	Frame Rails: 10-3/4 x 3-1/2 x 3/8in. Steel 285in.	10.8	10.8
Subframe	0000000	No sub frame	0	0
Suspension	3740130	Rear suspension: Tandem Kenworth Airglide 460 46K	10.5	10.5
Rear Tires	4270013	Front Tires: Bridgestone M749 295/60R22.5 18 PR	17.3	18.1
		Rear Frame Height	**38.6**	**39.4**
		Frame Rake	**0.4**	**-0.8**
		Frame Rake Slope (%)	**0.2**	**-0.3**

FIGURE 5-33. Top of Frame Rail Height from PremierSpec

- Frame Depth is given by the Frame line item.
- The Top of the Frame Height is given by the Front Frame Height line item.

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FRAME LAYOUTS

The dimensions in the frame layout section are intended to aid in layout of the chassis, and to help determine the best possible combination of fuel tanks, battery boxes, the diesel particulate filter (DPF) / SCR canister, and Diesel Exhaust Fluid (DEF) tank. For your application, the layouts focus on the under-cab area, with appropriate dimensional information included for pertinent back of cab components. Not all optional equipment is included in this section. Additional components may be placed on the rail behind components shown. The Back of Cab components are shown primarily for reference. For more specific requirements please work with your local Kenworth Dealer.

Please read the instructions carefully.

The following dimensions are consistent across the entire section to aid in the comparison of one layout option versus another.

Table 6-1. Frame Component Definition

Component Abbreviation	Description
B	Battery Box
D	DEF Tank
E	Exhaust
F1	Fuel Tank RHS
F2	Fuel Tank LHS
T	Toolbox

The layouts are organized by type and the specific arrangement of under cab components. The visual index that follows will give you a quick overview of the layouts that are included. Using the Frame Layout Index (on page XXX), locate the layout that you are interested in. The charts that follow are then model specific. It is important that the correct chart is used for accurate dimensional information.

Table 6-2. Visual Index

Symbol	Description	Symbol	Description
	RHUC DPF/SCR		Cantilever Battery Box
	Horizontal DPF/SCR		Toolbox
	Parallel Battery Box (STD Length)		DEF Tank
	In Cab Battery Box		Fuel Tank

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COMMON OPTIONAL COMPONENTS

The frame layouts that follow contain the minimum frame requirements to be operational (fuel tanks, battery box, and after-treatment components). All layouts are shown with standard length battery boxes unless otherwise noted. Dimensions for these components have been provided below to help complete the frame layout for chassis with more fuel tanks, additional toolboxes, etc.

Table 6-3. Fuel Tank Overall Length (in)

Fuel Tank Overall Length (in)			
Gallons	Fuel Tank Diameter		
	22in	24.5in	28.5in
45	N/A	23.0	N/A
56	35.6	N/A	N/A
60	38.0	30.6	N/A
75	47.3	38.5	28.7
90	N/A	45.5	34.3
100	62.2	50.0	N/A
105	N/A	N/A	38.8
110	N/A	55.0	N/A
120	74.3	60.6	45.8
135	N/A	67.2	50.9
150	N/A	74.5	56.2
177	N/A	N/A	66.1

Table 6-4. Battery Box Center Frame Lengths (in)

Battery Box Center Frame Lengths (in)			
Battery Box Type	T680	T880	W990
Parallel Short	34.8	34.8	34.8
Parallel Extended	42.0	42.0	42.0
Parallel BOC	34.8	34.8	34.8
Cantilever (Standard)	17.8	17.8	17.8
Cantilever (Vocational)	15.2	15.2	15.2

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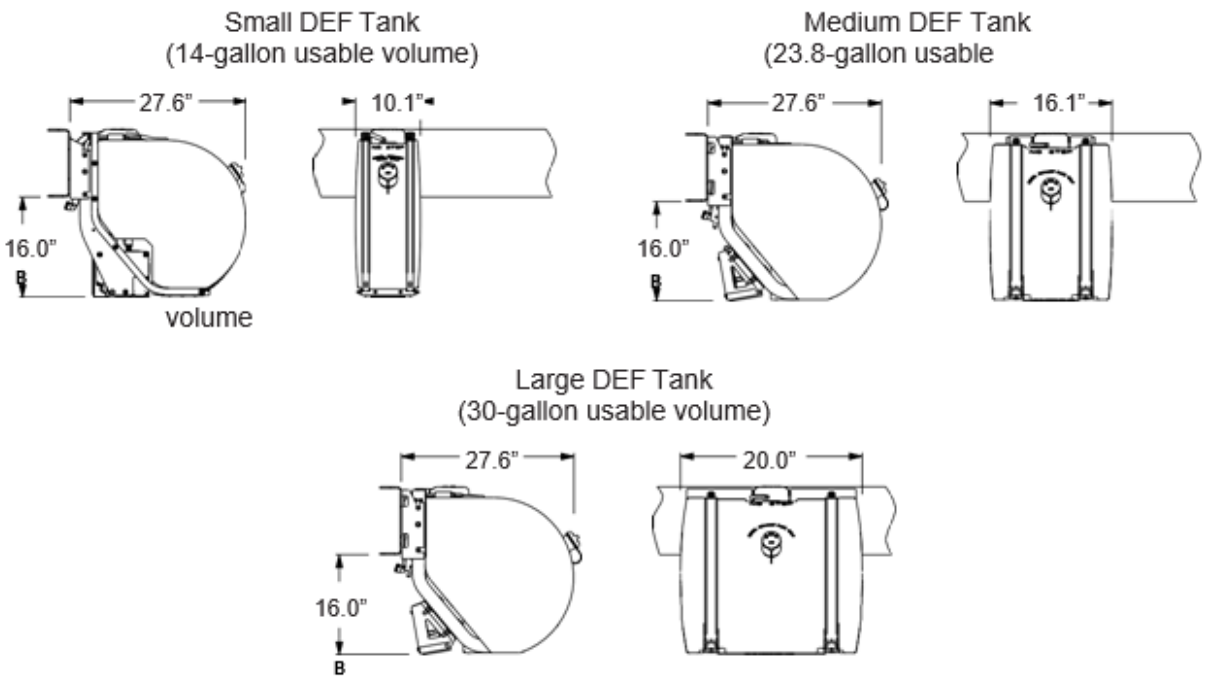


Figure 6-1. DEF Tank Dimensions (EPA 2021)

Acronyms Index

Throughout the Frame Layout section, you will see these acronyms. They are defined here to help you decode the layouts.

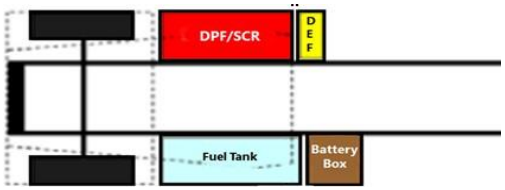
Table 6-5. Frame Layout Acronym Definitions

Acronym	Definition
BOC	Back of Cab
BOS	Back of Sleeper
CBOC	Clear Back of Cab
DEF	Diesel Exhaust Fluid
DSOC	Dual Side of Cab
LHUC	Left Hand Under Cab
RHUC	Right Hand Under Cab
SOC	Side of Cab

SECTION 6 – FRAME LAYOUTS 01/2022

FRAME LAYOUT INDEX

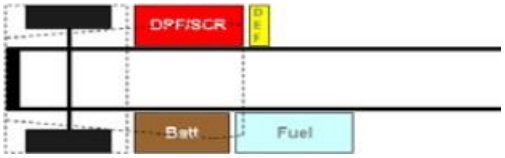
Daycab Chassis Layout Options



- **D1** is used with RHUC DPF/SCR, LHUC fuel tank, RH BOC DEF tank, and LH BOC cantilever battery box. Charts located on pages XXX-XXX.



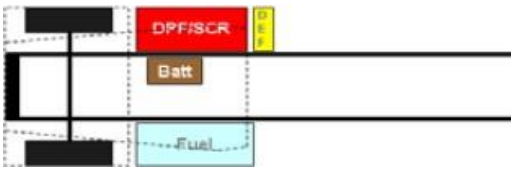
- **D2** is used with RHUC DPF/SCR, LHUC fuel tank, RH BOC cantilever battery box, and LH BOC DEF tank. Charts located on pages XXX-XXX.



- **D3** is used with RHUC DPF/SCR, LHUC battery box, RH BOC DEF tank, and LH BOC fuel tank. Charts located on pages XXX-XXX.



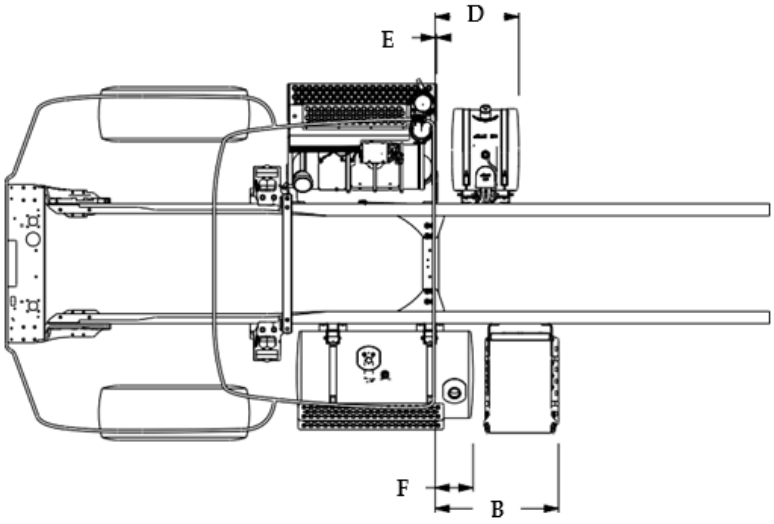
- **D4** is used with RHUC DPF/SCR, LHUC battery box, LH BOC DEF tank, and RH BOC fuel tank. Charts located on pages XXX-XXX.



- **D5** is used with RHUC DPF/SCR, LHUC fuel tank, RH BOC DEF tank, and in cab battery box. Charts located on pages XXX-XXX.

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D1 CHART – T880 STANDARD HOOD



Dimension E (BOC to DPF/SCR) = 2.7in

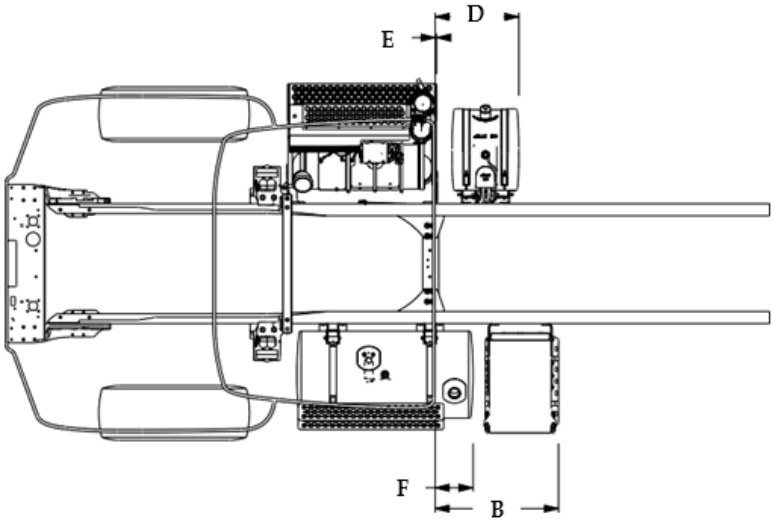
Table 6-6. T880 (SBFA) Standard Hood D1 Layout Dimensions

T880 (SBFA) Standard Hood Daycab							
Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension B BOC To Battery Box (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length			Small	Med	Large
22in	56	35.6	-2.1*	19.5	18.5	26.3	30.2
	60	38.0	0.4	21.4			
	75	47.3	9.6	31.3			
	100	62.2	24.5	47.0			
	120	74.3	36.6	58.8			
24.5in	60	30.6	-6.5	15.5			
	75	38.5	0.6	23.4			
	90	45.5	7.7	31.3			
	100	50.0	12.2	23.0			
	110	55.0	17.2	41.1			
	120	60.6	22.8	45.1			
	135	67.2	29.4	52.9			
	150	74.5	36.7	58.8			
28.5	75	28.7	-8.8*	13.9			
	90	34.3	-3.3*	19.5			
	105	38.8	-0.4*	23.4			
	110	42.4	4.0*	25.4			
	120	45.8	7.4*	29.3			
	135	50.9	12.5*	35.2			
	150	56.2	17.8*	41.1			
	177	66.1	27.7*	51.0			

NOTE: DIMENSION "B" IS CALCULATED USING A CANTILEVER SIZED BATTERY BOX. OPTIONAL BOXES WILL AFFECT THIS DIMENSION.
* N/A W/ DUAL SIDE OF CAB OR BACK OF CAB EXHAUST

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D1 CHART – T880 MX-OPTIMIZED HOOD



Dimension E (BOC to DPF/SCR) = 2.7in

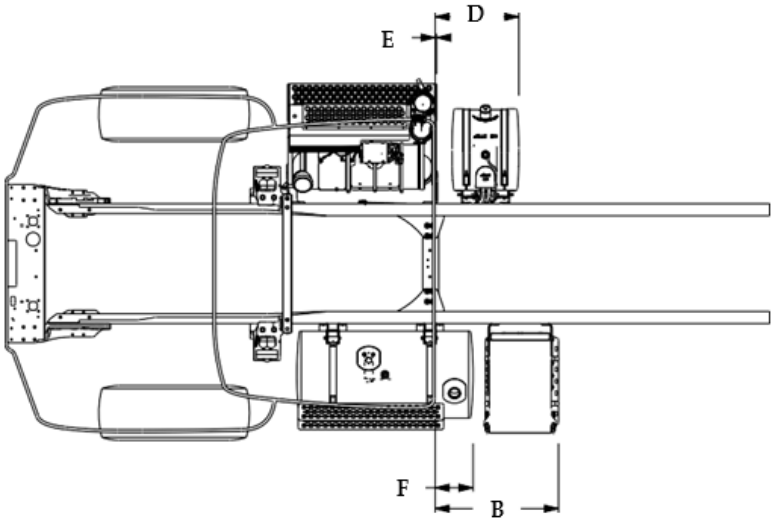
Table 6-7. T880 (SBFA) MX-Optimized Hood D1 Layout Dimensions

T880 (SBFA) MX-Optimized Hood Daycab							
Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension B BOC To Battery Box (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length			Small	Med	Large
22in	56	35.6	-2.1*	19.5	18.5	26.3	30.2
	60	38.0	0.4	21.4			
	75	47.3	9.6	31.3			
	100	62.2	24.5	47.0			
	120	74.3	36.6	58.8			
24.5in	60	30.6	-6.5	15.5			
	75	38.5	0.6	23.4			
	90	45.5	7.7	31.3			
	100	50.0	12.2	23.0			
	110	55.0	17.2	41.1			
	120	60.6	22.8	45.1			
	135	67.2	29.4	52.9			
	150	74.5	36.7	58.8			
28.5	75	28.7	-8.8*	13.9			
	90	34.3	-3.3*	19.5			
	105	38.8	-0.4*	23.4			
	110	42.4	4.0*	25.4			
	120	45.8	7.4*	29.3			
	135	50.9	12.5*	35.2			
	150	56.2	17.8*	41.1			
	177	66.1	27.7*	51.0			

NOTE: DIMENSION "B" IS CALCULATED USING A CANTILEVER SIZED BATTERY BOX. OPTIONAL BOXES WILL AFFECT THIS DIMENSION.
* N/A W/ DUAL SIDE OF CAB OR BACK OF CAB EXHAUST

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D1 CHART – T880S (SFFA) MX-OPTIMIZED HOOD



Dimension E (BOC to DPF/SCR) = 0.2in

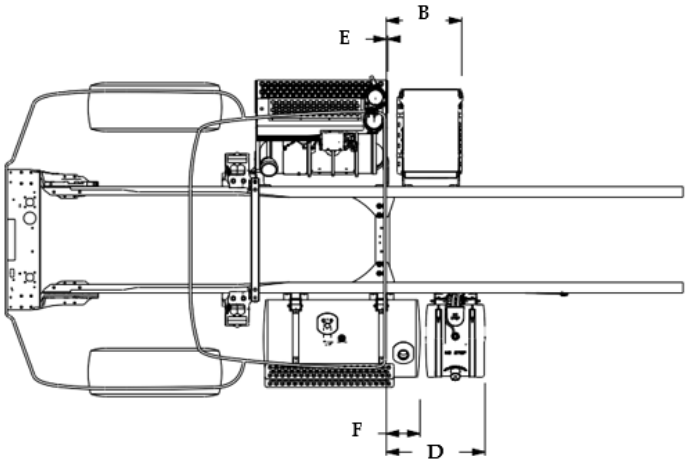
Table 6-8. T880S (SFFA) MX-Optimized Hood D1 Layout Dimensions

T880 (SFFA) MX-Optimized Hood Daycab							
Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension B BOC To Battery Box (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length			Small	Med	Large
22in	56	35.6	35.6	-8.2	16.5	22.4	26.3
	60	38.0	38.0	-5.2			
	75	47.3	47.3	0.0			
	100	62.2	62.2	14.9			
	120	74.3	74.3	27.0			
24.5in	60	30.6	-7.4	15.5			
	75	38.5	-4.4	17.5			
	90	45.5	-1.3	21.4			
	100	50.0	3.2	25.4			
	110	55.0	8.1	31.3			
	120	60.6	13.7	37.2			
	135	67.2	22.4	45.1			
	150	74.5	27.7	51.0			

NOTE: DIMENSION "B" IS CALCULATED USING A CANTILEVER SIZED BATTERY BOX. OPTIONAL BOXES WILL AFFECT THIS DIMENSION.

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D2 CHART – T880 STANDARD HOOD



Dimension B (BOC to Cantilever Battery Box) = 25.4in
Dimension E (BOC to DPF/SCR) = 2.7in

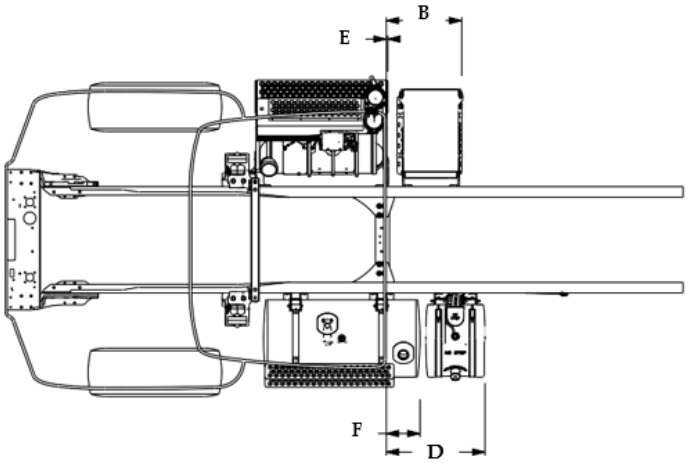
Table 6-9. T880 (SBFA) Standard Hood D2 Layout Dimensions

T880 (SBFA) Standard Hood Daycab							
Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension B BOC To Battery Box (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length			Small	Med	Large
22in	56	35.6	-2.1*	19.5	10.5	16.4	20.3
	60	38.0	0.4	21.4	12.5	18.4	22.3
	75	47.3	9.6	31.3	22.3	28.2	32.1
	100	62.2	24.5	47.0	36.1	42.0	45.9
	120	74.3	36.6	58.8	47.9	53.8	57.7
24.5in	60	30.6	-6.5	15.5	4.6	10.5	14.4
	75	38.5	0.6	23.4	13.4	19.3	23.2
	90	45.5	7.7	31.3	20.3	26.2	30.1
	100	50.0	12.2	23.0	24.3	30.2	34.1
	110	55.0	17.2	41.1	30.2	36.1	40
	120	60.6	22.8	45.1	36.1	42.0	45.9
	135	67.2	29.4	52.9	42.0	47.9	51.8
	150	74.5	36.7	58.8	49.9	55.8	59.7
28.5	75	28.7	-8.8*	13.9	8.5	14.4	18.3
	90	34.3	-3.3*	19.5	12.5	18.4	22.3
	105	38.8	-0.4*	23.4	20.3	26.2	30.1
	110	42.4	4.0*	25.4	26.2	32.1	36.0
	120	45.8	7.4*	29.3	30.2	36.1	40.0
	135	50.9	12.5*	35.2	40.0	45.9	49.8
	150	56.2	17.8*	41.1	10.5	16.4	20.3
	177	66.1	27.7*	51.0	12.5	18.4	22.3

NOTE: DIMENSION "B" IS CALCULATED USING A CANTILEVER SIZED BATTERY BOX. OPTIONAL BOXES WILL AFFECT THIS DIMENSION.
* N/A W/ DUAL SIDE OF CAB OR BACK OF CAB EXHAUST

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D2 CHART – T880 MX-OPTIMIZED HOOD



Dimension B (BOC to Cantilever Battery Box) = 25.4in
Dimension E (BOC to DPF/SCR) = 2.7in

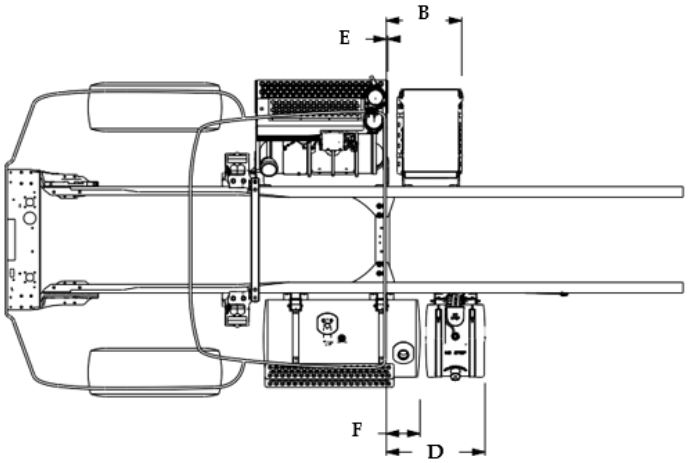
Table 6-10. T880 (SBFA) MX-Optimized Hood D2 Layout Dimensions

T880 (SBFA) MX-Optimized Hood Daycab							
Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension B BOC To Battery Box (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length			Small	Med	Large
22in	56	35.6	-2.1*	19.5	10.5	16.4	20.3
	60	38.0	0.4	21.4	12.5	18.4	22.3
	75	47.3	9.6	31.3	22.3	28.2	32.1
	100	62.2	24.5	47.0	36.1	42.0	45.9
	120	74.3	36.6	58.8	47.9	53.8	57.7
24.5in	60	30.6	-6.5	15.5	6.5**	12.4**	16.3**
	75	38.5	0.6	23.4	12.4	18.3	22.2
	90	45.5	7.7	31.3	20.3	26.2	30.1
	100	50.0	12.2	23.0	24.2	30.1	34.0
	110	55.0	17.2	41.1	28.1	34.0	37.9
	120	60.6	22.8	45.1	34.0	39.9	43.8
	135	67.2	29.4	52.9	41.9	47.8	51.7
	150	74.5	36.7	58.8	47.8	53.7	57.6
28.5	75	28.7	-8.8*	13.9	10.4	16.3	20.2
	90	34.3	-3.3*	19.5	10.4	16.3	20.2
	105	38.8	-0.4*	23.4	14.4	20.3	24.2
	110	42.4	4.0*	25.4	18.3	25.7	36.2
	120	45.8	7.4*	29.3	20.3	26.2	30.1
	135	50.9	12.5*	35.2	24.2	30.1	34.0
	150	56.2	17.8*	41.1	30.1	36.0	39.9
	177	66.1	27.7*	51.0	39.9	45.8	49.7

NOTE: DIMENSION "B" IS CALCULATED USING A CANTILEVER SIZED BATTERY BOX. OPTIONAL BOXES WILL AFFECT THIS DIMENSION.
* N/A W/ DUAL SIDE OF CAB OR BACK OF CAB EXHAUST
** ADD 2 INCHES FOR DUAL SIDE OF CAB EXHAUST

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D2 CHART – T880S (SFFA) MX-OPTIMIZED HOOD



Dimension B (BOC to Cantilever Battery Box) = 23.4in
Dimension E (BOC to DPF/SCR) = 0.2in

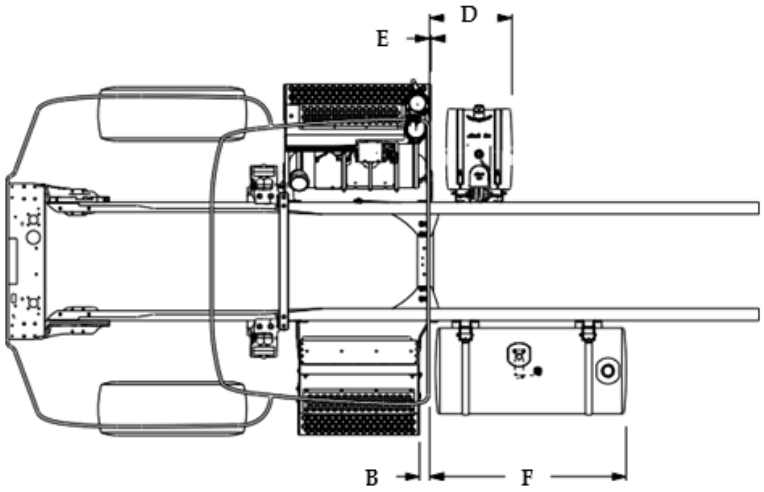
Table 6-11. T880S (SFFA) MX-Optimized Hood D2 Layout Dimensions

T880S (SFFA) MX-Optimized Hood Daycab							
Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension B BOC To Battery Box (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length			Small	Med	Large
22in	56	35.6	-2.1*	19.5	6.5***	12.4***	16.3***
	60	38.0	0.4	21.4	6.5**	12.4**	16.3**
	75	47.3	9.6	31.3	16.4	22.3	26.2
	100	62.2	24.5	47.0	32.1	38.0	41.9
	120	74.3	36.6	58.8	43.9	49.8	53.7
24.5in	60	30.6	-6.5	15.5	6.5**	12.4**	16.3**
	75	38.5	0.6	23.4	6.5	12.4	16.3
	90	45.5	7.7	31.3	12.5	18.4	22.3
	100	50.0	12.2	23.0	16.4	22.3	26.2
	110	55.0	17.2	41.1	20.3	26.2	30.1
	120	60.6	22.8	45.1	26.2	32.1	36.0
	135	67.2	29.4	52.9	32.1	38.0	41.9
	150	74.5	36.7	58.8	40.0	45.9	49.8

NOTE: DIMENSION "B" IS CALCULATED USING A CANTILEVER SIZED BATTERY BOX. OPTIONAL BOXES WILL AFFECT THIS DIMENSION.
* N/A W/ DUAL SIDE OF CAB OR BACK OF CAB EXHAUST
** ADD 2 INCHES FOR DUAL SIDE OF CAB EXHAUST
*** ADD 3.9 INCHES FOR DUAL SIDE OF CAB EXHAUST

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D3 CHART – T880 STANDARD HOOD



Dimension B (BOC to 34" Short Battery Box) = -2.5in
Dimension B (BOC to 40" Long Battery Box) = 3.5in
Dimension E (BOC to DPF/SCR) = 2.7in

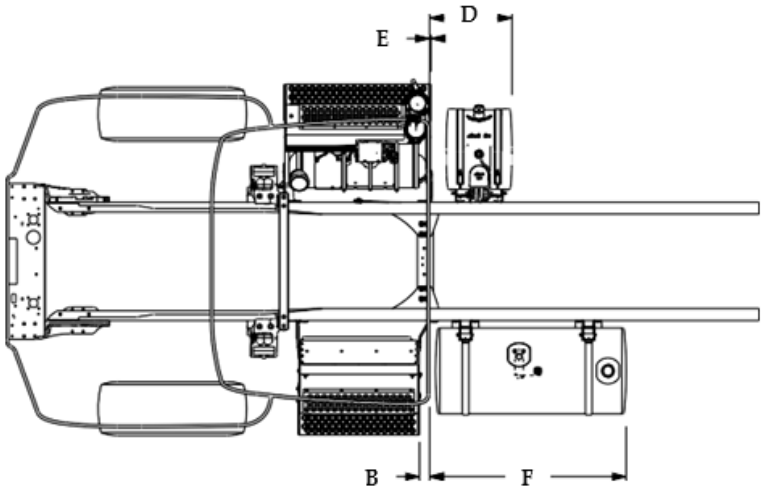
Table 6-12. T880 (SBFA) Standard Hood D3 Layout Dimensions

Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length		Small	Med	Large
22in	56	35.6	39.7	18.5*	26.3*	30.2*
	60	38.0	42			
	75	47.3	51			
	100	62.2	66			
	120	74.3	78			
24.5in	60	30.6	35			
	75	38.5	43			
	90	45.5	50			
	100	50.0	54.5			
	110	55.0	59.5			
	120	60.6	65			
	135	67.2	71.7			
	150	74.5	78.8			
28.5	75	28.7	32.6			
	90	34.3	38.2			
	105	38.8	42.7			
	110	42.4	46.3			
	120	45.8	49.7			
	135	50.9	54.8			
	150	56.2	60.1			
	177	66.1	70			

NOTE: DIMENSION "B" IS CALCULATED USING A CANTILEVER SIZED BATTERY BOX. OPTIONAL BOXES WILL AFFECT THIS DIMENSION.
* ADD 6.0 INCHES FOR 40IN LONG BATTERY BOX

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D3 CHART – T880 MX-OPTMIZED HOOD



Dimension B (BOC to 34" Short Battery Box) = -2.5in
Dimension B (BOC to 40" Long Battery Box) = 3.5in
Dimension E (BOC to DPF/SCR) = 2.7in

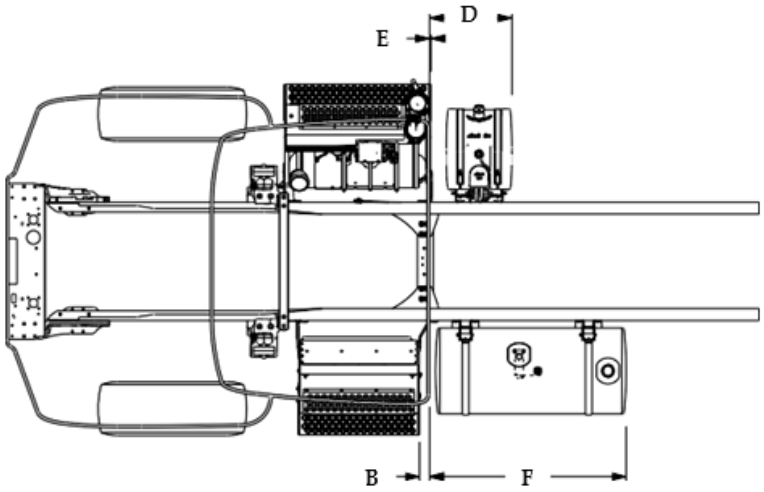
Table 6-13. T880 (SBFA) MX-Optimized Hood D3 Layout Dimensions

Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length		Small	Med	Large
22in	56	35.6	39.7	18.5*	26.3*	30.2*
	60	38.0	42			
	75	47.3	51			
	100	62.2	66			
	120	74.3	78			
24.5in	60	30.6	35			
	75	38.5	43			
	90	45.5	50			
	100	50.0	54.5			
	110	55.0	59.5			
	120	60.6	65			
	135	67.2	71.7			
	150	74.5	78.8			
28.5	75	28.7	32.6			
	90	34.3	38.2			
	105	38.8	42.7			
	110	42.4	46.3			
	120	45.8	49.7			
	135	50.9	54.8			
	150	56.2	60.1			
	177	66.1	70			

NOTE: DIMENSION "B" IS CALCULATED USING A CANTILEVER SIZED BATTERY BOX. OPTIONAL BOXES WILL AFFECT THIS DIMENSION.
* ADD 6.0 INCHES FOR 40IN LONG BATTERY BOX

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D3 CHART – T880S (SFFA) MX-OPTMIZED HOOD



Dimension B (BOC to 34" Short Battery Box) = -6.5in
Dimension B (BOC to 40" Long Battery Box) = -4.0in
Dimension E (BOC to DPF/SCR) = 0.2in

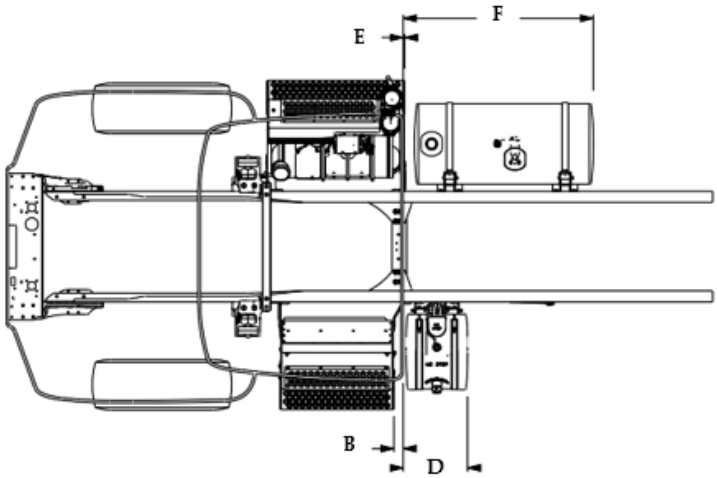
Table 6-14. T880S (SFFA) MX-Optimized Hood D3 Layout Dimensions

Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length		Small	Med	Large
22in	56	35.6	36.3	16.5*	22.4*	26.3*
	60	38.0	38.7			
	75	47.3	48			
	100	62.2	62.9			
	120	74.3	74.9			
24.5in	60	30.6	31.9			
	75	38.5	39.7			
	90	45.5	46.7			
	100	50.0	51.2			
	110	55.0	56.2			
	120	60.6	61.8			
	135	67.2	68.5			
	150	74.5	75.7			
28.5	75	28.7	29.4			
	90	34.3	35			
	105	38.8	39.5			
	110	42.4	43.1			
	120	45.8	46.5			
	135	50.9	51.6			
	150	56.2	56.9			
	177	66.1	66.9			

NOTE: DIMENSION "B" IS CALCULATED USING A CANTILEVER SIZED BATTERY BOX. OPTIONAL BOXES WILL AFFECT THIS DIMENSION.
* ADD 6.0 INCHES FOR 40IN LONG BATTERY BOX

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D4 CHART – T880 STANDARD HOOD



Dimension B (BOC to 34" Short Battery Box) = -2.5in
Dimension B (BOC to 40" Long Battery Box) = 3.5in
Dimension E (BOC to DPF/SCR) = 2.7in

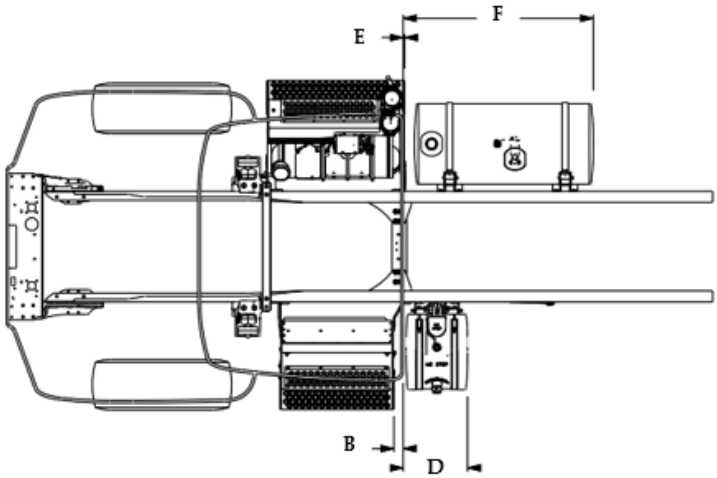
Table 6-15. T880 (SBFA) Standard Hood D4 Layout Dimensions

Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length		Small	Med	Large
22in	56	35.6	40.9	12.5*	18.4*	22.3*
	60	38.0	43.3			
	75	47.3	52.4			
	100	62.2	67.2			
	120	74.3	79.2			
24.5in	60	30.6	36.1			
	75	38.5	44.1			
	90	45.5	51.1			
	100	50.0	55.5			
	110	55.0	60.5			
	120	60.6	66.1			
	135	67.2	72.8			
	150	74.5	80.1			
28.5	75	28.7	33.8			
	90	34.3	39.3			
	105	38.8	43.9			
	110	42.4	47.5			
	120	45.8	50.9			
	135	50.9	55.9			
	150	56.2	61.3			
	177	66.1	71.2			

NOTE: DIMENSIONS "B" AND "F" ARE CALCULATED USING A 34" SHORT BATTERY BOX. OPTIONAL BOXES WILL AFFECT THESE DIMENSIONS
* ADD 6.0 INCHES FOR 40IN LONG BATTERY BOX

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D4 CHART – T880 MX-OPTIMIZED HOOD



Dimension B (BOC to 34" Short Battery Box) = -2.5in
Dimension B (BOC to 40" Long Battery Box) = 3.5in
Dimension E (BOC to DPF/SCR) = 2.7in

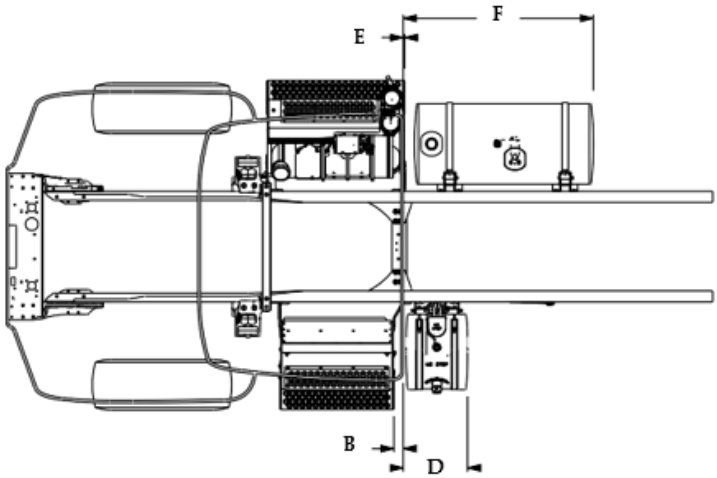
Table 6-16. T880 (SBFA) MX-Optimized Hood D4 Layout Dimensions

Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length		Small	Med	Large
22in	56	35.6	40.9	12.5*	18.4*	22.3*
	60	38.0	43.3			
	75	47.3	52.4			
	100	62.2	67.2			
	120	74.3	79.2			
24.5in	60	30.6	36.1			
	75	38.5	44.1			
	90	45.5	51.1			
	100	50.0	55.5			
	110	55.0	60.5			
	120	60.6	66.1			
	135	67.2	72.8			
	150	74.5	80.1			
28.5	75	28.7	33.8			
	90	34.3	39.3			
	105	38.8	43.9			
	110	42.4	47.5			
	120	45.8	50.9			
	135	50.9	55.9			
	150	56.2	61.3			
	177	66.1	71.2			

NOTE: DIMENSIONS "B" AND "F" ARE CALCULATED USING A 34" SHORT BATTERY BOX. OPTIONAL BOXES WILL AFFECT THESE DIMENSIONS
* ADD 6.0 INCHES FOR 40IN LONG BATTERY BOX

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D4 CHART – T880S (SFFA) MX-OPTIMIZED HOOD



Dimension B (BOC to 34" Short Battery Box) = -6.5in
Dimension B (BOC to 40" Long Battery Box) = -4.0in
Dimension E (BOC to DPF/SCR) = 0.2in

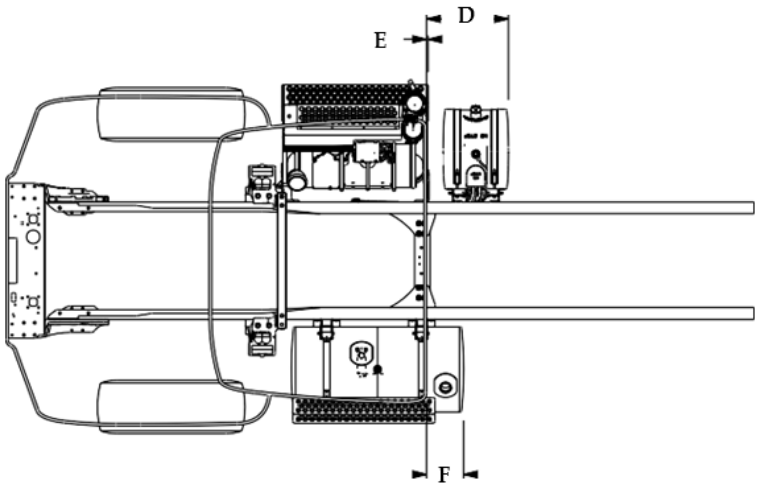
Table 6-17. T880S (SFFA) MX-Optimized Hood D4 Layout Dimensions

Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length		Small	Med	Large
22in	56	35.6	38.8	10.5*	16.4*	20.3*
	60	38.0	41.2			
	75	47.3	50.4			
	100	62.2	65.3			
	120	74.3	77.3			
24.5in	60	30.6	34.1			
	75	38.5	42.1			
	90	45.5	49.1			
	100	50.0	53.5			
	110	55.0	58.5			
	120	60.6	64.1			
	135	67.2	70.8			
	150	74.5	78.1			
28.5	75	28.7	31.8			
	90	34.3	37.3			
	105	38.8	41.9			
	110	42.4	45.5			
	120	45.8	48.9			
	135	50.9	53.9			
	150	56.2	59.3			
	177	66.1	69.2			

NOTE: DIMENSIONS "B" AND "F" ARE CALCULATED USING A 34" SHORT BATTERY BOX. OPTIONAL BOXES WILL AFFECT THESE DIMENSIONS
* ADD 6.0 INCHES FOR 40IN LONG BATTERY BOX

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D5 CHART – T880 STANDARD HOOD



Dimension E (BOC to DPF/SCR) = 2.7in

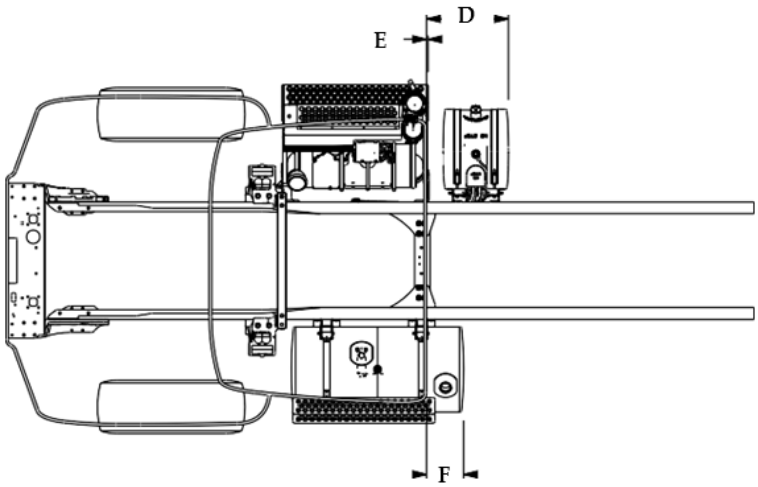
Table 6-18. T880 (SBFA) Standard Hood D4 Layout Dimensions

Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length		Small	Med	Large
22in	56	35.6	-2.1	18.5	26.6	30.2
	60	38.0	0.4			
	75	47.3	9.6			
	100	62.2	24.5			
	120	74.3	36.6			
24.5in	60	30.6	-6.5			
	75	38.5	0.6			
	90	45.5	7.7			
	100	50.0	12.2			
	110	55.0	17.2			
	120	60.6	22.8			
	135	67.2	29.4			
	150	74.5	36.7			
28.5	75	28.7	-8.8*			
	90	34.3	-3.3*			
	105	38.8	-0.4*			
	110	42.4	4.0*			
	120	45.8	7.4*			
	135	50.9	12.5*			
	150	56.2	17.8*			
	177	66.1	27.7*			

* N/A W/DUAL SIDE OF CAB EXHAUST

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D5 CHART – T880 MX-OPTIMIZED HOOD



Dimension E (BOC to DPF/SCR) = 2.7in

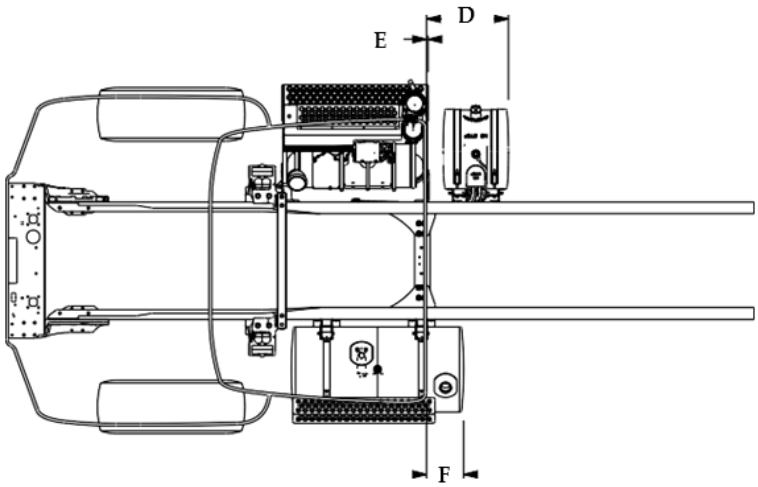
Table 6-19. T880 (SBFA) MX-Optimized Hood D4 Layout Dimensions

Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length		Small	Med	Large
22in	56	35.6	-2.1	18.5	26.6	30.2
	60	38.0	0.4			
	75	47.3	9.6			
	100	62.2	24.5			
	120	74.3	36.6			
24.5in	60	30.6	-6.5			
	75	38.5	0.6			
	90	45.5	7.7			
	100	50.0	12.2			
	110	55.0	17.2			
	120	60.6	22.8			
	135	67.2	29.4			
	150	74.5	36.7			
28.5	75	28.7	-8.8*			
	90	34.3	-3.3*			
	105	38.8	-0.4*			
	110	42.4	4.0*			
	120	45.8	7.4*			
	135	50.9	12.5*			
	150	56.2	17.8*			
	177	66.1	27.7*			

* N/A W/DUAL SIDE OF CAB EXHAUST

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D5 CHART – T880S (SFFA) MX-OPTIMIZED HOOD



Dimension E (BOC to DPF/SCR) = 2.7in

Table 6-20. T880S (SFFA) MX-Optimized Hood D4 Layout Dimensions

Fuel Tank Size			Dimension F BOC to Fuel Tank (in)	Dimension D BOC to DEF Tank (in)		
Diameter	Gallons	Length		Small	Med	Large
22in	56	35.6	-2.1	16.5	22.4	26.3
	60	38.0	0.4			
	75	47.3	9.6			
	100	62.2	24.5			
	120	74.3	36.6			
24.5in	60	30.6	-6.5			
	75	38.5	0.6			
	90	45.5	7.7			
	100	50.0	12.2			
	110	55.0	17.2			
	120	60.6	22.8			
	135	67.2	29.4			
	150	74.5	36.7			

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FRAME INFORMATION

Frame information provided is per rail, some specifications are written for RBM requirements per pair of rails. Make sure to know the requirement before deciding on the frame rail.

TABLE 7-1. Single Steel Rails

Rail Height		Flange Width		Web Thickness	Section Modulus (in3)	RBM (in lbs)	Weight (lbs/in)
H		W		T	S	R	W
10 - 5/8"	x	3 -1/2"	x	5/16"	14.80	1,776,000	2.90
10 - 3/4"	x	3 -1/2"	x	3/8"	17.80	2,132,000	3.46
10 -11/16"	x	3 -1/2"	x	1/2"	22.35	2,683,000	4.53
11- 5/8"	x	3 -7/8"	x	3/8"	21.43	2,572,000	3.80

TABLE 7-2. Inserted Steel Rails

Rail Height	Insert Material	Section Modulus	RBM (in lbs)	Weight (lbs/in)
10 - 5/8"	Single 9-7/8"x 2-7/8" x 1/4"	24.37	2,925,000	4.96
10 - 3/4"	Single 9-7/8"x 2-7/8" x 1/4"	27.33	3,280,000	5.53
11- 5/8"	Single 10-3/4" x 3-1/2" x 1/4"	39.20	4,704,000	7.28
11- 5/8"	Double (one 10-3/4" x 3-1/2" x 1/4" and one 9-7/8"x 2-7/8" x 1/4")	48.77	5,853,000	9.33

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CRITICAL CLEARANCES

Rear Wheel Clearance

CAUTION

Insufficient clearance between rear tires and body structure could cause damage to the body during suspension movement. Allow at least 8 inches clearance (See Figure 7–1).

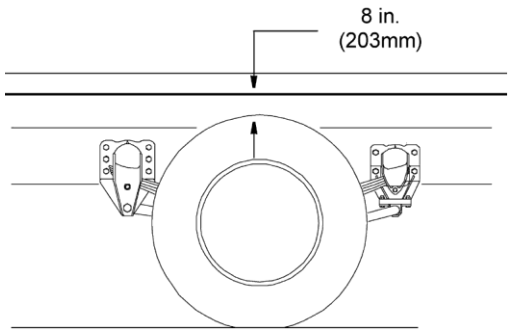


Figure 7-1. Minimum Clearance Between Top of Rear Tires and Body Structure

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Cab Clearance

CAUTION

Maintain adequate clearance between back of cab and the front (leading edge) of mounted body. See Figure 7–2.

NOTE

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

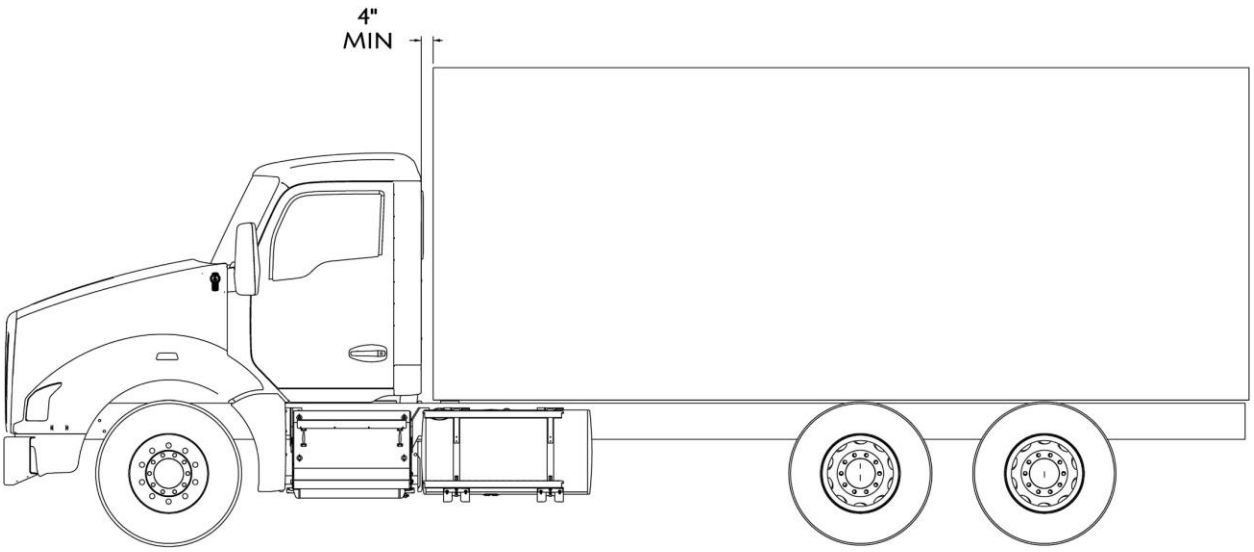


Figure 7-2. Minimum Back of Cab Clearance

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BODY MOUNTING USING BRACKETS

WARNING

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

CAUTION

Always install a spacer between the body subframe and the top flange of the frame rail. Failure to do so could result in corrosion due to dissimilar materials.

Frame Sill

If the body is mounted to the frame with brackets, we recommend that the frame sill spacer be 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 7–3.

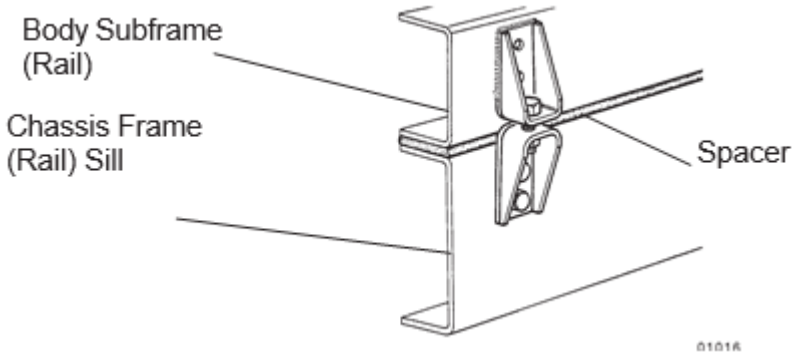


Figure 7-3. Spacer Between Frame Sill and Body Rail – Rubber or Plastic

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Brackets

When mounting a body to the chassis with brackets, we recommend designs that offer limited amount of relative movement, bolted securely but not too rigid. Brackets should allow for slight movement between the body and the chassis. For instance, Figure 7–4 shows a high compression spring between the bolt and the bracket.

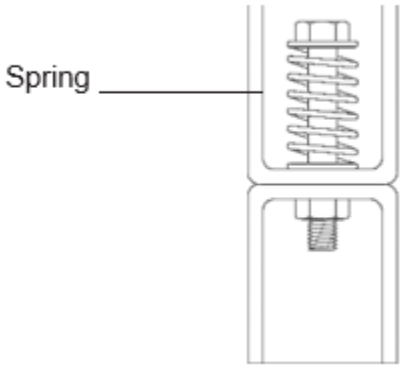


Figure 7-4. High Compression Spring Between Mounting Bolt and Upper Bracket

Another possibility is mounting a rubber spacer between the brackets. See Figure 7–5.

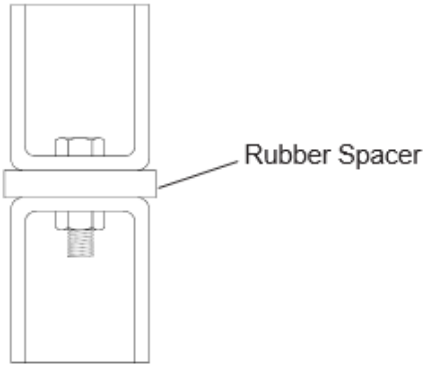


Figure 7-5. Rubber Spacer Between Brackets

These designs will allow relative movement between the body and the chassis during extreme frame racking situations. Extreme frame racking, and mountings that are too rigid, could cause damage to the body. This is particularly true with tanker installations.

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MOUNTING HOLES

When installing the lower bracket on 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 6–6. The hole diameter should not exceed the bolt diameter by more than .060 inches (1.5 mm).

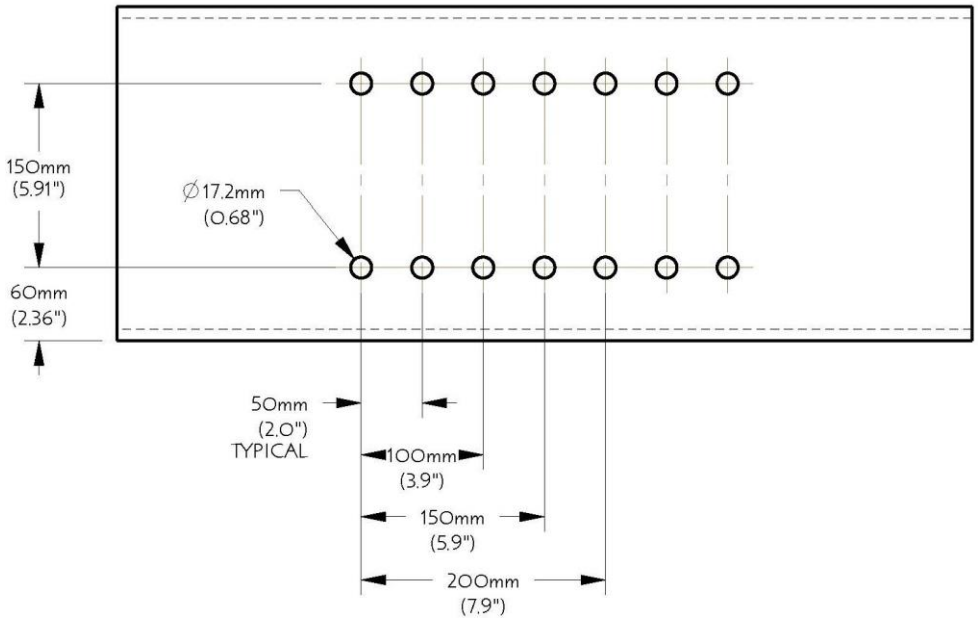
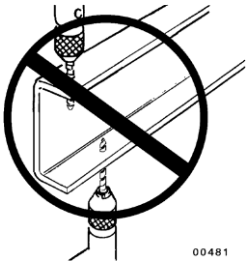


Figure 7-6. Crossmember-Gusset Hole Pattern Requirements (mm / in)

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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.

CAUTION

Use care when drilling the frame web so that 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.

WARNING

Do not drill closely spaced holes in the frame rail. 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 holes.

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BODY MOUNTING USING U–BOLTS

Spacers

If the body is mounted to the frame with U–bolts, use a hardwood sill (minimum 1/2 inch (12 mm) 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 7–7.

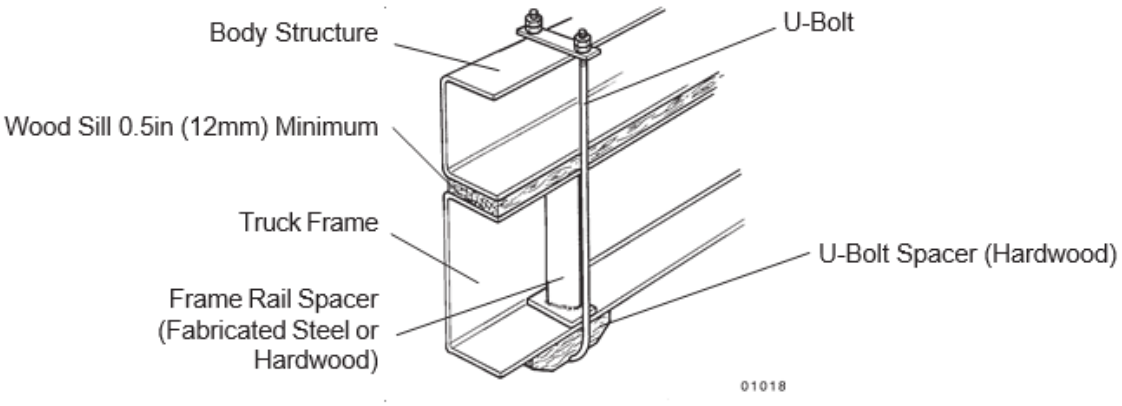


Figure 7-7. Acceptable U-Bolt Mounting with Wood and Fabricated Spacers

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 7–8.

CAUTION

Mount U–bolts so that they do not chafe on the frame rail. Failure to do so could result in premature wear of the U-bolt or the frame rail.

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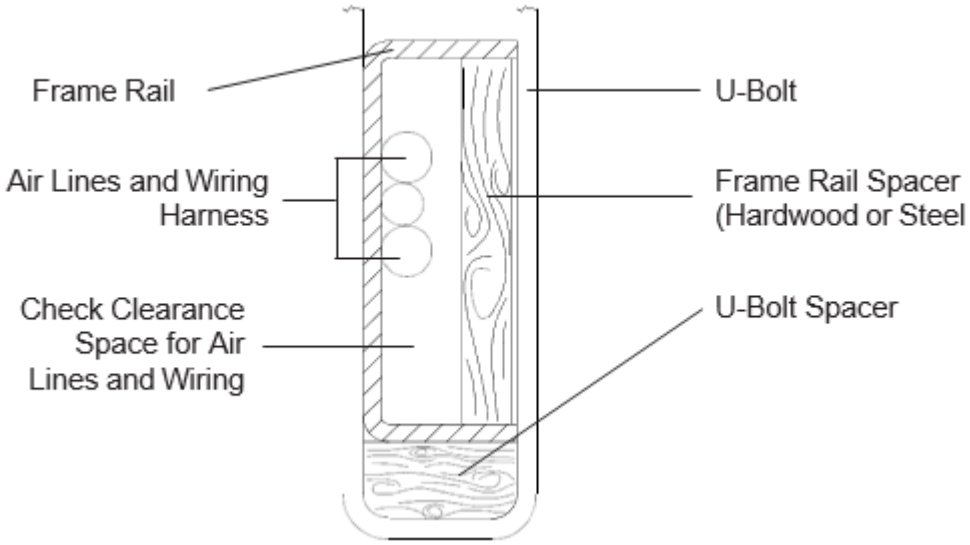
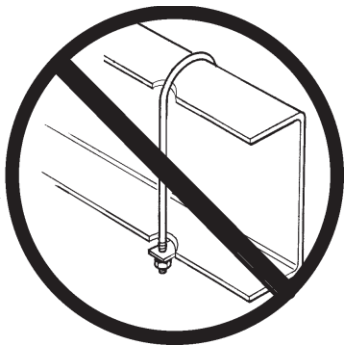


Figure 7-8. Clearance Space for Air Lines and Cables

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. Use a hardwood spacer as shown in Figure 7-7.



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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 7–9. This provides a firm attaching point and helps prevent any relative fore or aft movement between the body and frame.

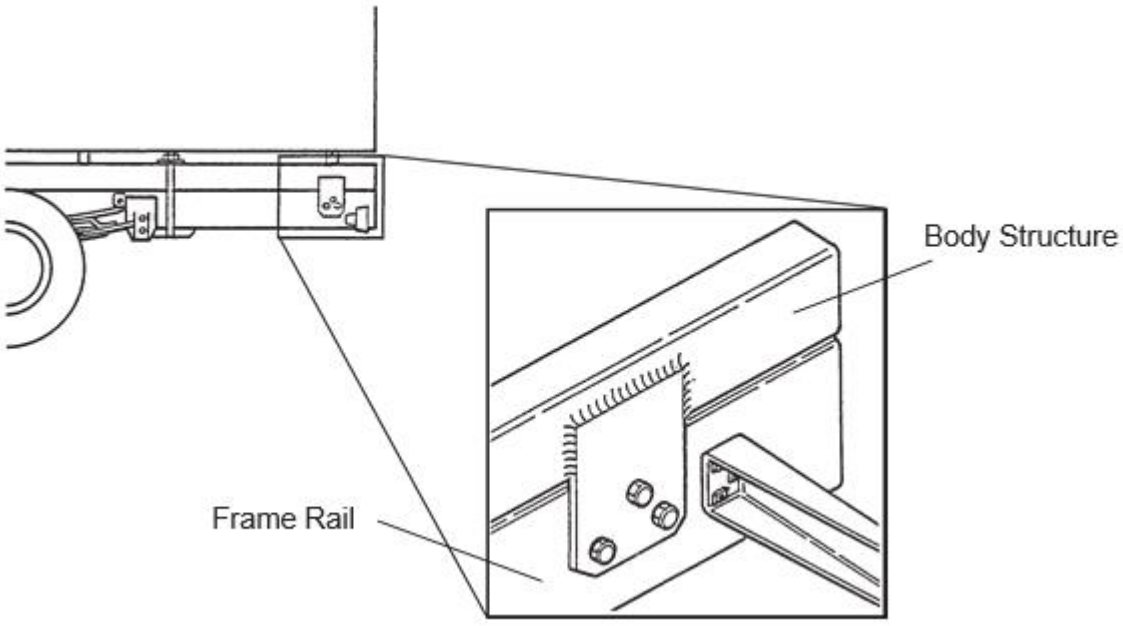


Figure 7-9. Example of Fishplate Bracket at Rear End of Body Installation with U-Bolts

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FRAME MODIFICATIONS

Introduction

Kenworth offers customer specified wheelbases. However, some installations may require slight modifications, while other installations will require extensive modifications. Sometimes an existing dealer stock chassis may need wheelbase adjustments to better fit a customer's application. The modifications may be as simple as shortening or lengthening the frame cutoff, or they may be as complex as changing the wheelbase.

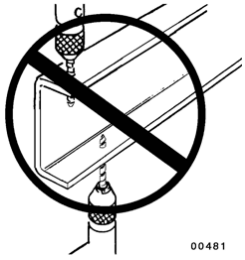
DRILLING RAILS

Location and Hole Pattern

If holes need to be drilled for body attachments to the rail, see SECTION 6 BODY MOUNTING 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 closely spare holes in the web of the 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 holes.

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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 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

Hole diameter should not exceed the bolt diameter by more than .060 inches (1.5 mm). Oversized holes could result in excessive frame wear around the hole.

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MODIFYING FRAME LENGTH

The frame cutoff 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 1 to 2 inches (25 to 50 mm) of the flame cut and may not adversely affect the strength of the chassis or body installation.

The frame cutoff can be lengthened by adding frame extenders.

When extending 10.5" frame rails, the additional sections can be welded to the existing rails. The joint should be welded and reinforced as illustrated in Figure 8–1.

NOTE

See page XXX for more information on welding frames.

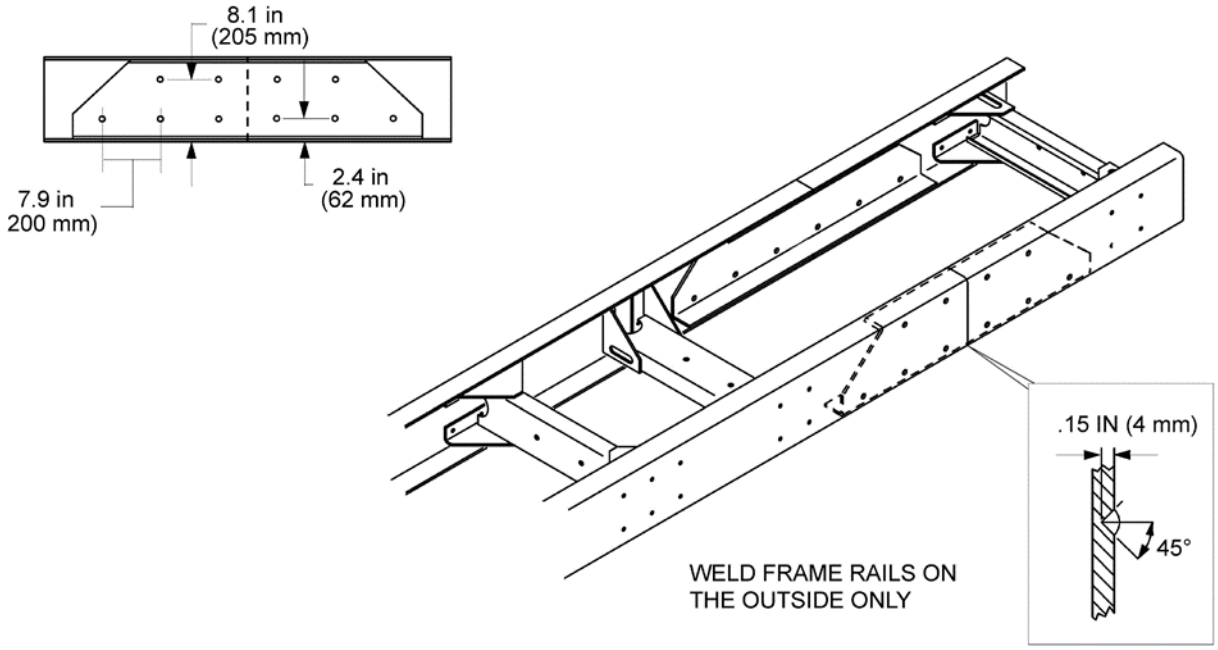


FIGURE 8-1. Detail of Frame Extension and Joint Welding

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Frame Insert

A frame insert must be added after welding a frame rail extension to compensate for lost strength. The insert should be of the same material as the frame member, or of steel, and at least equal to the frame rail in thickness. Attachment of the insert to the frame should be made with Ream-Fit heat-treated bolts, 5/8 in. (16 mm) dia. or the next larger size. Both the reinforcement and frame holes should be reamed to provide a fit of from .001 in. to .003 in. (.025 to .076 mm) clearance. Do not weld reinforcing members. The insert should span a distance of at least 24 in. (610 mm) on either side of the joint to insure an even distribution of stresses. Cut the ends of the insert at 45° as shown in Figure 8–2 unless the insert extends to the end of the frame.

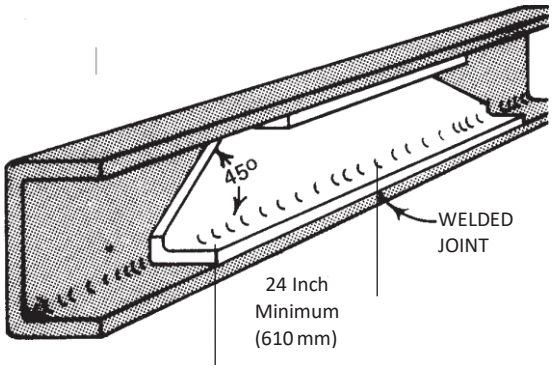


FIGURE 8-2. Frame Insert

Where possible, use existing bolt holes to attach the insert to the frame. Bolt holes must not be located closer to the frame flanges than the present bolt pattern.

If the insert is placed in a section of the main frame where few bolts are located, additional bolts are required. Use the following guideline for locating additional bolt holes.

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CHANGING WHEELBASE

We do not recommend modifying the wheelbase. Occasionally, however, a chassis wheelbase will need to be reduced or lengthened. When this needs to be done there are a few guidelines that should 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.

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

WARNING

When changing the wheelbase, a continuous blank frame insert must be added in the new rear suspension mounting bolts. All new mounting holes must pass through the original rail and the insert. Failure to do so could cause excessive stress in the original rail due to additional holes.

WARNING

When relocating a suspension bracket, do not mount it on the extended (added) section of a frame rail. The suspension loading could result in premature failure of the added section splice. This could cause an accident. Use care when planning the wheelbase so that the rear suspension bracket is always mounted on the original rail section. See Figure 8–3.

When reducing the wheelbase, we recommend that the suspension be moved forward and relocated on the original rail. The rail behind the suspension can then be cut to achieve the desired frame cutoff. See Figure 8–3.

WARNING

Do not drill new holes any closer than 2 inches (50 mm) to existing holes. Frame drilling affects the strength of the rails.

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 not come any closer than 2 inches (50 mm) to existing holes.

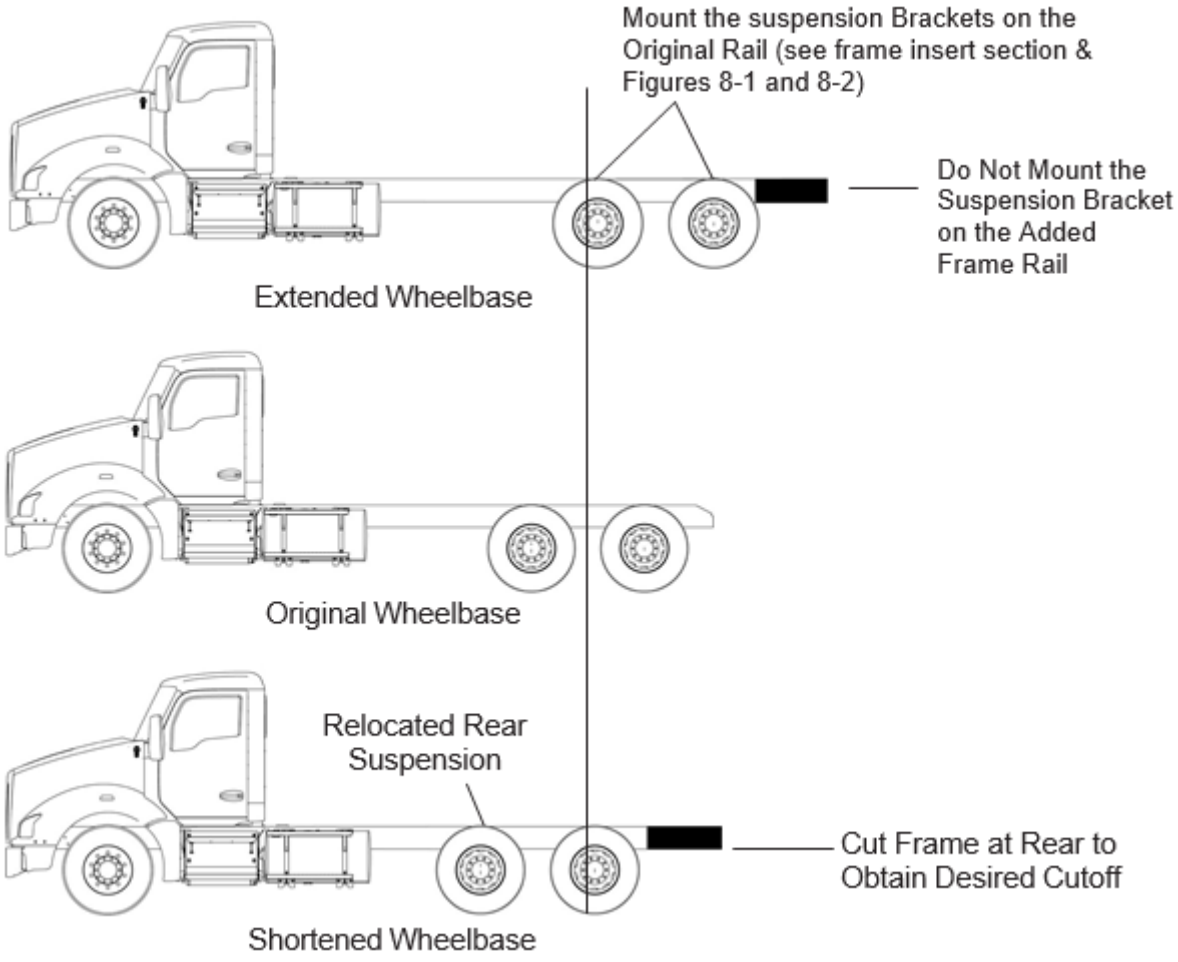


FIGURE 8-3. Comparison of Original, Shortened, and Extended Wheelbases

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CROSSMEMBERS

After changing a wheelbase, an additional crossmember may be required to maintain the original frame strength. The maximum allowable distance between adjacent crossmembers is 60 inches (1524 mm). If the distance between adjacent crossmembers exceeds this dimension, add a crossmember between them. See Figure 8–4.

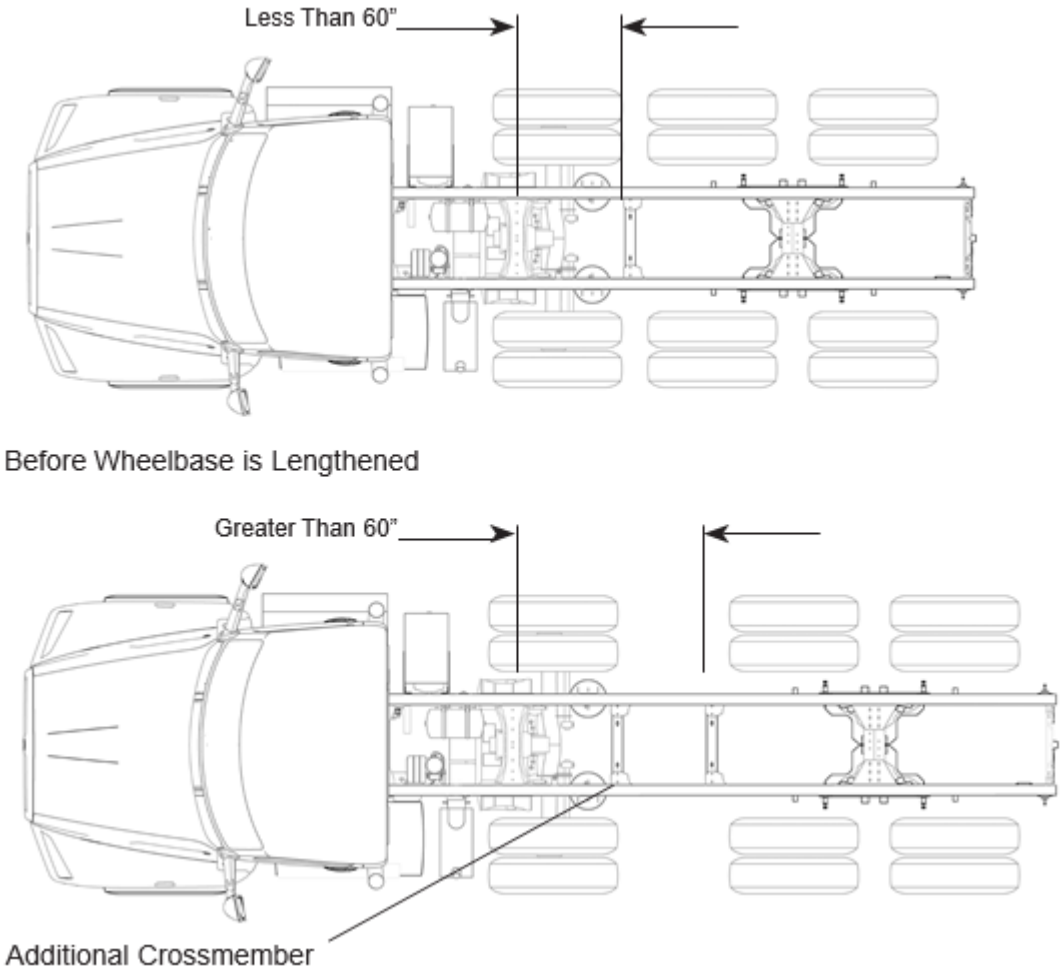


FIGURE 8-4. Crossmembers when Frame Addition Distance Exceeds 60in (1524mm)

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WELDING

Kenworth DOES NOT recommend frame welding. 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 hacksaw 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.

Precautions



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.

SECTION 8 – FRAME MODIFICATIONS 01/2022

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 connectors.
3. Do no use the ECM 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 maxi- mum weld current and minimum risk to damage electrical components on the vehicle.
5. Turn off key.



NOTE

Bendix ABS, Bosch ABS, and WABCO ABS: Disconnect ECU.

TORQUE REQUIREMENTS

TABLE 8-1. Customary Grade 8 UNF or UNC.

Fastener	Torque	
Size	Nm	Lb.-Ft
5/16	22–30	16–22
3/8	41–54	30–40
7/16	75–88	55–65
1/2	109–122	80–90
9/16	156–190	115-140
5/8	224–265	165–195
3/4	394–462	290–340
7/8	517–626	380–460
1	952–1129	800–830
1-1/8	1346–1591	990–1170
1-1/4	1877–2217	1380–1630

TABLE 8-2. U.S. Customary – Grade 8 (Metric Class 10.9)

Fastener	Torque	
	Nm	Lb-Ft
M6	9–15	7–11
M8	23–31	17–23
M10	33–43	24–32
M12	75–101	55–75
M14	134–164	99–121
M16	163–217	120–160
M20	352–460	260–340

SECTION 9 – CAN COMMUNICATION 01/2022

INTRODUCTION

Controller Area Network (CAN) is a serial network technology that was originally designed for the automotive industry but has also become popular in the commercial trucking industrial. The CAN bus is primarily used in embedded systems and is a network technology that provides fast communication among controllers up to real-time requirements, eliminating the need for the much more expensive and complex technology.

CAN is a two-wire high-speed network system, that is far superior to conventional hardwired technologies regarding functionality and reliability. CAN is designed for real-time requirements and can easily beat hardwire connections when it comes to shorter reaction times, timely error detection, quick error recovery and error repair.

Characteristics of Controller Area Network

- Is a serial networking technology for embedded solutions
- Needs only two wires to communicate messages
- Operates at data rates of 250K and 500K
- Supports a maximum of 8 bytes per message frame
- One Bus can support multiple message IDs
- Supports message priority (i.e. the lower the message ID the higher its priority)

SAE J1939

The Society of Automotive Engineers (SAE) Truck and Bus Control and Communications Subcommittee have developed a family of standards concerning the design and use of devices that transmit electronic signals and control information
among vehicle components. SAE J1939 and its companion documents are the accepted industry standard and the vehicle network of choice for commercial truck applications. SAE J1939 is used in the commercial vehicle area for communication in the embedded systems of the commercial vehicle.

SAE J1939 uses CAN as physical layer. The J1939 standards are a set of recommended practices that define which and how the data is communicated between the Electronic Control Units within a vehicle network. Typical controllers are the Engine, Brake, Transmission, etc. The messages exchanged between these units can be data such as vehicle road speed, torque control message from the transmission to the engine, oil temperature, and many more.

Characteristics of J1939

- Extended CAN identifier (29 bit)
- Peer-to-peer and broadcast communication
- Network management
- Definition of parameter groups for commercial vehicles and others
- Manufacturer specific parameter groups are supported
- Diagnostics features
- Is a standard developed by the Society of Automotive Engineers
- Defines communication for vehicle networks
- Is a Higher-Layer Protocol using CAN as the physical layer
- Uses shielded twisted pair wire
- Applies a maximum network length of 120 ft.
- Applies a standard baud rate of 250 Kbit/sec
- Supports peer-to-peer and broadcast communication
- Supports message lengths up to 1785 bytes
- Defines a set of Parameter Group Numbers
- Supports network management

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PARAMETER GROUP NUMBER

Parameter Groups contain information on parameter assignments within the 8-byte CAN data field of each message as well as repetition rate and priority. Parameters groups are, for instance, engine temperature, which includes coolant temperature, fuel temperature, oil temperature, etc. Parameter Groups and their numbers are listed in SAE J1939 and defined in SAE J1939/71, a document containing parameter group definitions plus suspect parameter numbers.

SUSPECT PARAMETER NUMBER

A Suspect Parameter Number is a number assigned by the SAE to a specific parameter within a parameter group. It describes the parameter in detail by providing the following information:

Data Length in bytes
Data Type
Resolution
Offset Range
Reference Tag (Label)

SPNs that share common characteristics are grouped into Parameter Groups and they will be transmitted throughout the network using the Parameter Group Number.

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CAN MESSAGES AVAILABLE ON BODY CONNECTIONS

Table 9-1. CAN Messages Available on Body Connections

SPN	CAN Signal Description	PGN	CAN BUS
5400	SCR Thermal Management Active	61443, EEC2	SCAN, KCAN, BCAN
91	Accelerator Pedal Position 1	61443, EEC2	SCAN, KCAN, BCAN
92	Engine Percent Load At Current Speed	61443, EEC2	SCAN, KCAN, BCAN
5399	DPF Thermal Management Active	61443, EEC2	SCAN, KCAN, BCAN
559	Accelerator Pedal Kickdown Switch	61443, EEC2	SCAN, KCAN, BCAN
2979	Vehicle Acceleration Rate Limit Status	61443, EEC2	SCAN, KCAN, BCAN
1437	Road Speed Limit Status	61443, EEC2	SCAN, KCAN, BCAN
558	Accelerator Pedal1 Low Idle Switch	61443, EEC2	SCAN, KCAN, BCAN
3357	Actual Max Available Engine Torque	61443, EEC2	SCAN, KCAN, BCAN
5398	Estimated Pumping-Percent Torque	61443, EEC2	SCAN, KCAN, BCAN
513	Actual Engine-Percent Torque	61444, EEC1	SCAN, KCAN, BCAN
512	Driver's Demand Engine-Percent Torque	61444, EEC1	SCAN, KCAN, BCAN
2432	Engine Demand–Percent Torque	61444, EEC1	SCAN, KCAN, BCAN
190	Engine Speed	61444, EEC1	SCAN, KCAN, BCAN
899	Engine Torque Mode	61444, EEC1	SCAN, KCAN, BCAN
1483	Source Address of Controlling Device for Engine Control	61444, EEC1	SCAN, KCAN, BCAN
1675	Engine Starter Mode	61444, EEC1	SCAN, KCAN, BCAN
4154	Actual Engine - Percent Torque (Fractional)	61444, EEC1	SCAN, KCAN, BCAN
3697	Diesel Particulate Filter Lamp Command	64892, DPFC1	SCAN, KCAN, BCAN
3700	Aftertreatment Particulate Filter Active Regen Status	64892, DPFC1	SCAN, KCAN, BCAN
3703	Particulate Filter Active Regen Inhibited Due to Inhibit Switch	64892, DPFC1	SCAN, KCAN, BCAN
3701	Aftertreatment Diesel Particulate Filter Status	64892, DPFC1	SCAN, KCAN, BCAN
3702	Filter Active Regen Inhibited Status	64892, DPFC1	SCAN, KCAN, BCAN
3704	Filter Active Regen Inhibited Due to Clutch Disengaged	64892, DPFC1	SCAN, KCAN, BCAN
3705	Filter Active Regen Inhibited Due to Service Brake Active	64892, DPFC1	SCAN, KCAN, BCAN
3706	Filter Active Regen Inhibited Due to PTO Active	64892, DPFC1	SCAN, KCAN, BCAN
3707	Filter Active Regen Inhibited Due to Accelerator Pedal Off Idle	64892, DPFC1	SCAN, KCAN, BCAN
3708	Filter Active Regen Inhibited Due to Out of Neutral	64892, DPFC1	SCAN, KCAN, BCAN
3709	Filter Active Regen Inhib Due to Vehicle spd Above Allowed Spd	64892, DPFC1	SCAN, KCAN, BCAN
3710	Filter Active Regen Inhibited Due to Parking Brake Not Set	64892, DPFC1	SCAN, KCAN, BCAN
3711	Filter Active Regen Inhibited Due to Low Exhaust Temperature	64892, DPFC1	SCAN, KCAN, BCAN
3712	Filter Active Regen Inhibited Due to System Fault Active	64892, DPFC1	SCAN, KCAN, BCAN
3713	Filter Active Regen Inhibited Due to System Timeout	64892, DPFC1	SCAN, KCAN, BCAN
3716	Filter Active Regen Inhibited Due to Engine Not Warmed Up	64892, DPFC1	SCAN, KCAN, BCAN
3717	Filter Active Regen Inhib Due to Vehicle spd Below Allowed Spd	64892, DPFC1	SCAN, KCAN, BCAN
3718	Filter Automatic Active Regen Initiation Configuration	64892, DPFC1	SCAN, KCAN, BCAN
3698	Exhaust System High Temperature Lamp Command	64892, DPFC1	SCAN, KCAN, BCAN
4175	Particulate Filter Active Regen Forced Status	64892, DPFC1	SCAN, KCAN, BCAN
1761	Aftertreatment 1 Exhaust Fluid Tank Volume	65110, AT1T1I1	SCAN, KCAN, BCAN
3031	Aftertreatment 1 Exhaust Fluid Tank Temperature	65110, AT1T1I	SCAN, KCAN, BCAN

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Table 9-1. (Continued) CAN Messages Available on Body Connections

SPN	CAN Signal Description	PGN	CAN BUS
3363	Aftertreatment 1 Exhaust Fluid Tank Heater	65110, AT1T1I	SCAN, KCAN, BCAN
5246	Aftertreatment SCR Operator Inducement Severity	65110, AT1T1I	SCAN, KCAN, BCAN
5245	Aftertreatment Exhaust Fluid Tank Low Level Indicator	65110, AT1T1I	SCAN, KCAN, BCAN
1639	Fan speed	65213, FD1	SCAN, KCAN, BCAN
975	Engine Fan1 Estimated Percent Speed	65213, FD1	SCAN, KCAN, BCAN
977	Fan Drive State	65213, FD1	SCAN, KCAN, BCAN
247	Engine Total Hours of Operation	65253, HOURS	SCAN, KCAN, BCAN
249	Engine Total Revolutions	65253, HOURS	SCAN, KCAN, BCAN
250	Engine Total Fuel Used	65257, LFC1	SCAN, KCAN, BCAN
182	Engine Trip Fuel	65257, LFC1	SCAN, KCAN, BCAN
110	Engine Coolant Temperature	65262, ET1	SCAN, KCAN, BCAN
174	Engine Fuel Temperature 1	65262, ET1	SCAN, KCAN, BCAN
52	Engine Intercooler Temperature	65262, ET1	SCAN, KCAN, BCAN
175	Engine Oil Temperature 1	65262, ET1	SCAN, KCAN, BCAN
111	Engine Coolant Level 1	65263, EFLP1	SCAN, KCAN, BCAN
94	Engine fuel Delivery Pressure	65263, EFLP1	SCAN, KCAN, BCAN
100	Engine Oil Pressure	65263, EFLP1	SCAN, KCAN, BCAN
101	Engine Crankcase Pressure	65263, EFLP1	SCAN, KCAN, BCAN
98	Engine Oil Level	65263, EFLP1	SCAN, KCAN, BCAN
185	Engine Average Fuel Economy	65266, LFE1	SCAN, KCAN, BCAN
184	Engine Instantaneous Fuel Economy	65266, LFE1	SCAN, KCAN, BCAN
183	Engine Fuel Rate	65266, LFE1	SCAN, KCAN, BCAN
51	Engine Throttle Valve1 Postion1	65266, LFE1	SCAN, KCAN, BCAN
171	Ambient Air Temperature	65269, AMB	SCAN, KCAN, BCAN
108	Barometric Pressure	65269, AMB	SCAN, KCAN, BCAN
173	Engine Exhaust Temperature	65270, IC1	SCAN, KCAN, BCAN
105	Engine Intake Manifold 1 Temperature	65270, IC1	SCAN, KCAN, BCAN
81	Aftertreatment 1 Particulate Filter Intake Pressure	65270, IC1	SCAN, KCAN, BCAN
106	Engine Intake Air Pressure	65270, IC1	SCAN, KCAN, BCAN
102	Engine Intake Manifold #1 Pressure	65270, IC1	SCAN, KCAN, BCAN
191	Transmission Output Shaft Speed	61442, ETC1	SCAN, KCAN, BCAN
574	Transmission Shift in Process	61442, ETC1	SCAN, KCAN, BCAN
4816	Transmission Torque Converter Lockup Transition in Process	61442, ETC1	SCAN, KCAN, BCAN
573	Transmission Torque Converter Lockup Engaged	61442, ETC1	SCAN, KCAN, BCAN
560	Transmission Driveline Engaged	61442, ETC1	SCAN, KCAN, BCAN
606	Engine Momentary Overspeed Enable	61442, ETC1	SCAN, KCAN, BCAN
607	Progressive Shift Disable	61442, ETC1	SCAN, KCAN, BCAN
161	Transmission Input Shaft Speed	61442, ETC1	SCAN, KCAN, BCAN
1482	Source Address of Controlling Device for Transmission Control	61442, ETC1	SCAN, KCAN, BCAN
526	Transmission Actual Gear Ratio	61445, ETC2	SCAN, KCAN, BCAN
523	Transmission Current Gear	61445, ETC2	SCAN, KCAN, BCAN
524	Transmission Selected Gear	61445, ETC2	SCAN, KCAN, BCAN

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Table 9-1. (Continued) CAN Messages Available on Body Connections

SPN	CAN Signal Description	PGN	CAN BUS
163	Transmission Current Gear	61445, ETC2	SCAN, KCAN, BCAN
162	Transmission Requested Range	61445, ETC2	SCAN, KCAN, BCAN
177	Transmission Oil Temperature1	65272, TRF1	SCAN, KCAN, BCAN
3027	Transmission Oil Level1 High/Low	65272, TRF1	SCAN, KCAN, BCAN
3026	Transmission Oil Level 1 Measurement Status	65272, TRF1	SCAN, KCAN, BCAN
3028	Transmission Oil Level 1 Countdown Timer	65272, TRF1	SCAN, KCAN, BCAN
597	Brake Switch	65265, CCVS1	SCAN, KCAN, BCAN
598	Clutch Switch	65265, CCVS1	SCAN, KCAN, BCAN
595	Cruise Control Active	65265, CCVS1	SCAN, KCAN, BCAN
976	PTO Governor State	65265, CCVS1	SCAN, KCAN, BCAN
527	Cruise Control States	65265, CCVS1	SCAN, KCAN, BCAN
70	Parking Brake Switch	65265, CCVS1	SCAN, KCAN, BCAN
596	Cruise Control Enable Switch	65265, CCVS1	SCAN, KCAN, BCAN
599	Cruise Control Set Switch	65265, CCVS1	SCAN, KCAN, BCAN
600	Cruise Control Coast (Decelerate) Switch	65265, CCVS1	SCAN, KCAN, BCAN
601	Cruise Control Resume Switch	65265, CCVS1	SCAN, KCAN, BCAN
602	Cruise Control Accelerate Switch	65265, CCVS1	SCAN, KCAN, BCAN
86	Cruise Control Set Speed	65265, CCVS1	SCAN, KCAN, BCAN
69	Two Speed Axle Switch	65265, CCVS1	SCAN, KCAN, BCAN
84	Wheel-Based Vehicle Speed	65265, CCVS1	SCAN, KCAN, BCAN
244	Trip Distance	65248, VD	SCAN, KCAN, BCAN
245	Total Vehicle Distance	65248, VD	SCAN, KCAN, BCAN
979	Engine Remote PTO Governor Preprogrammed spd Control Switch	65264, PTO	SCAN, KCAN, BCAN
3447	Remote PTO Governor Preprogrammed spd Control Switch 2	65264, PTO	SCAN, KCAN, BCAN
974	Remote Accelerator Pedal Position	61443, EEC2	SCAN, KCAN, BCAN
980	Engine PTO Governor Enable Switch	65264, PTO	SCAN, KCAN, BCAN
982	Engine PTO Governor Resume Switch	65264, PTO	SCAN, KCAN, BCAN
984	Engine PTO Governor Set Switch	65264, PTO	SCAN, KCAN, BCAN
90	PTO Oil Temperature	65264, PTO	SCAN, KCAN, BCAN
695	Engine Override Control Mode	0,TSC1	SCAN, KCAN, BCAN
696	Engine Requested Speed Control Conditions	0,TSC1	SCAN, KCAN, BCAN
897	Override Control Mode Priority	0,TSC1	SCAN, KCAN, BCAN
898	Engine Requested Speed/Speed Limit	0,TSC1	SCAN, KCAN, BCAN
518	Engine Requested Torque/Torque Limit	0,TSC1	SCAN, KCAN, BCAN
3349	TSC1 Transmission Rate	0,TSC1	SCAN, KCAN, BCAN
3350	TSC1 Control Putpose	0,TSC1	SCAN, KCAN, BCAN
4191	Engine Requested Torque - High Resolution	0,TSC1	SCAN, KCAN, BCAN
4206	Message Counter	0,TSC1	SCAN, KCAN, BCAN
4207	Message Checksum	0,TSC1	SCAN, KCAN, BCAN
187	Power Take Off Set Speed	65264,PTO	SCAN, KCAN, BCAN
3696	Force Regen	57344,CM1	SCAN, KCAN, BCAN
3695	Inhibit Regen	57344,CM1	SCAN, KCAN, BCAN

SECTION 10 – ELECTRICAL 01/2022

INTRODUCTION

This section is written to provide information to the body builder when installing equipment into vehicles built with Multiplexed instrumentation. The new technology presented by VECU level instrumentation integrates J-1939 CAN data communications between equipment on the vehicle. This book is intended to address how to work in aftermarket equipment while still maintaining full functionality of the OEM vehicle.

These topics apply to 2.1M chassis built with VMUX architecture. The electrical architecture for these trucks will be named VMUX which replaces VECU01. This system integrates a parallel control unit to manage outbound messages via a faster baud rate 500kbps and FCAN signals for the chassis module(s). The CECU3 unit has been removed on chassis with the VMUX architecture. The F-CAN is located on the VECU, so the VCAN is divided into VCAN1 and VCAN2. The second CAN is dedicated to OBD communication.

The most important advancement of electrical instrumentation is the implementation of the updated VECU controller. While it is still possible to wire completely outside of the VECU system, utilizing the VECU functions will make a cleaner installation and will maintain OEM functionality. VECU expands controls to air operated devices by receiving input from dash switches, remote (aftermarket) switches, sensors mounted to the aftermarket equipment and other vehicle parameters (engine speed, transmission status etc.) With the proper programming, VECU will then process the inputs and will create a J-1939 Data instruction which is communicated to another controller outside the cab called the Chassis Module. This chassis module receives the instruction and connects 12V power to an air solenoid. 12V power will open the solenoid and supply air pressure to that air circuit.

Acronym	Definition
CAN	Controller Area Network
DTC	Diagnostics Trouble Code
ECM	Engine Control Module
ECU	Electrical Control Unit
EOA	Electric Over Air
EOH	Electric Over Hydraulic
J-1939	SAE CAN Communication Standard
LIN	Local Interconnect Network
MSB	Master Solenoid Bank
MSM	Master Switch Module
MUX	Multiplex Switch
OBD	On Board Diagnostics
OEM	Original Equipment Manufacture
PCC	Predictive Cruise Control
PDC	Power Distribution Center
PGN	Parameter Group Number
PTO	Power Take Off
RP1226	TMS Messaging Standard
SPN	Suspect Parameter Number
TCM	Transmission Control Module
VECU	Vehicle Electrical Control Unit

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ELECTRICAL WIRING CIRCUIT CODES

Kenworth will continue to use the wiring scheme that was employed on legacy trucks. The wiring system uses 10 different colors and only one striped wire color. Each wire has a minimum of seven characters, with the first three characters as the wire color. The remaining four characters are related to the wire services. The colors determine the circuits function as follows:

Table 10-1. Electrical Wire Circuit Code Table

PACCAR Electrical Circuit Code		
Insulation Color	**Color Code**	**Electrical Function**
Red w/white stripe	R/WXXXX	Direct battery power
Red	REDXXXX	Protected battery power
Orange	ORNXXXX	Ignition, Accessory, Low Voltage Disconnect, Start Power
Yellow	YELXXXX	Activated Power
White	WHTXXXX	Ground
Black	BLKXXXX	Load Return
Gray	GRAXXXX	Control
Brown	BRNXXXX	Indicator Illumination Backlit Illumination
Violet	VIOXXXX	Reference Voltage or +5VDC or Sensor Power
Light Blue	BLUXXXX	Sensor Signal
Light Green	GRNXXXX	Sensor Common Sensor Ground

MULTIPLEX SYSTEM

The VMUX electrical architecture uses a multiplexing system. Multiplexing can be defined as the process of sending multiple digital signals on the same shared medium at the same time. These signals are introduced into the multiplexing system through data connection points which are defined by J1939 backbone.

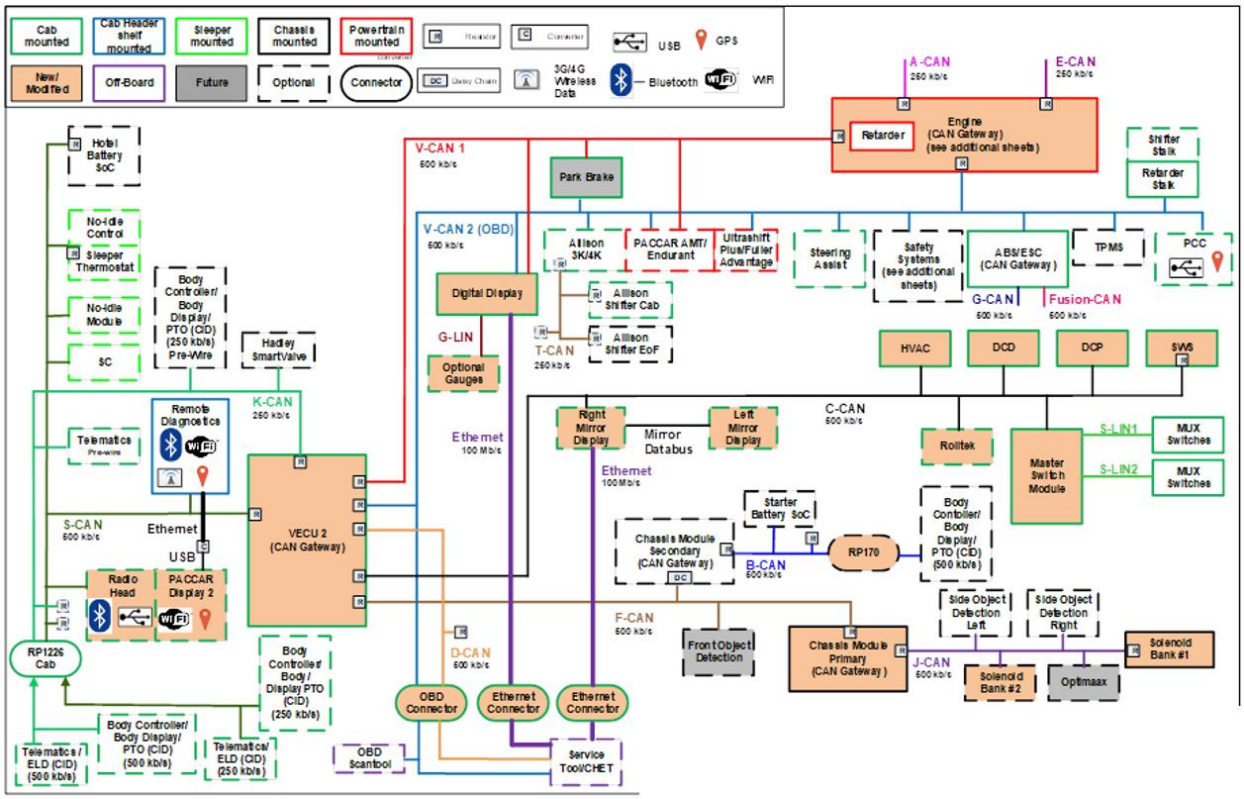


FIGURE 10-1. CAN Bus System Overview

CAN BUS SPEEDS AND CIRCUIT DESIGNATION

J1939-14 (500KBPS):

- B-CAN – 0813 Body Builder
- D-CAN – 0822 Diagnostics
- F-CAN – 0819 Frame
- G-CAN – 0825 Bendix ACB Antenna
- J-CAN – 0826 Solenoid Bank
- T-CAN – 0828 Transmission
- S-CAN – 8027 Radio and PACCAR 15in Digital Display
- V-CAN1 – 0812 Vehicle 1
- V-CAN2 – 0823 Vehicle 2

J1939-15 (250KBPS):

- T-CAN – 0828 Transmission
- K-CAN – 0829 Telematics and Remote PTO

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ELECTRICAL COMPONENT OVERVIEW

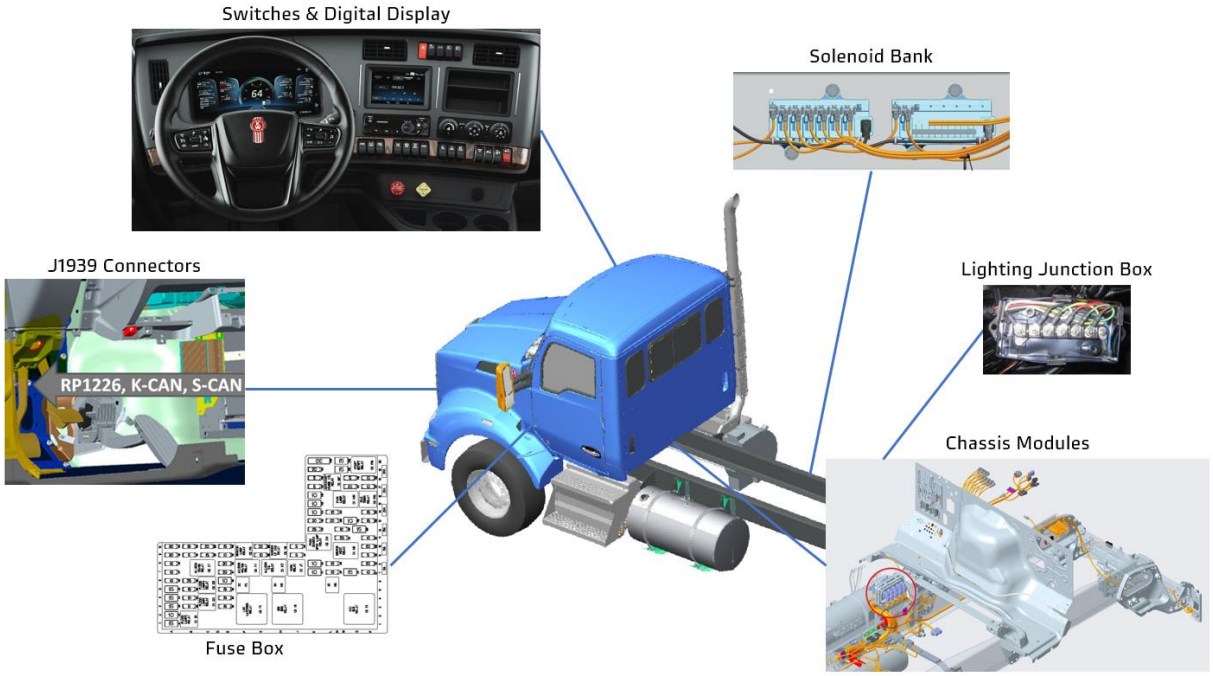


FIGURE 10-2. Overview Diagram of Electrical Component Locations

ELECTRICAL HARNESS OVERVIEW

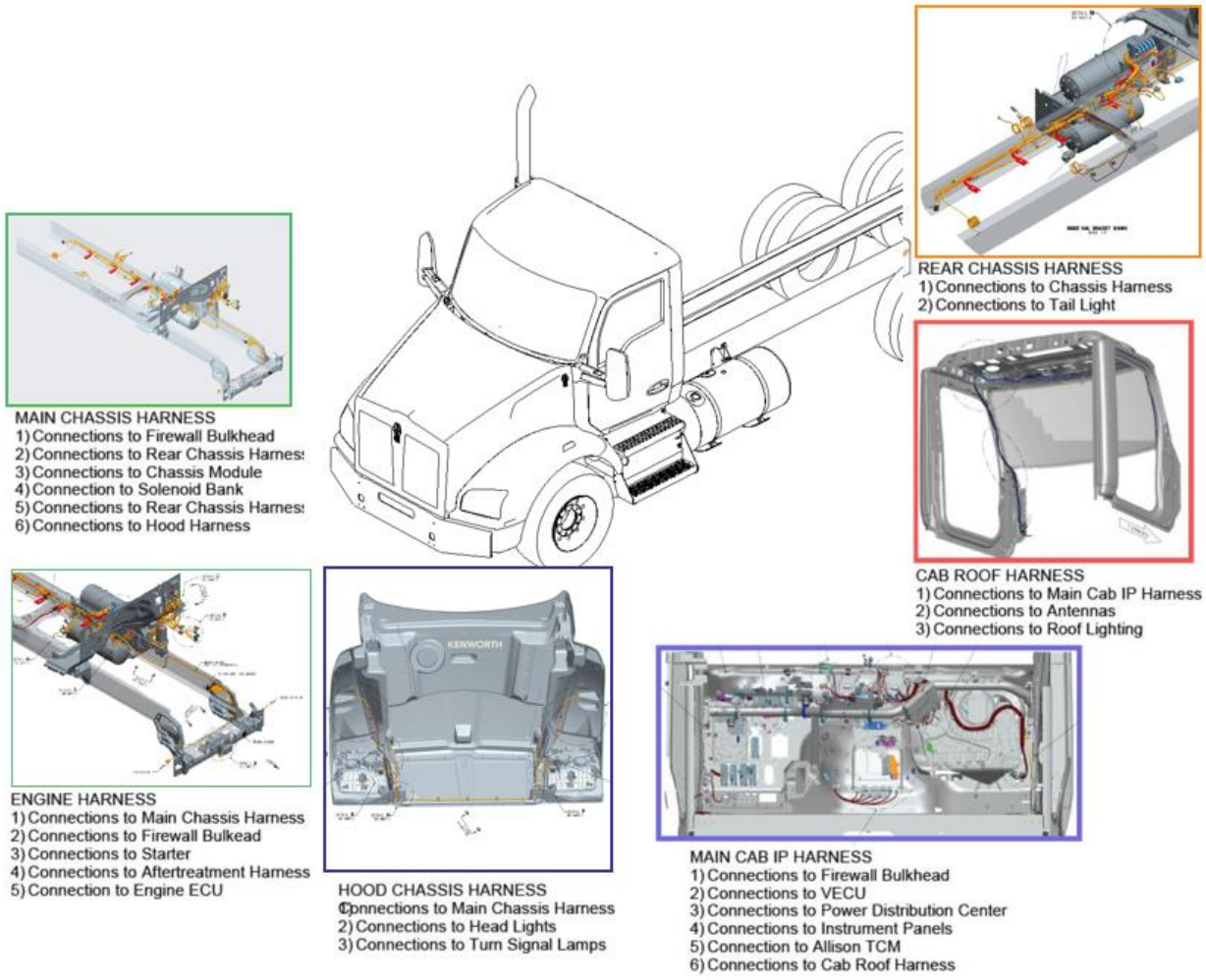


FIGURE 10-3. Electrical Harness Overview

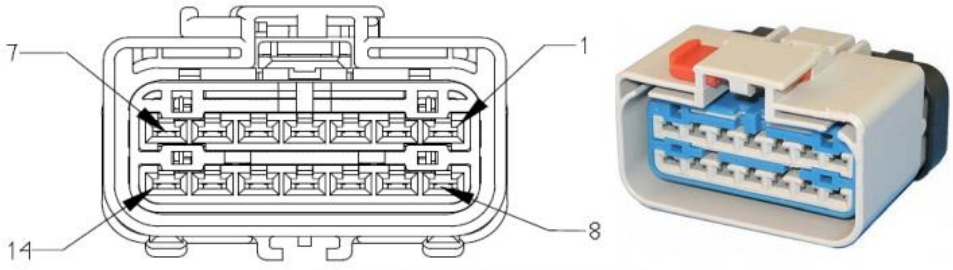
IN CAB CAN BASED MESSAGING CONNECTOR

RP1226 CONNECTOR

The RP1226 connector is located on the left-hand side of the steering wheel behind the dash near the OBD connector. The RP1226 connector can be used for aftermarket telematics, ELD, body controls, and PTO controls. There will be multiple bus speeds available. KCAN for 250kbps and SCAN for 500 kbps. The RP1226 provides defined messages and major telematics supplier data for customer use.



FIGURE 10-4. RP1226 Location (Driver's Side Kick Panel)



Pin	Description
1	PROTECTED POWER
2	J1939 S-CAN (+)
4	J1939 K-CAN (+)
7	IGNITION POWER
8	GROUND
9	J1939 S-CAN (-)
11	J1939 K-CAN (-)

FIGURE 10-5. RP1226 Pinout

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BODY CONNECTION POINTS

Location diagrams for various body connectors on the main chassis harness.

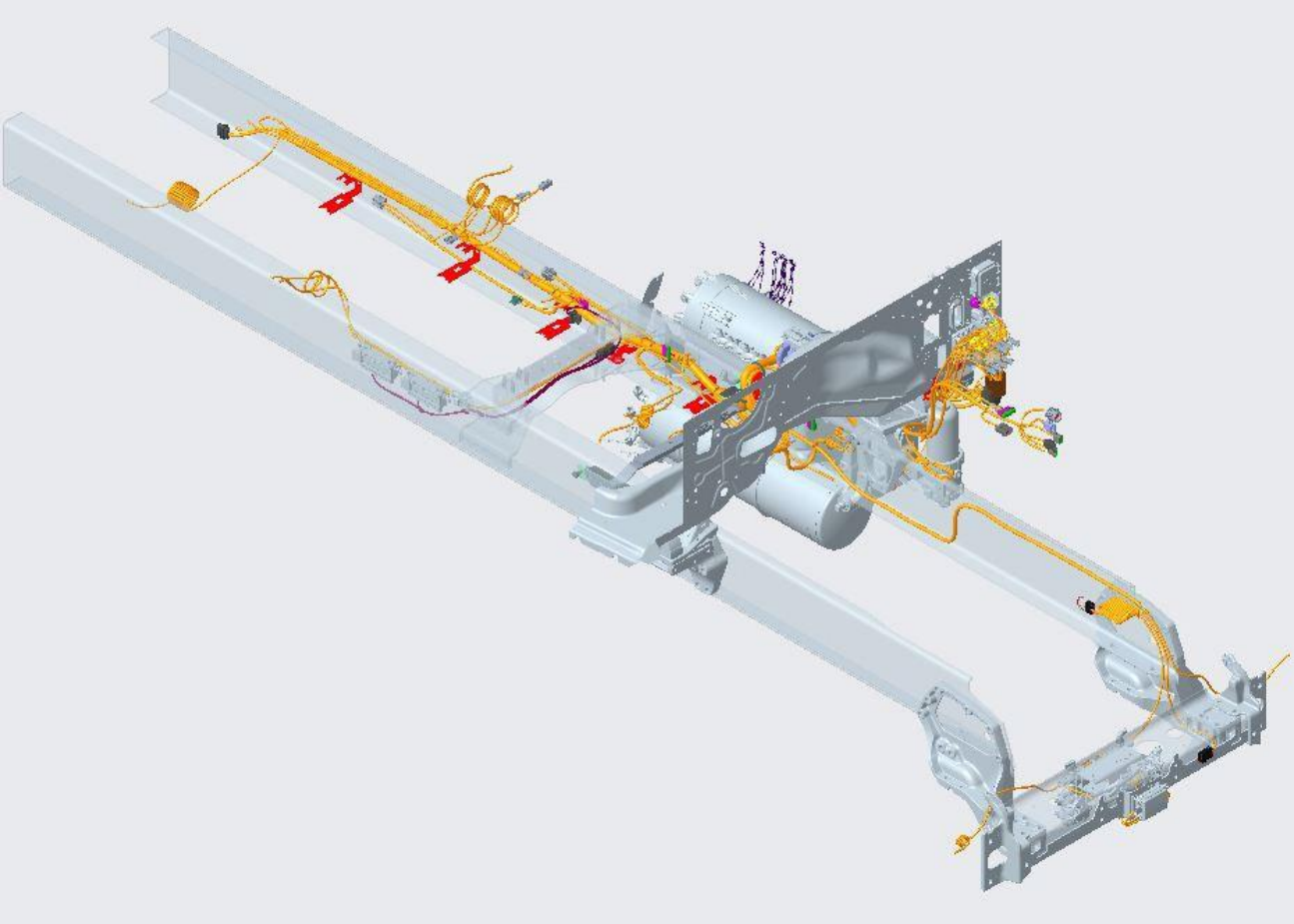


FIGURE 10-6. Isometric View

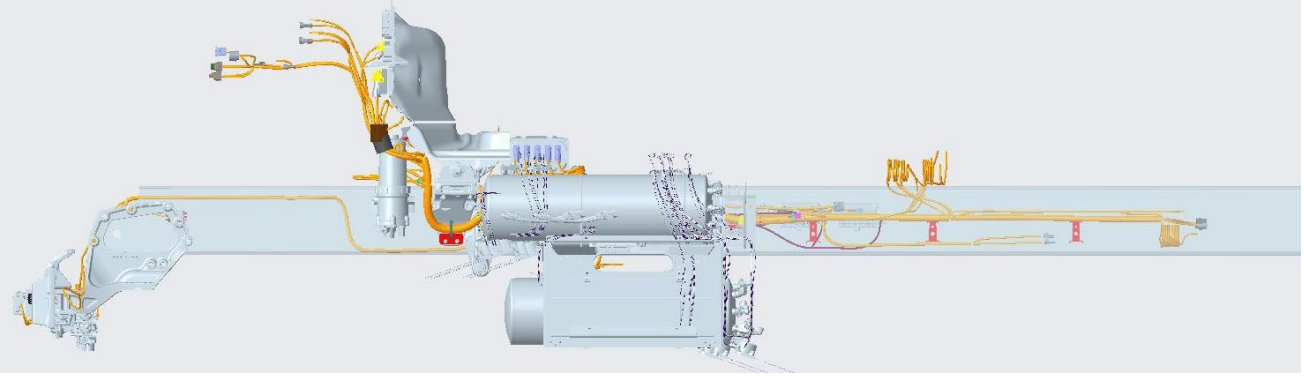


FIGURE 10-7. Side View

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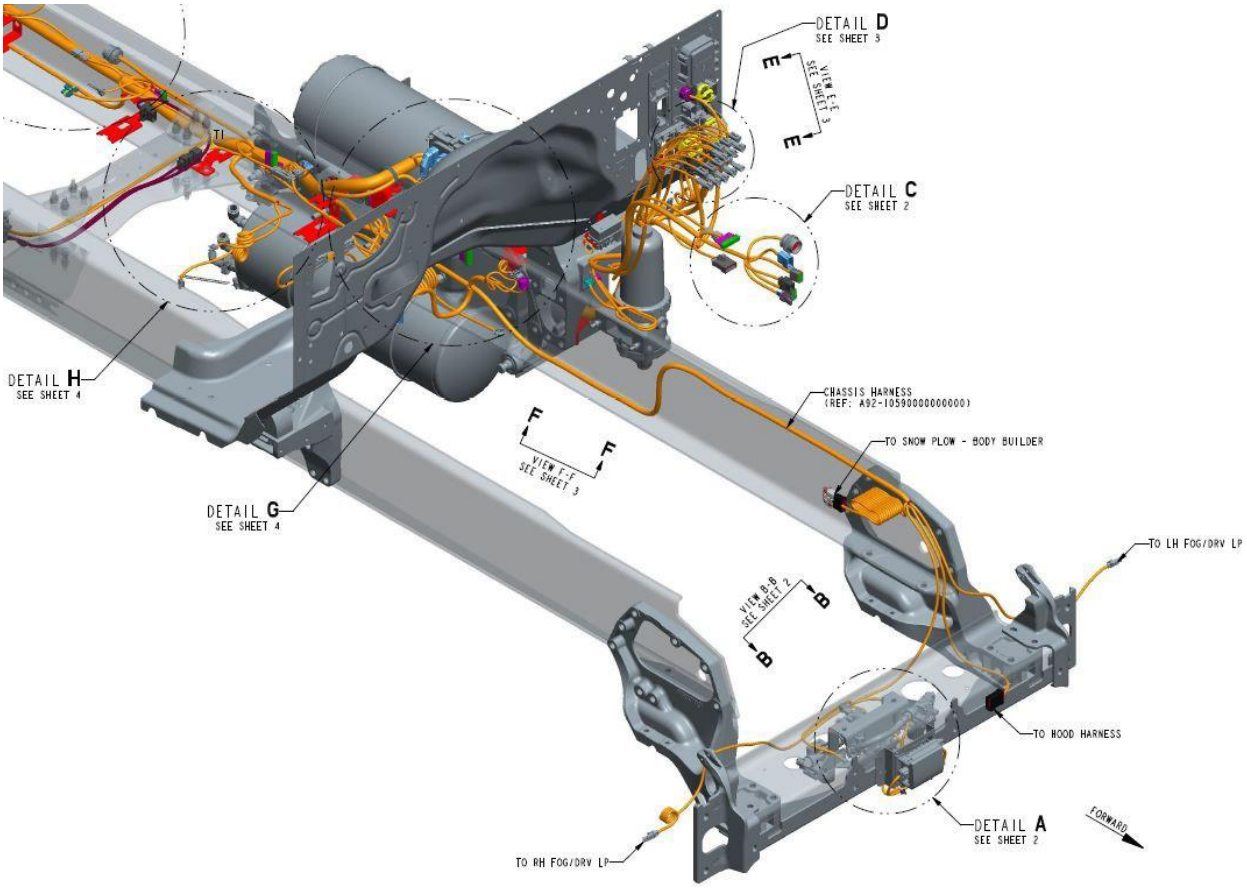


FIGURE 10-8. Front Portion View

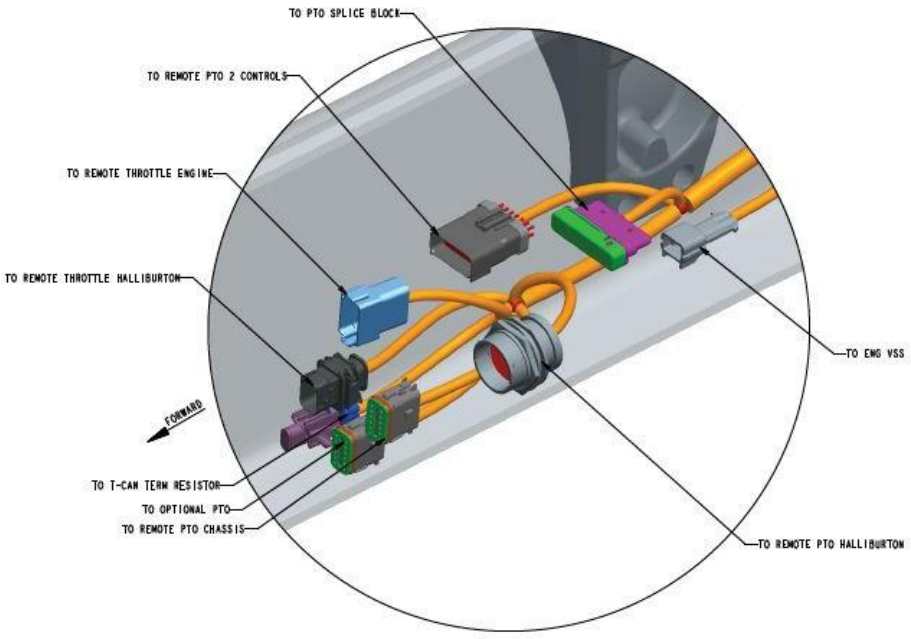


FIGURE 10-9. Detail View of Engine Compartment Body Connectors

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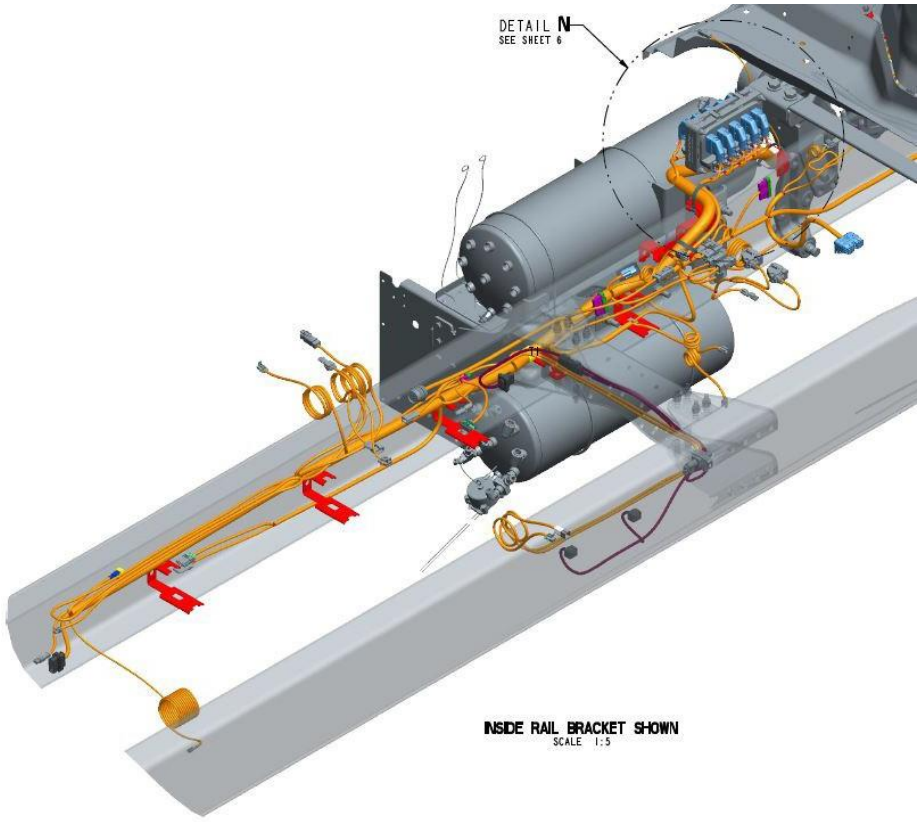


FIGURE 10-10. Rear Portion View

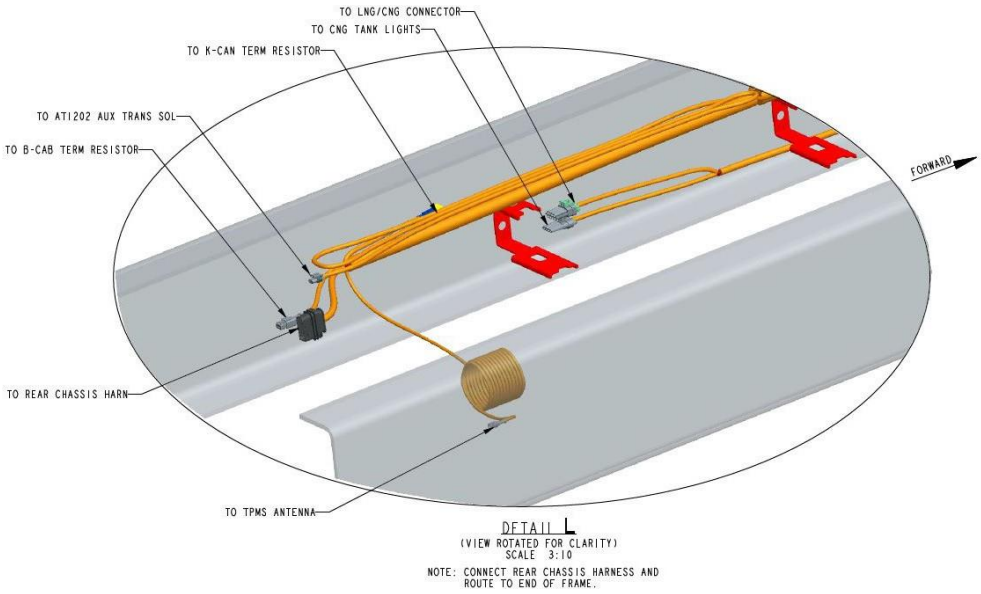


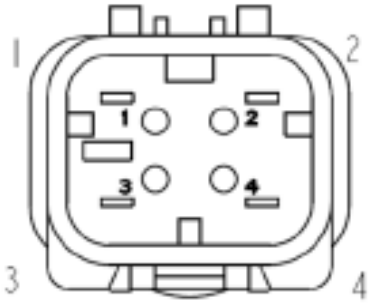
FIGURE 10-11. Detail View of BOC/BOS and EOF Body Connectors

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ELECTRIC ENGAGED EQUIPMENT

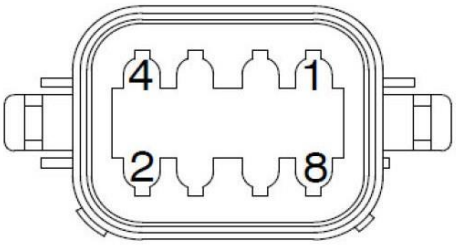
At the left-hand forward cab mount, P198 is available for PTO controls that are electrically engaged via ground.





Pin	Description
1	VEHICLE GROUND
2	#1 PTO ON/OFF
3	PTO PUMP MODE SIGNAL
4	#2 PTO ON/OFF

FIGURE 10-12. P198 (4-Pin) Connector Pinout





Pin	Function
1	12V Ignition Signal / 2nd PTO Engaged
2	PTO Interlock Input
3	Remote PTO Preset 3
4	Remote PTO Preset 2
5	Remote PTO Preset 1
6	Remote PTO Increment +
7	Remote PTO Increment -
8	Vehicle Ground

FIGURE 10-13. P197N (8-Pin) Connector Pinout

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REMOTE THROTTLE AND REMOTE PTO CONTROLS

PACCAR MX ENGINES

Chassis must be ordered with the appropriate option to have a 12-pin connector on the chassis harness. All signals will feed into the Chassis Modules, which will have Active Low inputs.

Wiring Function Description:

Connect pins 5 & 6 to pin 8 to activate PTO Mode Control (PMC) and Enable PTO Speed Control (PSC).

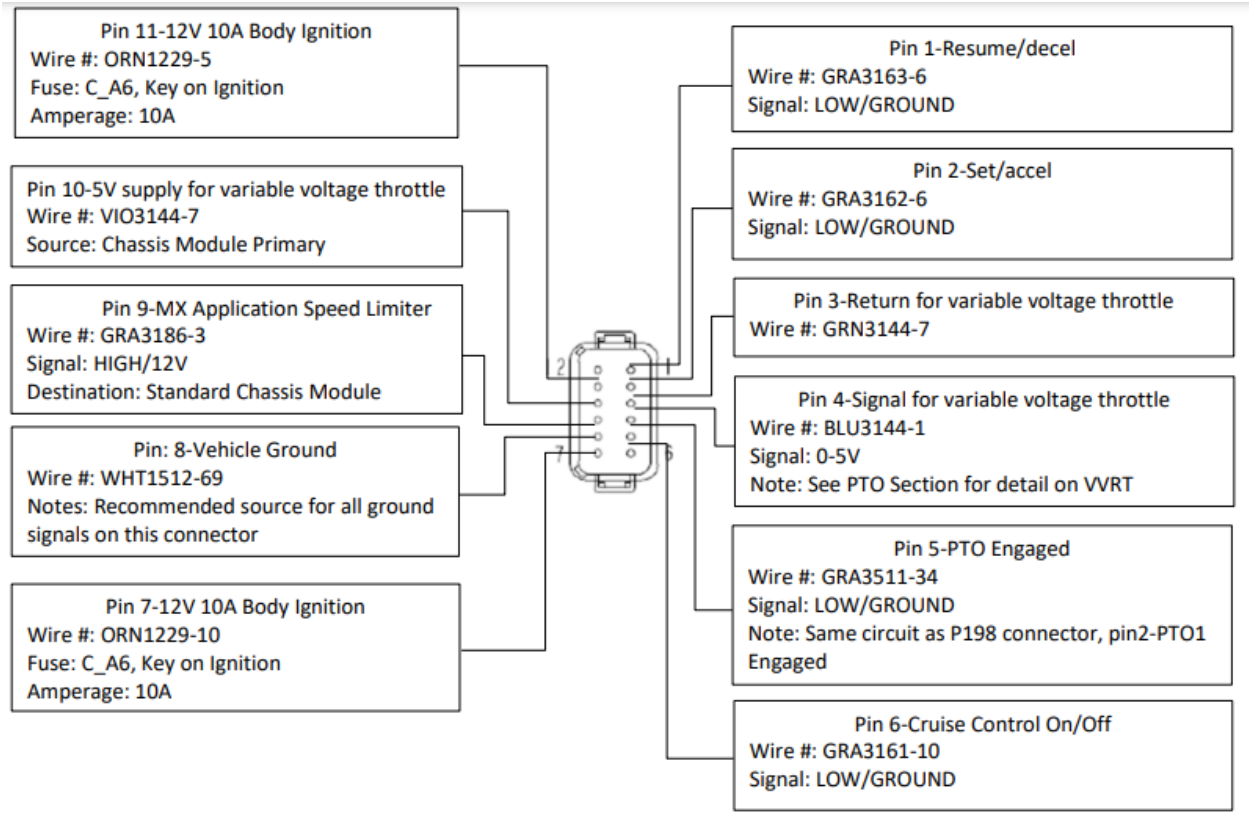
WARNING

DO NOT install a permanent jumper wire between Pins 5 & 6.



FIGURE 10-14. P197C (12-Pin) Connector and Mating Connector Information

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WARNING!
DO NOT install a permanent jumper wire between pins 5 and 6. May cause unexpected vehicle behavior.

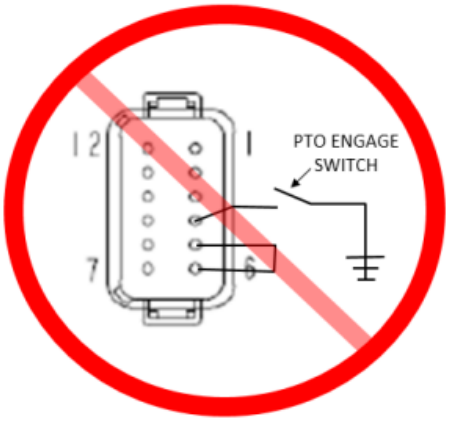


FIGURE 10-15. MX Engine 12-Pin Connector Pinout

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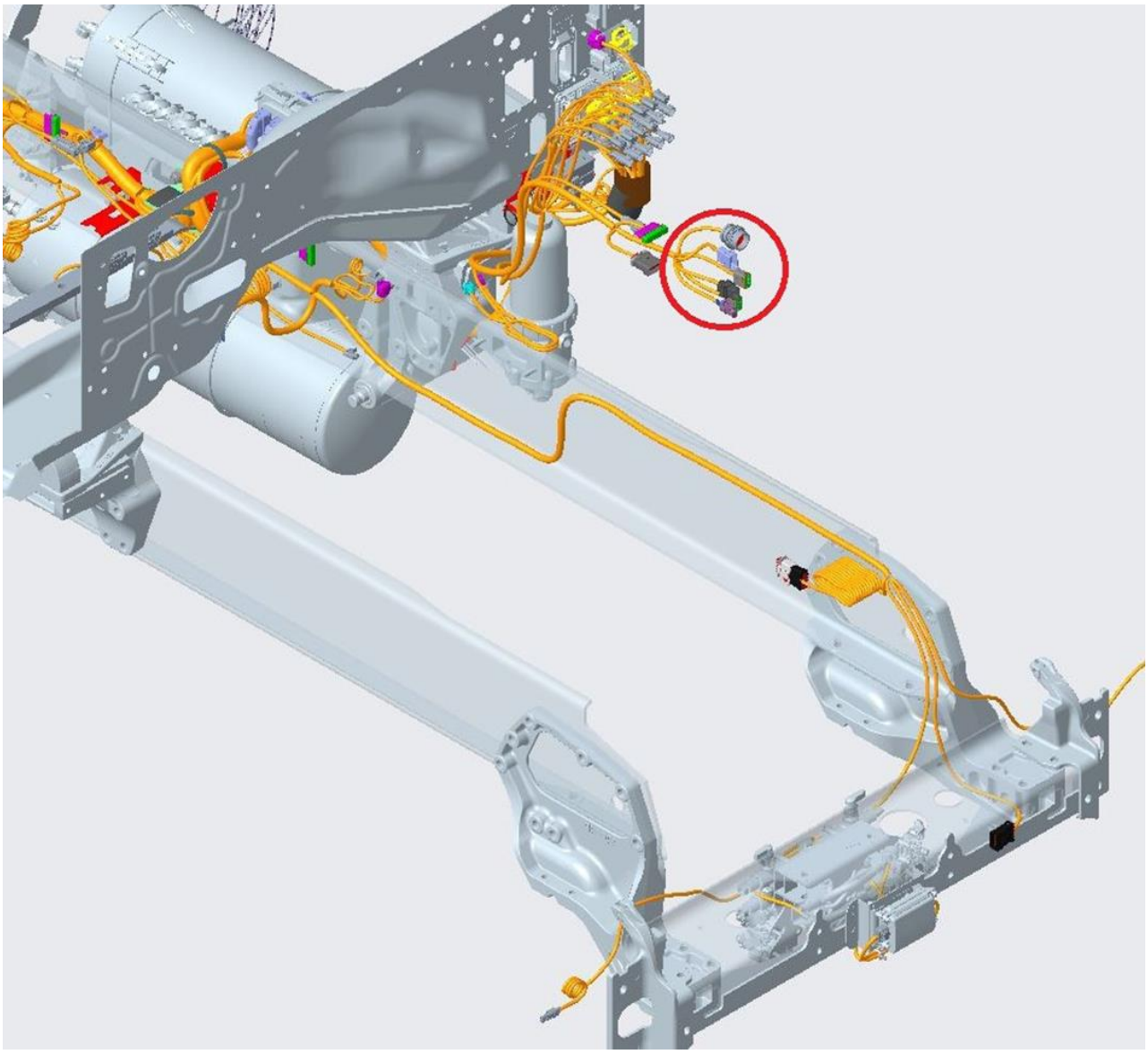


FIGURE 10-16. MX-11 and MX-13 Connector Location

CUMMINS ENGINES

Chassis must be ordered with the appropriate option to have a 12-pin connector on the engine harness. The Body IGN signal was moved off the engine harness connector, so for Cummins, the Chassis Harness will include the PTO layer to insert the Body IGN signal back into the 12-way connector. Signals that feed directly to the engine ECM typically will be active low signals. Connect pins 3 and 5 for simple PTO ON/OFF signal. For Remote throttle bump, you must connect pins 3 & 6. Having a momentary switch to signal ground on pins 2 and 1 will then increase/decrease engine speed. Engine speed will depend on how engine is programmed. Unless otherwise specified, engine is set by default for incremental speed increase. Full remote throttle control can be achieved with a twisted triple to pin 4, 10, and 11.



Pin	Function
1	INPUT FOR REMOTE PTO RESUME (ACTIVE LOW)
2	INPUT FOR REMOTE PTO SET (ACTIVE LOW)
3	SWITCH RETURN
4	INPUT FOR REMOTE THROTTLE SENSOR CIRCUIT (TWISTED TRIPLE)
5	PTO ENGAGED SIGNAL (LOW = ENGAGED)
6	CRUISE ON/OFF (ACTIVE LOW)
7	+12V 10A BODY IGN FUSE C_A6
8	VEHICLE GROUND
9	TORQUE LIMIT INPUT (ACTIVE LOW)
10	PWR SUPPLY +5V (TWISTED TRIPLE)
11	ANALOG RETURN (TWISTED TRIPLE)
12	REMOTE ACCELERATOR ENABLE

FIGURE 10-17. Cummins Engine 12-Pin Connector Pinout

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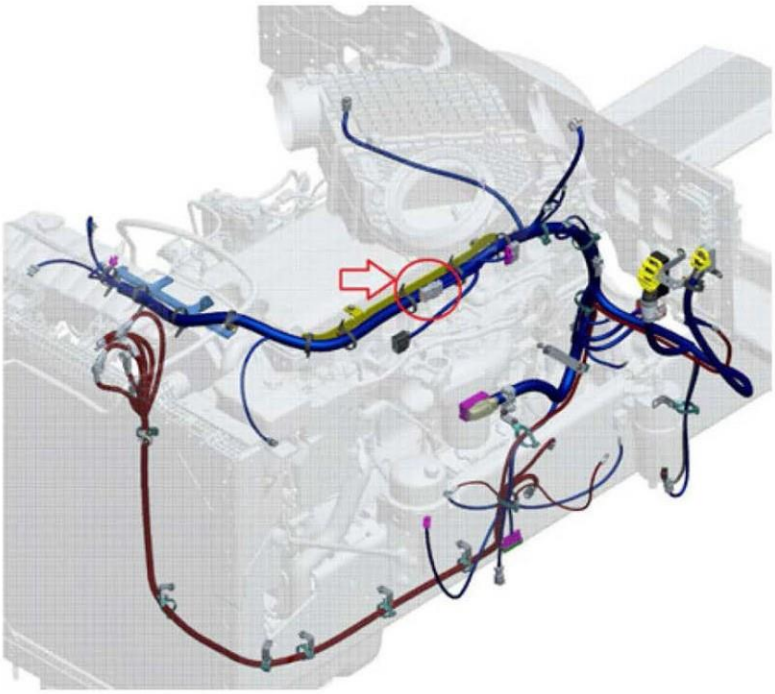


FIGURE 10-18. Cummins X15 Connector Location

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POWER DISTRIBUTION CENTER

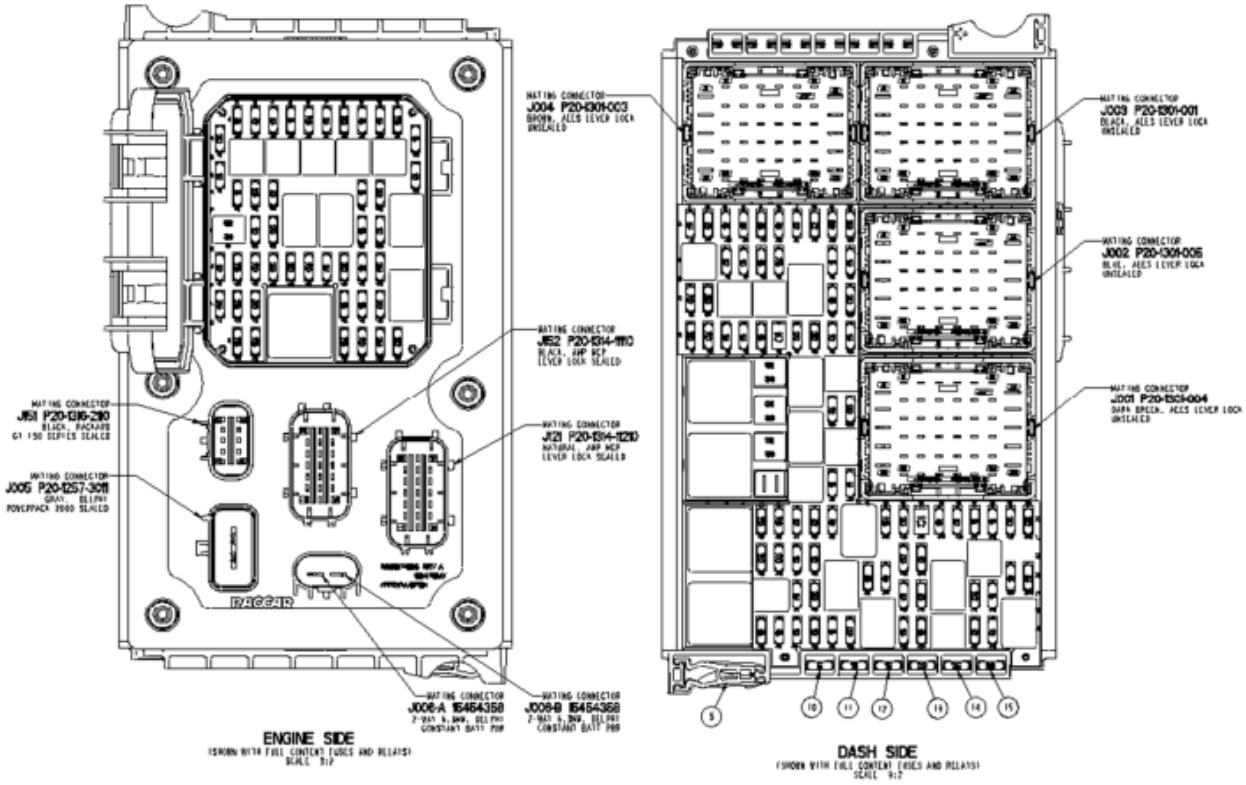
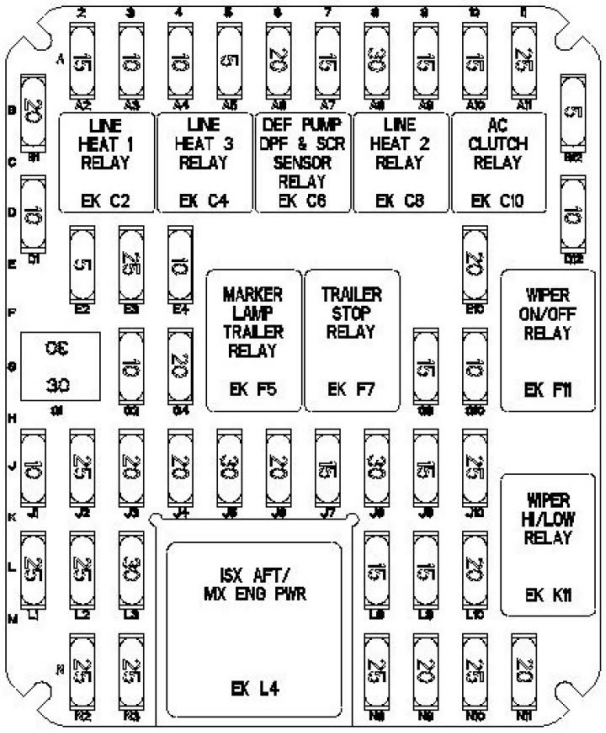


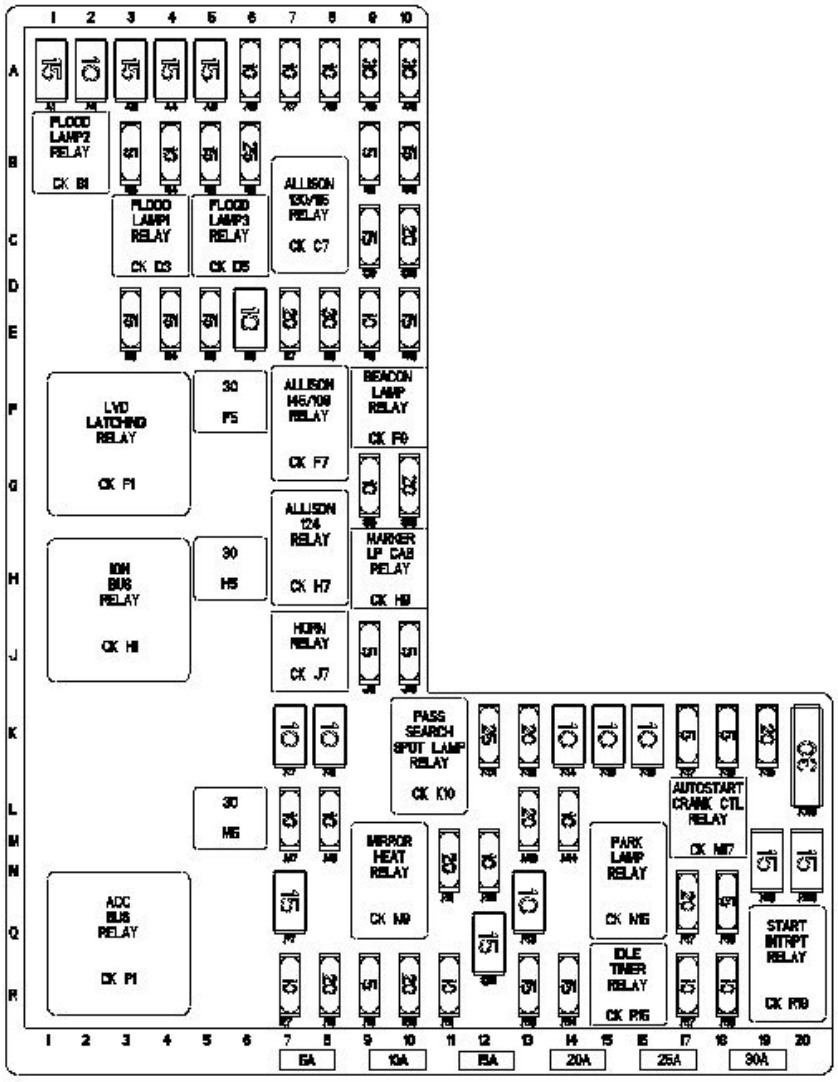
FIGURE 10-19. Power Distribution Center



FUSE ID	AMP	DESCRIPTION
A2	15A	LINE HEAT 1 (PRESSURE) -PWR
A3	10A	ALLISON/AUTO/ULTRASHIFT
A4	10A	CHASSIS MODULE
A5	5A	LINE HEAT 3
A6	20A	SCM F1-HDLP LH HI/RH RR TURN/BRK
A7	15A	DEF PUMP / DPF### SENSORS PWR
A8	30A	CAB ABS
A9	15A	LINE HEAT 2 (BACKFLOW) -PWR
A10	15A	AUX TRANS AIR TO OIL COOLER
A11	25A	WIPER MOTOR
B1	20A	EXT REGEN / SPARE IGN
B12	5A	HVAC HEAD PWR
D1	10A	ACC RADAR/TPMS
D12	10A	AC CLUTCH RELAY - PWR
E2	5A	ECU WAKEUP (ENG SIDE)
E3	25A	OCM F6
E4	10A	MUX SOL BANK 2
E10	20A	SPARE BATT 2
G1	30A JCASE	HVAC BLDC MOTOR
G3	10A	MUX SOL BNK 1
G4	20A	OCM F4
G9	15A	ISX AFT / MX ENGINE PWR
G10	10A	VECU BATT PWR 1
J1	10A	CAB ABS PWR -10A IGN
J2	25A	SCM F3-HDLP RH LO/FRNT PARK/RH DRL/TURN
J3	20A	SCM F2-HDLP LH LO/FRNT PARK/LH DRL/TURN
J4	20A	SCM F7
J5	30A	TRLR MARKER RELAY-PWR
J6	20A	OCM F5
J7	15A	BACKUP LAMP
J8	30A	TRAILER STOP RELAY-PWR
J9	15A	VTG
J10	25A	WIPER ON CTL
L1	25A	QUALCOMM TRLR TRACKS
L2	25A	SCM F4-HDLP RH HI/FRNT FOG/PB DRL
L3	30A	AUTO TRANS
L8	15A	MX AFT/ CUM AFT PWR (CNG/LNG)
L9	15A	MX ENG ACC PWR
L10	20A	DCU PWR/LPC(MX)/ISX SM/DEF HT CTL
N2	25A	SCM F5
N3	25A	SCM F6
N8	25A	FRAME FUEL HEATER
N9	20A	MX ENGINE PWR 1
N10	25A	MX ECM
N11	20A	CUM ECM/ MX ACM PWR 1&2

FIGURE 10-20. Engine Side Fuse Box Full Content Population

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FUSE ID	AMP	DESCRIPTION
A1	15A	FLOOD LAMP 2 *
A2	10A	SPOT LAMP *
A3	15A	FLOOD LAMP 1 *
A4	15A	FLOOD LAMP 3 *
A5	15A	FLOOD BEACON PWR *
A6	10A	BODY IGN
A7	10A	RP1226 IGN
A8	10A	RP1226 BATT
A9	30A	SLEEPER PDC 1
A10	30A	SLEEPER PDC 2
B9	5A	DOOR AJAR SENSOR
B4	10A	VECU BATT PWR 2
B5	15A	CECU BATT PWR 2
B6	25A	PACCAR AWT/SPARE BATT
B9	5A	MASTER SWITCH MODULE
B10	15A	CECU BATT PWR 1
C9	15A	CB/RADIO POWER
C10	20A	OCN F1
E9	15A	SPARE LVD 2
E4	15A	POWER PORT 1
E5	15A	POWER PORT 2
E6	10A	CAB DOME LP *
E7	20A	SPARE LVD 1
E8	30A	RADIO AMPLIFIER
E9	10A	QUALCOMM-BATT
E10	15A	OCN F2
F5	30A JCASE	RH DOOR MOD
G9	10A	EOAS
G10	20A	TELEMATICS
H5	30A JCASE	LH DOOR MOD
J9	5A	DIAGNOSTIC POWER
J10	5A	CECU LVD V SENSE
K7	10A	HORN RELAY - PWR *
K8	10A	CAB MARKER PWR 1 *
K12	25A	MX ON ENG FULL HT
K13	20A	SPARE IGN 1
K14	10A	ETRAC VALVE *
K15	10A	VECU STOP LAMP SW *
K16	10A	PARK LAMP CAB PWR 1*
K17	5A	CECU/VECU IGN PWR
K18	5A	RH STALK SHIFTER
K19	20A	OCN F3
K20	30A	TRAILER HOT LINE *
M5	30A JCASE	SLEEPER PDC 3
M7	10A	SPLICE FEED IGN
M8	10A	RH HEATED SEAT
N13	20A	SPARE IGN 2
N14	10A	SIGN LAMP SW
N11	20A	SPARE ACC 2
N12	10A	LH HEATED SEAT
N19	15A	LH MIRROR HEAT *
N20	15A	PARK LAMP TRLR PWR*
P7	15A	AIR DRYER *
P13	10A	GAUGE CLUSTER *
P17	20A	SPARE ACC 3
P18	5A	HVAC HEAD ACC
Q12	15A	RH MIRROR HEAT *
R7	10A	SPARE ACC 6
R8	20A	SPARE ACC 1
R9	5A	VECU/CECU ACC PWR
R10	20A	SPARE ACC 1
R11	10A	REMOTE DIAG
R13	15A	SPARE ACC SW 3,485
R14	15A	SPARE ACC SW 1&2
R17	10A	SPARE ACC 4
R18	10A	RADIO WAKE UP

FIGURE 10-21. Dash Side Fuse Box Full Content Population

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CHASSIS MODULE

There will be two standard chassis modules with one a primary chassis module on all trucks and a secondary for optional content. The primary chassis module will be mounted as a primary chassis module under the cab on the left-hand side of the over-bell mounting bracket. The secondary optional chassis module will be located above the rail on the left-hand side on the back of cab cross-member. There are hardware and software-based protections to prevent damage. The standard chassis modules will generate and store faults to free up space for the VECU. The standard chassis module can be diagnosed through the DAVIE Service Tool.

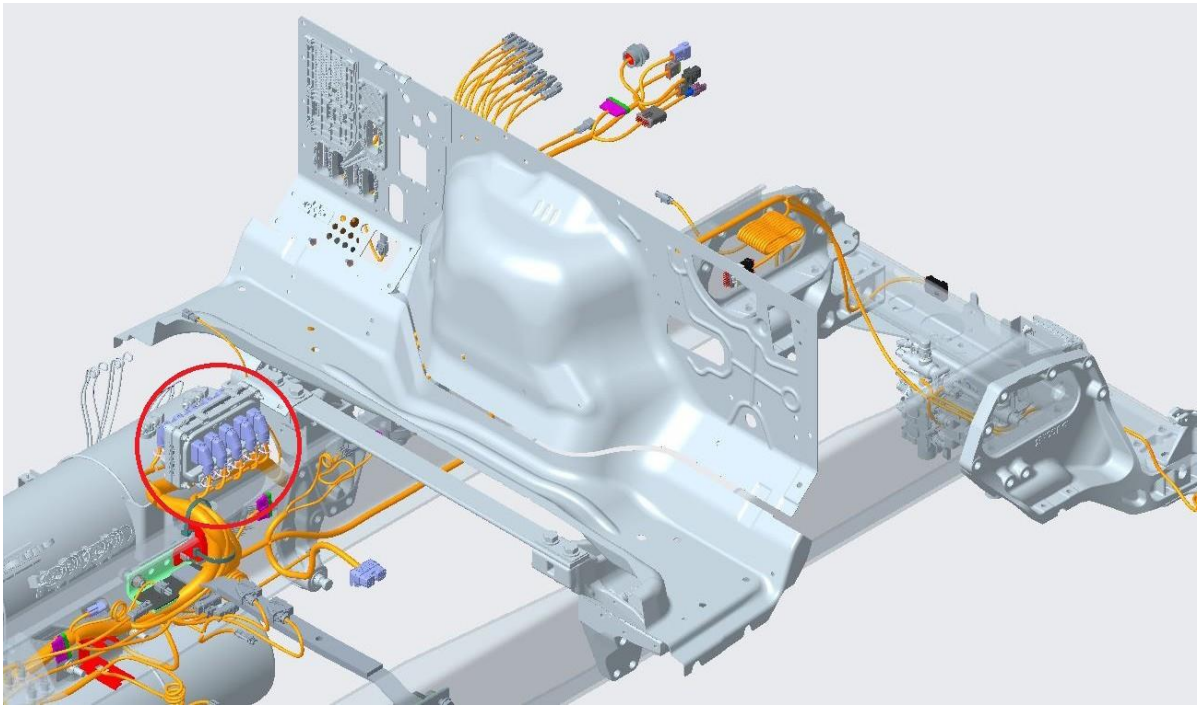


FIGURE 10-22. Chassis Module Locations

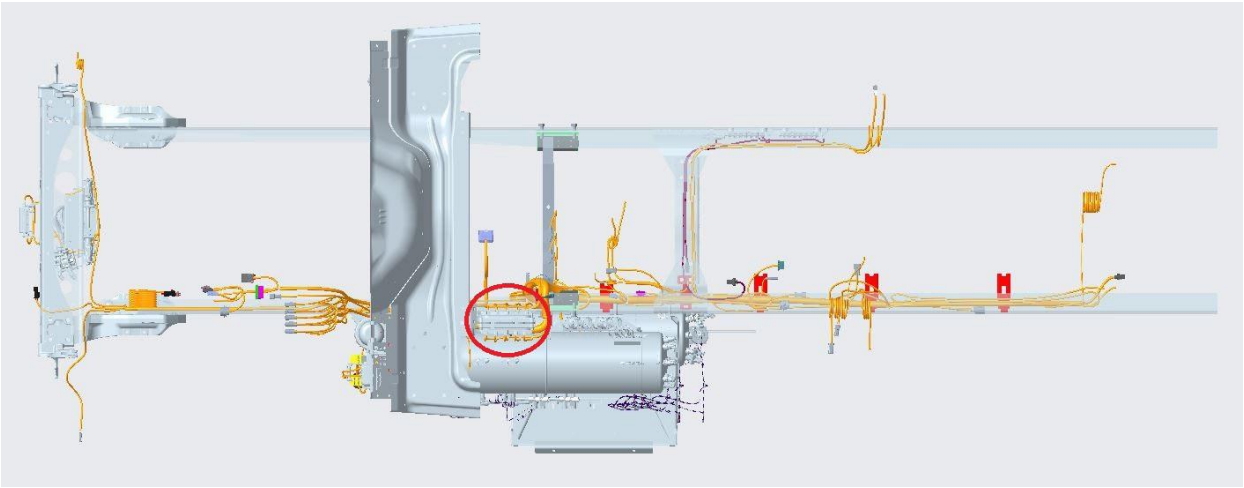


FIGURE 10-23. Chassis Module Locations (Plan View)

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PRIMARY CHASSIS MODULE

- Exterior Lighting: Headlamps, Park/Tail, Turn, Brake, DRL, Reverse etc.
- Axle Temperature Sensor Inputs Front Rear and Rear
- Ammeter Sensor Input
- Secondary Kingpin Release Solenoid Control
- Primary/Secondary Fuel Level Sensors
- Lift Axle Air Solenoid Controls 1st, 2nd
- Primary Transmission Neutral Position Switch
- Remote PTO/Throttle Control Inputs
- J-CAN Multiplexed EOA Solenoid Bank Control
- Fuel Filter Gauges
- Main Transmission Oil Temp
- PTO 1 Activation

SECONDARY CHASSIS MODULE

- External Notification of DPF Regeneration
- AT1202 Aux Trans Neutral Switch
- Axle Temperature Gauges Center Rear
- Lift Axle Air Solenoid Controls 3rd , Tag (Rocker Panel Controls)
- NAMCO/FABCO Split Shaft PTO/Transfer Case Sensors
- Aux Transmission Temperature Sensor
- Split Shaft PTO Temperature Sensor
- Fuel Temp Sensor (Auto Start)
- Chicken/Panel Lamps, Snow Plow Lamp
- ISO 3731 Spare Outputs
- B-CAN
- Auto Start/Stop Hood Tilt Switch
- City Horn
- PTO 2, 3, & 4 Activation

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ELECTRIC OVER AIR SOLENOIDS

Air solenoids are the devices that translate the electrical signal into physical change that controls the air pressure in various circuits. The air solenoids are mounted to a bracket outside the cab. The solenoids are designed to stack on each other so that they share a common air supply which reduces the amount of air lines on the vehicle.

The aftermarket installer/final vehicle manufacturer needs to decide what type of valve to install and ensure that the documentation to the operator provides them with enough understanding of how the customized switches work.

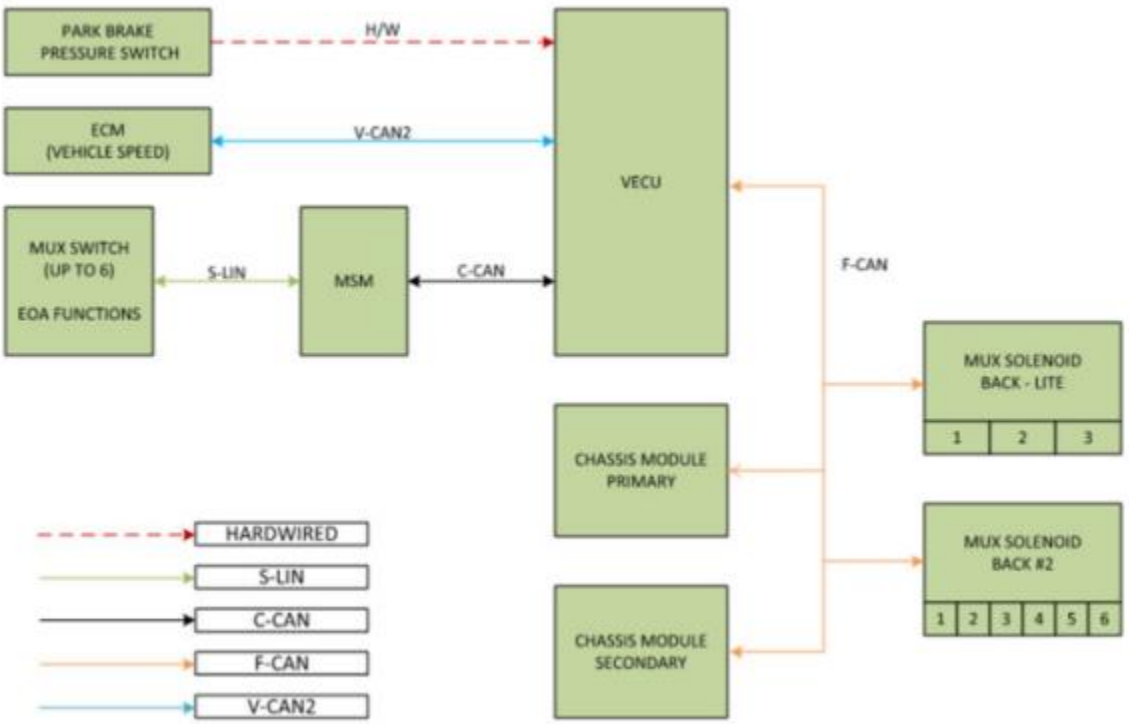


FIGURE 10-24. Solenoid Bank Diagram

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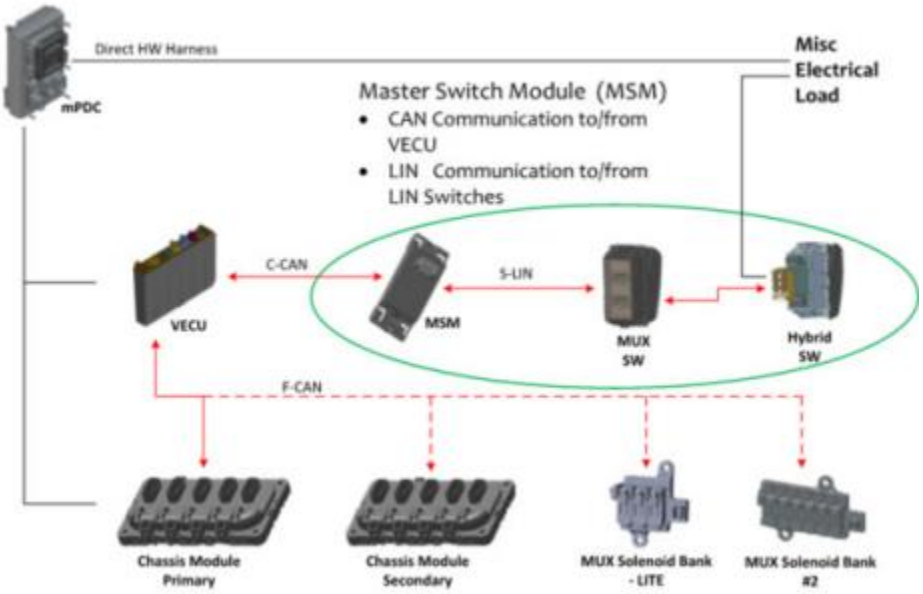


FIGURE 10-25. Module & Solenoid Bank Overview Layout

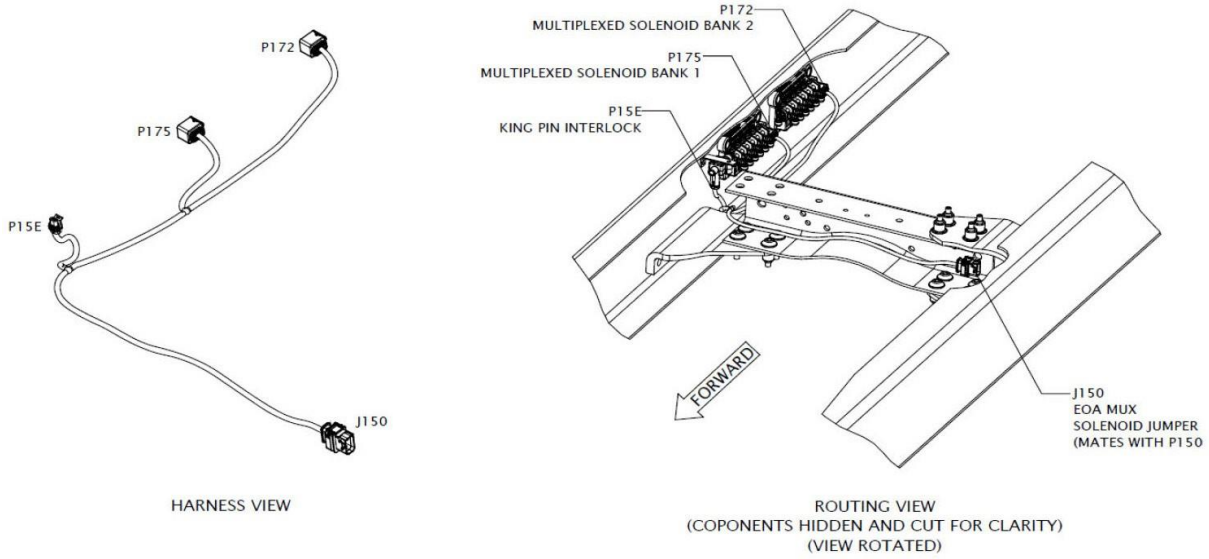


FIGURE 10-26. Solenoid Bank Location & Routing

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SWITCHES

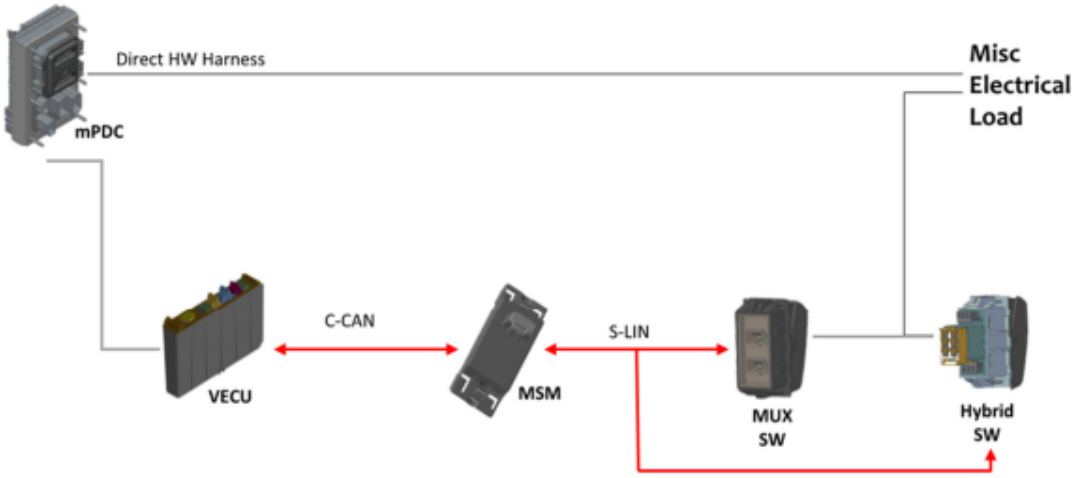


FIGURE 10-27. Switch Overview Layout

Benefits of Multiplexing are:

- Shorter wire bundles.
- Improved diagnostics.
- Greater driver feedback.
- Safety critical switches use hybrid switches with hardwire for redundancy.
- Less expensive switches with fewer wires behind dash and on chassis.
- Self-diagnosable to improve troubleshooting with DAVIE.

Master Switch Module (MSM)
CAN Communication to/from VECU
LIN Communication to/from Switches

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SPARE SWITCHES

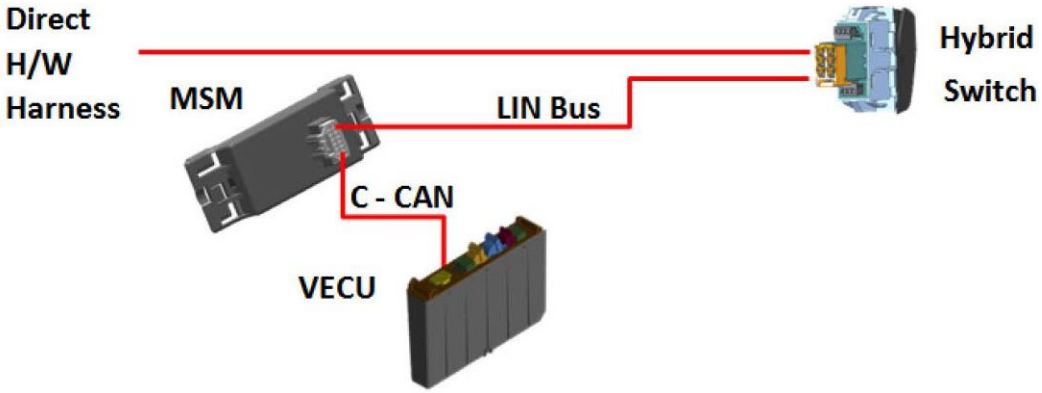


FIGURE 10-28. Spare Switch Overview Layout

Spare switches offer customers and body builders a convenient way to control power and air to various sources, like a body or trailer. They should be flexible and easily configurable to meet the vast and unique needs of body builders. Kenworth shall offer up to five (5) spare dash switches to control spare electrical outputs within the cabin.

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SWTICH RELEARN PROCESS

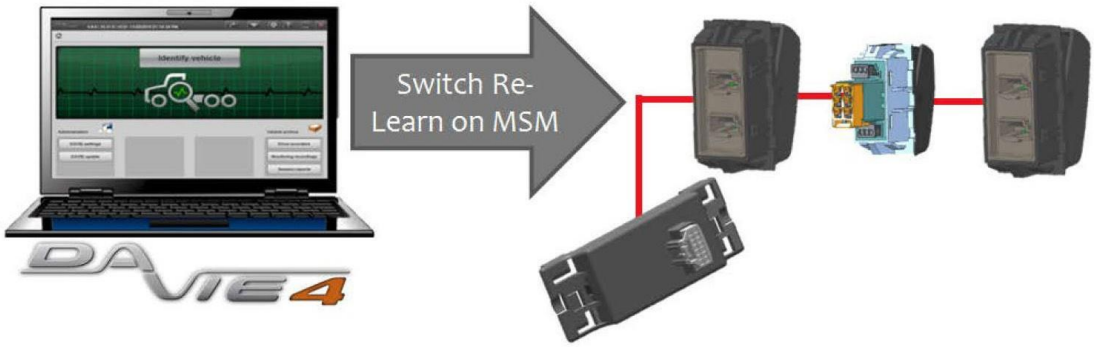


FIGURE 10-29. DAVIE Switch Relearn Process

Switch replacement installation instructions:

1. Turn off the engine and all switches
2. Remove dash panel
3. Unplug LIN jumpers from the original existing switch
4. Remove original switch
5. Replace the old switch with the new switch
6. Reconnect LIN jumpers into the replacement switch
7. Reinstall the dash panel
8. Open DAVIE application
9. Select the “Repair Support” tab.
10. Select the “Learn Dash Switches”
11. When prompted by DAVIE Cycle the key on and then off
12. Run “Quick Check”
13. Clear Inactive DTCs (Diagnostics trouble code) from MSM
14. Finished

New switch installation instructions:

1. Turn off the engine and put all switches into the off position
2. Remove the dash panels
3. Remove the switch blank
4. Add the new switch into the dash panel
5. Connect the LIN jumper between the last open switch to the newly installed switch
6. Part Number S92-1127-0125
7. Reinstall the dash panel
8. Open DAVIE application
9. Select the “Repair Support” tab.
10. Select the “Learn Dash Switches”
11. Cycle the key on and then off
12. Run “Quick Check”
13. Clear Inactive DTCs (Diagnostics trouble code) on the MSM
14. Finished

SWITCH LOCATION

Switch on the same LIN bus can be reordered in any configuration without needing a relearn with DAVIE tool. Switches that are swapped across LIN buses will need to be relearned with DAVIE. LIN bus 1 consisted of all the switches on the A panel. LIN bus 2 consist of all the switches on B and C panels

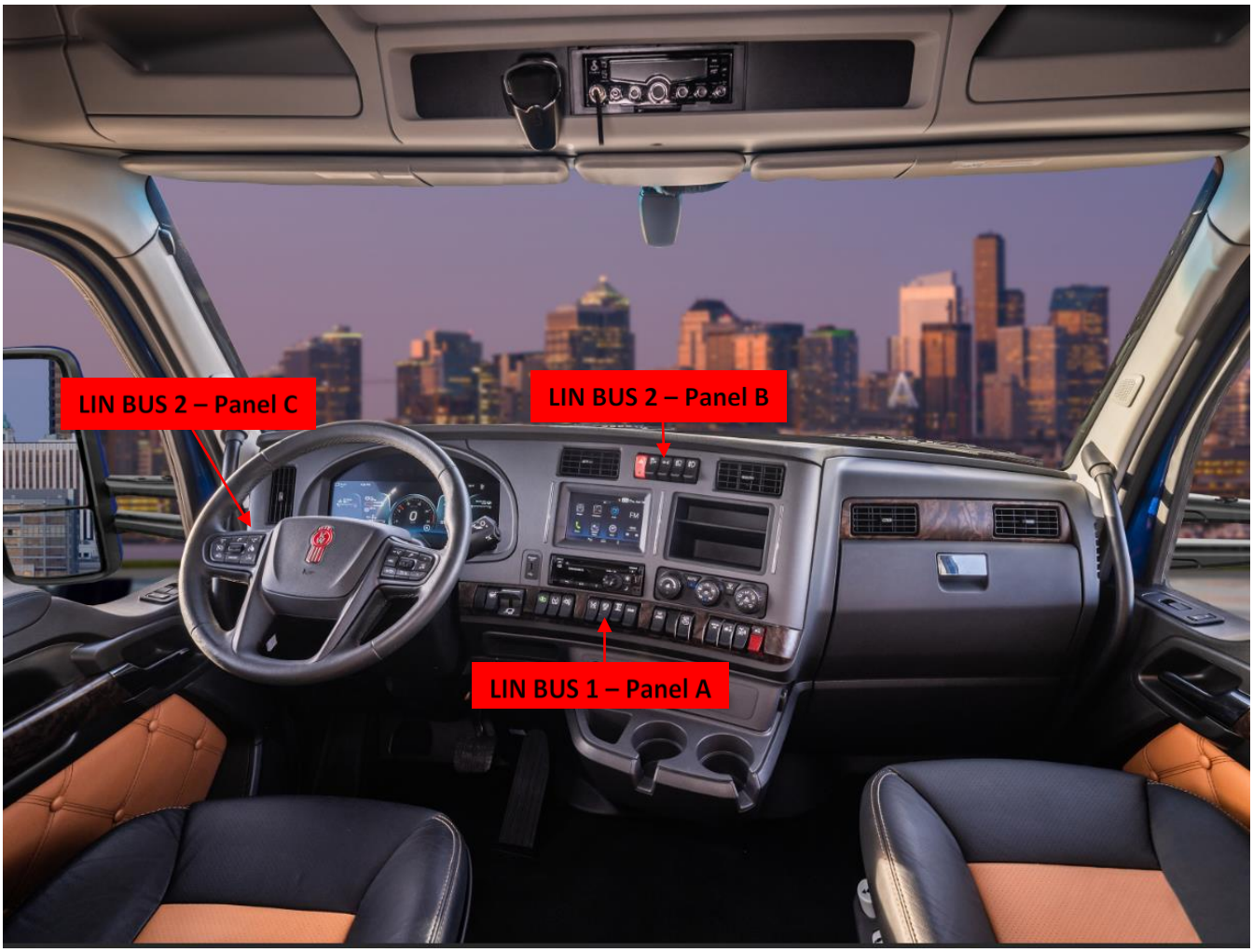


FIGURE 10-30. Dash & Switch Layout

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GROUNDING

Grounding any post-OEM component/device/apparatus/etc. to the metal cab structure or frame is not acceptable. Failure to properly ground add-on components can result in vehicle damage and possibly bodily injury.

Ground all post-OEM component/device/apparatus/etc. with combined current draw of less than 30A to the firewall ground buss bar with appropriately sized wire/cable for the load required.

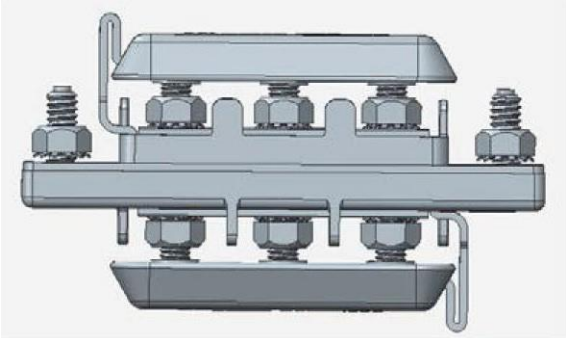


FIGURE 10-31. Grounding Buss Bar Design

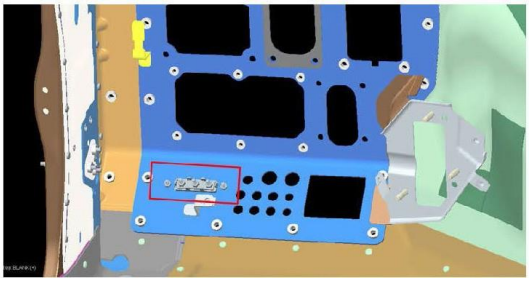


FIGURE 10-32. Grounding Point – Cab Interior Behind Driver's Side Kick Panel

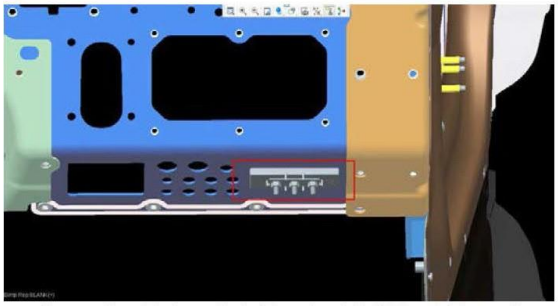
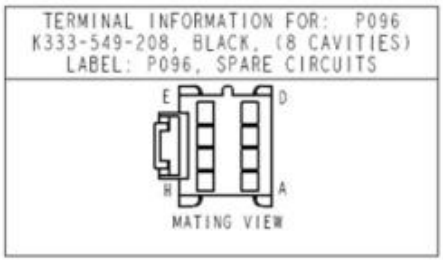


FIGURE 10-33. Grounding Point – Cab Exterior LH Side of Firewall

Post OEM components/devices/apparatus/etc. with combined current draw more than 30A, ground must be attained from vehicle batteries directly with appropriately sized wire/cable for the load required.

SPARE POWER

Spare power connector P096 is located on lower left side of dash behind key switch or kick panel. The mating harness is available from PACCAR parts with pre-labeled pigtails, P92-8916-000000001. Any spare power requiring more than 20 amps must go directly to the battery box, not this spare circuit.



Pin	Spare Circuit No.	Designation	Fuse Location and Max Rating
F	ORN0731-001	Spare Ignition #2	Cab Side M13 - 20A
C	ORN0752-001	Spare Accessory #1	Cab Side R10 - 20A
E	ORN0731-002	Spare Ignition #1	Cab Side K13 - 20A
B	RED0712-002	Spare Battery #1	Cab Side G10 - 20A
G	ORN0791-001	Spare LVD #1	Cab Side E7 - 20A
A	RED0711-001	Spare Battery #2	Engine Side E10 - 20A (Not available with Chassis built after 12/1/14)
H	BRN2620-001	Spare Backlight	Not Applicable
D	WHT1515-001	Spare Ground	Not Applicable

FIGURE 10-34. Spare Circuit Connector and Pinout

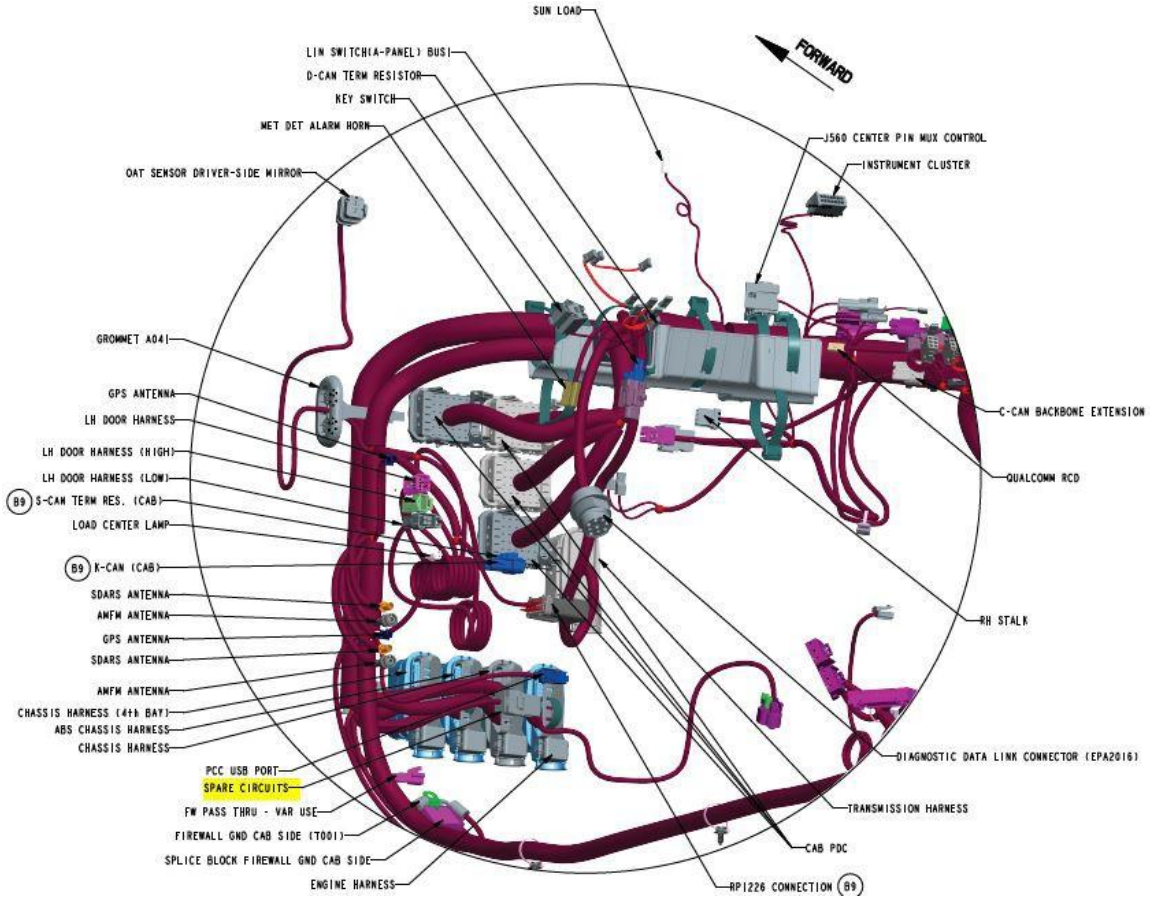


FIGURE 10-35. Spare Circuit Location Under-Dash

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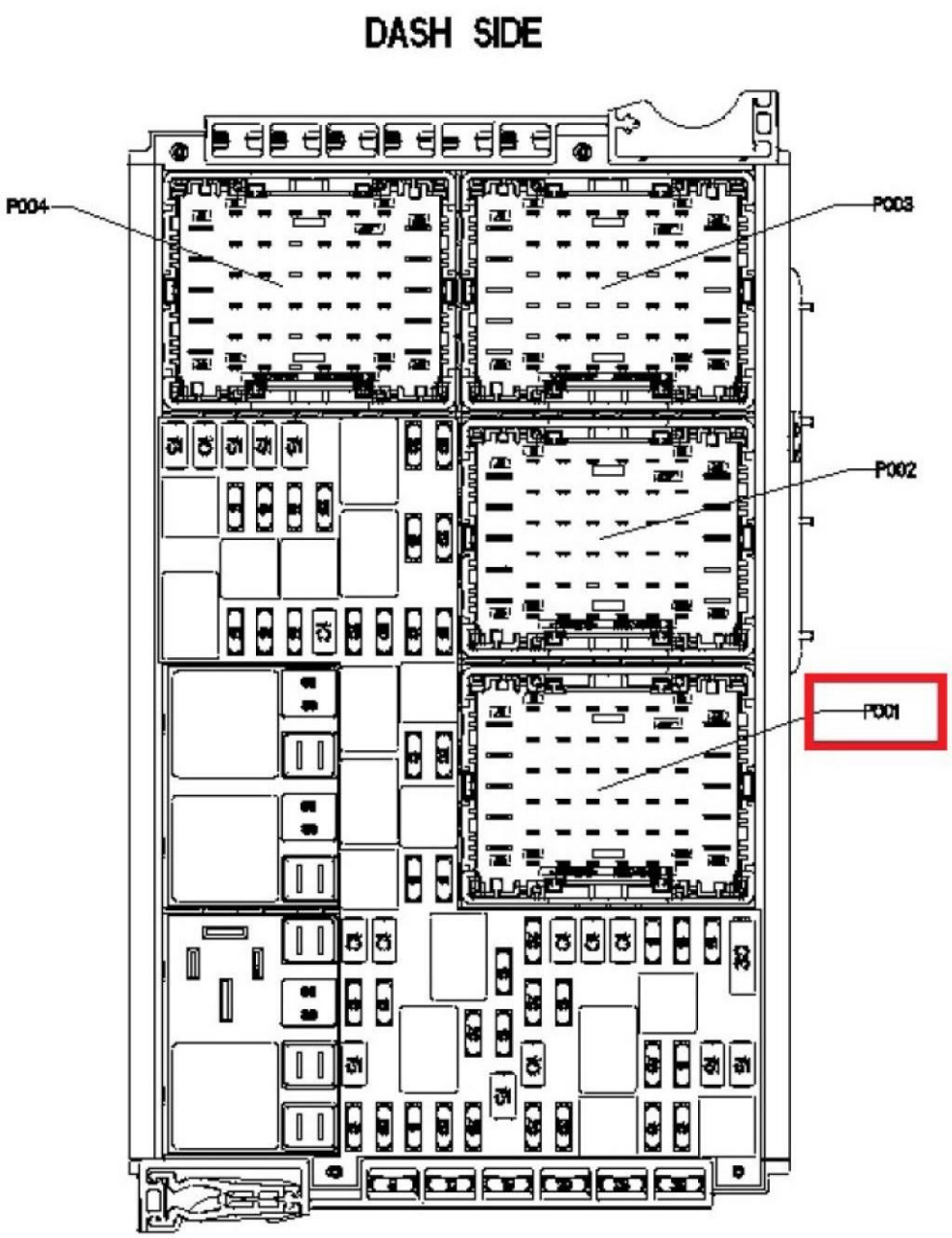


FIGURE 10-36. Spare Circuit Location on PDC (Dash-Side)

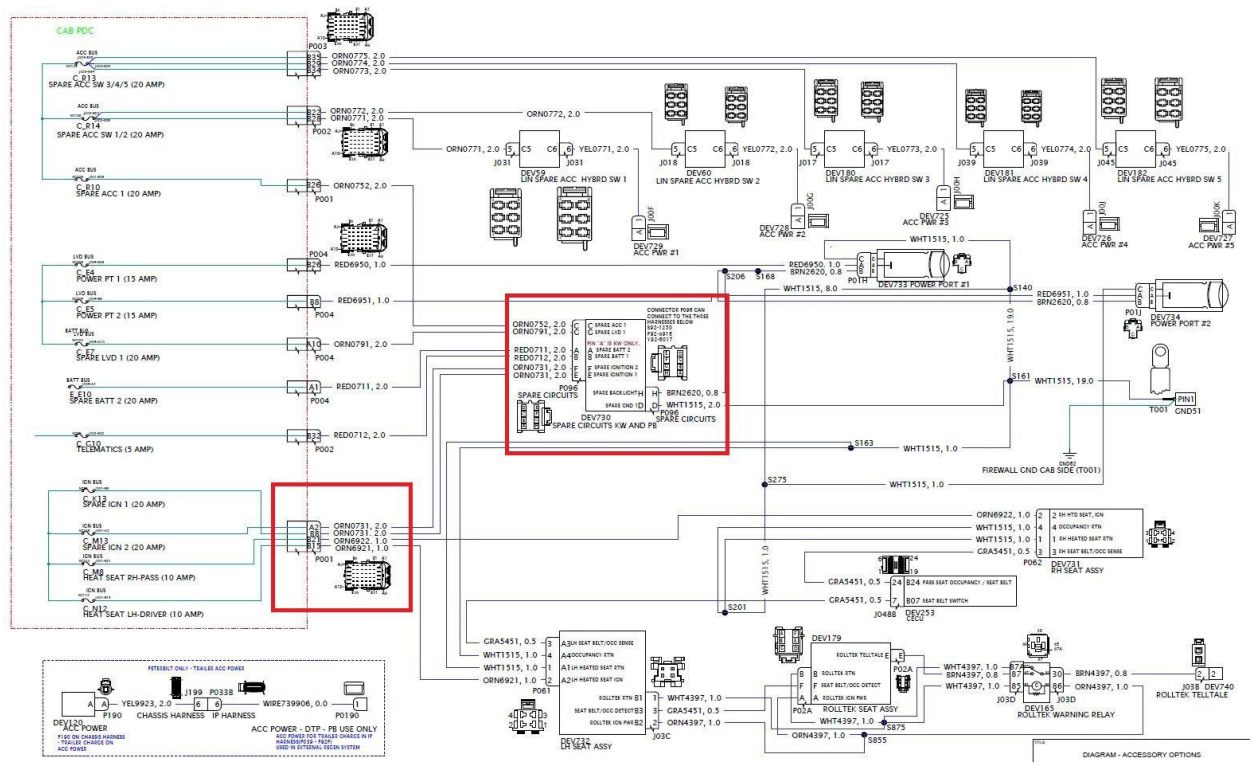


FIGURE 10-37. Spare Circuit Diagram (P001 & P096)

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JUNCTION BOX

The junction box provides access to lighting signals. Located Back of Cab or End of Frame (depending on specified sales order).

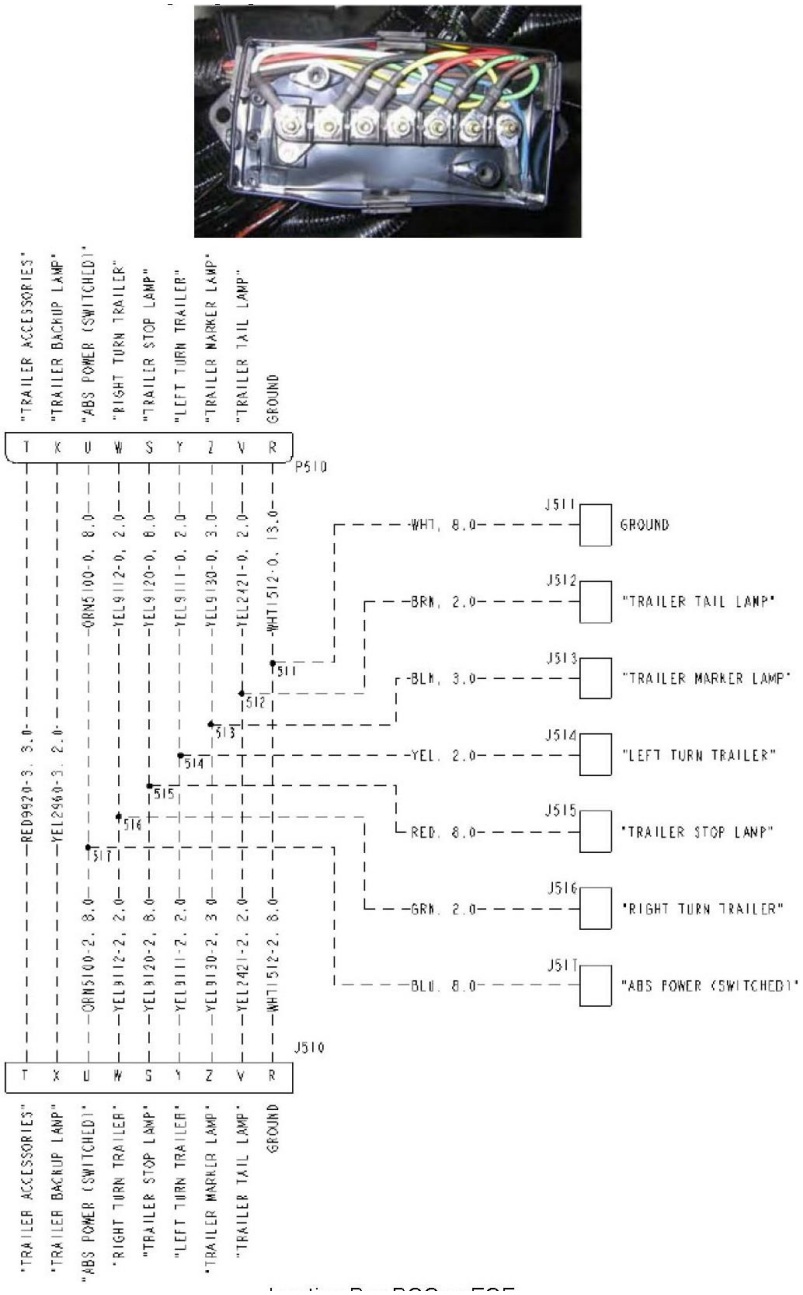
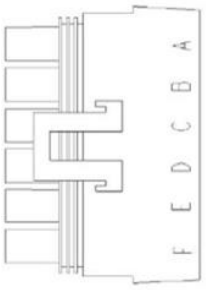


FIGURE 10-38. Junction Box Diagram

TRANSMISSION BACK UP SIGNALS

The back-up signal can be accessed from pin D of the 6-way taillight connector located at the end of frame. The taillight connector is a 6-way connector located in the chassis harness at the end of frame. It will either be connected to a taillight, a jumper harness, or tied up in the rail if no taillights are provided.



PIN	CIRCUIT DESCRIPTION
A	Park Lamp
B	Left Turn/Stop Lamp
C	Right Turn/Stop Lamp
D	Backup Lamp
E	Aux Chassis
F	Ground

FIGURE 10-39. Mating Connector: Packard PN 12020789

SNOWPLOW LIGHTING

When the optional switch and wiring for snowplow lights are ordered, the truck will include a switch on the dash to control the snowplow lights and a body builder connection at the front of the chassis.



Pin	Description
1	LOW BEAM LH
2	LOW BEAM RH
3	HIGH BEAM LH
4	HIGH BEAM LH
5	TURN INDICATOR LH
6	TURN INDICATOR RH
7	MARKER LAMPS
8	NOT USED
9	SNOWPLOW GROUND
10	SNOWPLOW GROUND
11	TURN INDICATOR, LH DRL
12	TURN INDICATOR, RH DRL

FIGURE 10-40. Snowplow Connector Pinout

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LIFT AXLES

All truck lift axles (pushers and tag) are direct wire Electric-Only from the switch to the axle mounted solenoid. The wiring comes from the Primary Chassis Module or Secondary Chassis Module. This is not from the EoA Solenoid Bank. There are a total of four lift axle controls available: 3 pushers and 1 tag axle. These are controlled with separate switches by default. The customer can order the following configurations: steerable, non-steerable, with auto-reverse, and with park brake interlock. A lift axle comes with a control switch (single or separate), a gauge, and a regulator valve.

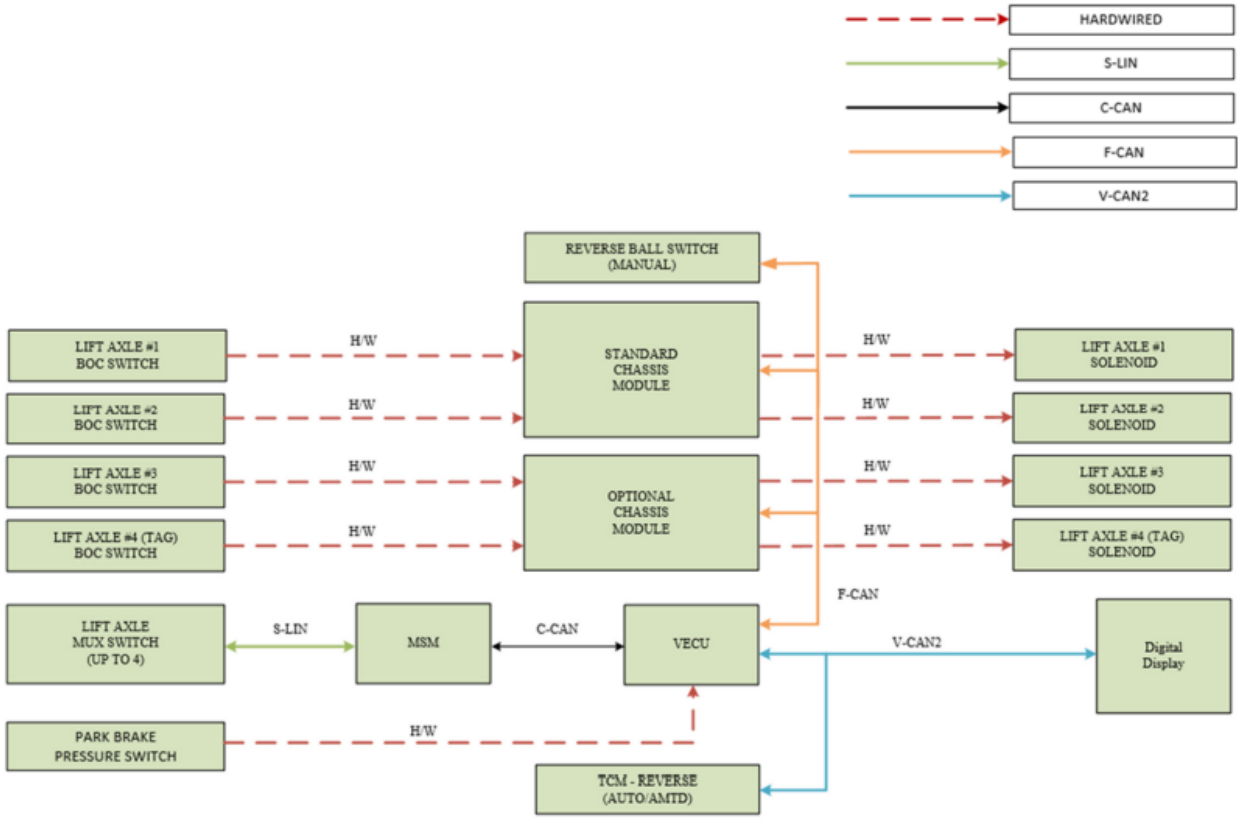


FIGURE 10-41. Lift Axle Electrical Diagram

Table 1. Truck Lift Axle Logic

Lift Axle Type	Raise Condition Logic	Lower Condition Logic
Steerable Lift Axle w/o Auto Reverse	• Lift Axle is Inactive OR • Park Brake Active OR • Trans in Reverse	• Lift Switch is Active AND • Park Brake Inactive AND • Trans Not in Reverse
Steerable Lift Axle w/ Auto Reverse OR Non-Steerable Lift Axle w/o Park Brake	• Lift Switch is Inactive OR • Park Brake Active	• Lift Switch is Active AND • Park Brake Inactive
Non-Steerable Lift Axle w/ Park Brake	• Lift Switch is Inactive AND • Park Brake Inactive	• Lift Switch is Active OR • Park Brake Active

TRAILER LIFT AXLE

Trailer lift axles can be either EoA or Electric-Only type. There is a total of two available EoA trailer lift axle controls using latching solenoids. If one axle is ordered, the customer will receive a switch labeled “Trailer Lift Axle”. If two axles are ordered the customer can have a single switch that controls both axles or two switches that controls both axles. If two switches are present, they are labeled “Forward Trailer Lift Axle” and “Rear Trailer Lift Axle”.

DIGITAL DISPLAY & TELLTALES



FIGURE 10-42. Digital Display Telltales

Custom telltales are no longer available with a physical card inserted into the dash cluster. Instead, the body builder telltales will populate on a portion of the Digital Display (from a limited list which can be configured using PVP at a local Kenworth dealership). The location of the telltale will be dependent on the configuration of the vehicle and other telltales present on the vehicle’s Digital Display.

TELLTALE CONNECTOR LOCATIONS

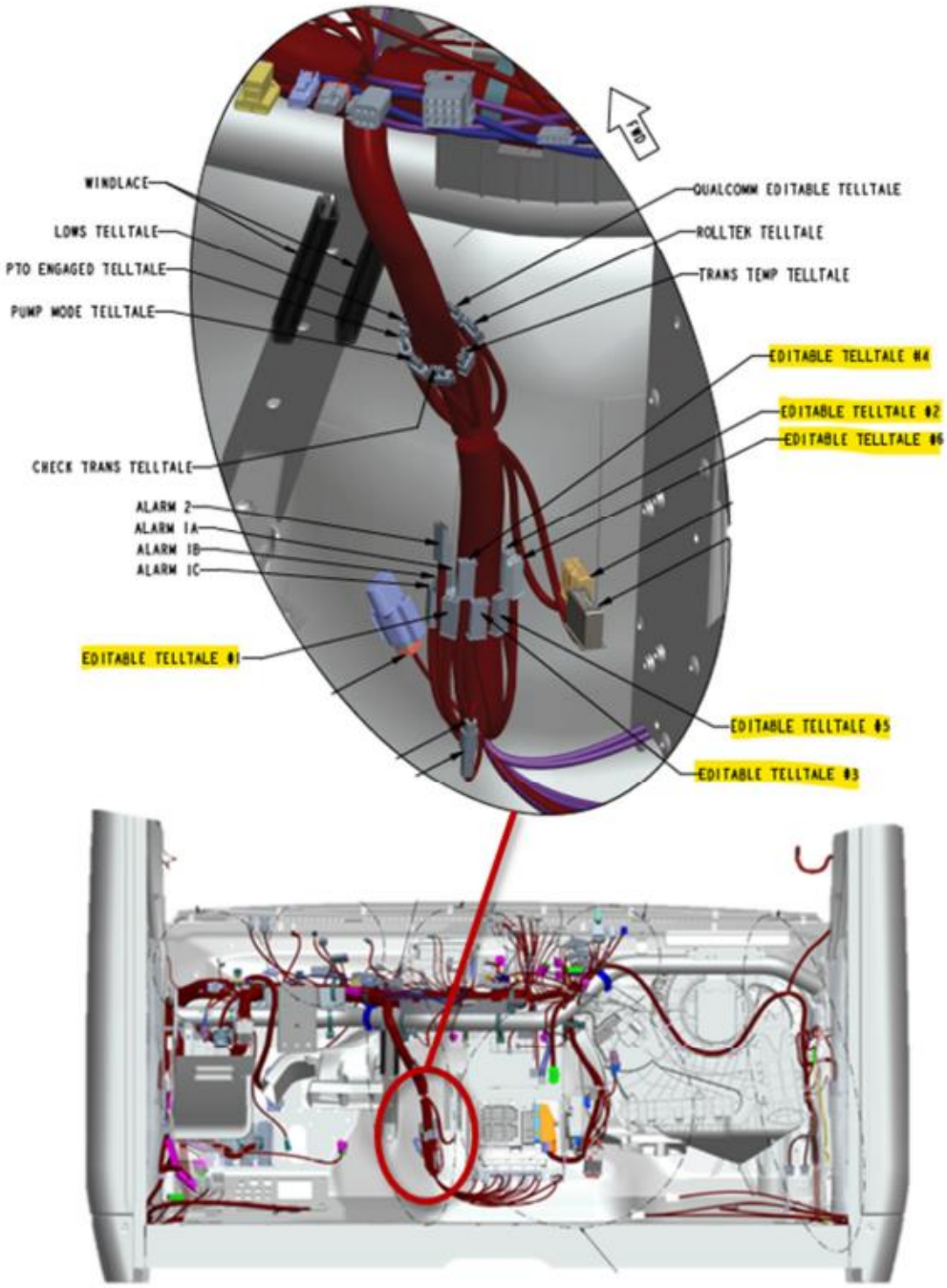


FIGURE 10-43. Telltale Connector Locations

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CUSTOMIZABLE TELLTALES – DIGTAL DASH

Function Name	Activation Color	Indicator
BB-Snowplow Active Indicator	White	
BB-Strobe Front Indicator	White	STROBE FRONT
BB-Strobe Rear Indicator	White	STROBE REAR
BB-Sander Light Indicator	White	SANDER LIGHT
BB-Wing Light Indicator	White	WING LIGHT
BB-Wing Spot Light Indicator	White	WING SPOT
BB-Spreader Light Indicator	White	SPREAD LIGHT
BB-Bar Light Indicator	White	BAR LIGHT
BB-Tarp Light Indicator	White	TARP LIGHT

Function Name	Activation Color	Indicator
BB-Boom Flood Indicator	White	BOOM FLOOD
BB-Tailgate Indicator	White	TAIL GATE
BB-Dump Box Shaker Indicator	Amber	
BB-Bed/Body Up Indicator	Amber	BODY UP
BB-Boom Down/Stowed Indicator	White	BOOM STORED
BB-Outriggers Down Indicator	White	OUTRIG DOWN
BB-Conveyor Active Indicator	White	CONVEY ACTIVE
BB-Sander Active Indicator	White	SANDER ACTIVE
BB-Air Slide Indicator	White	AIR SLIDE

FIGURE 10-44. Customizable Telltales – Digital Dash

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GAUGES

Gauges and switches are fastened directly to the panel. Once the panel is free, the gauge or switch can be installed. Gauges are held by a screwed-on collar while switches have a plastic tab. Optional gauges may be installed and connected to the Digital Display via a jumper harness.

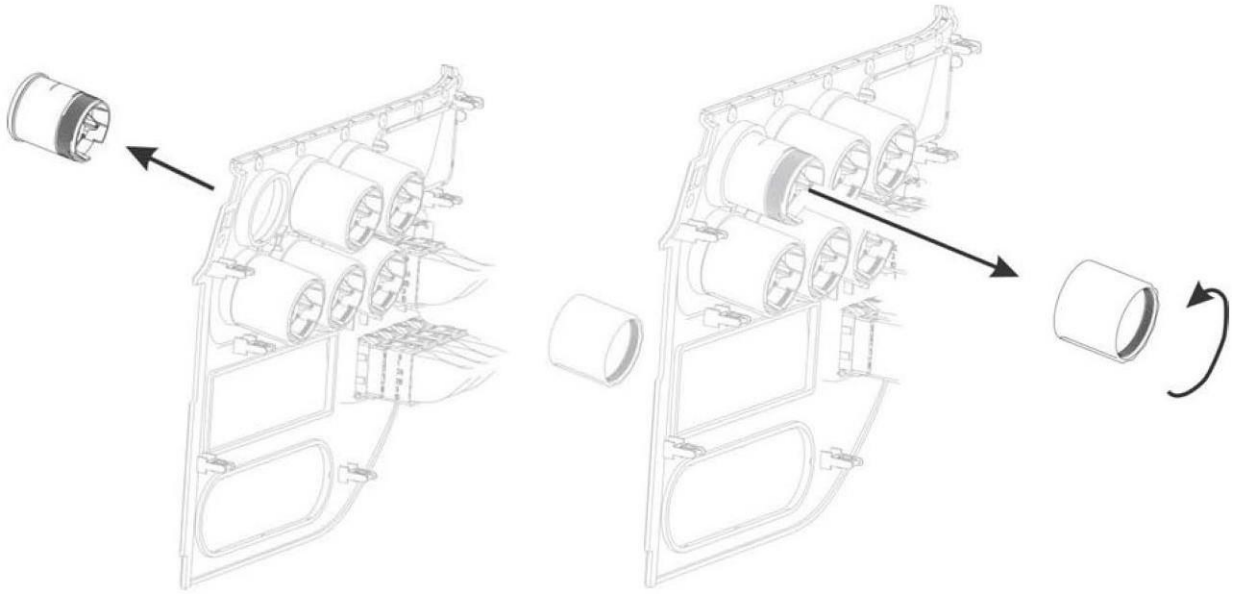


FIGURE 10-45. Gauge Removal & Installation

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ROUTING

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 com- pressor 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. 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.

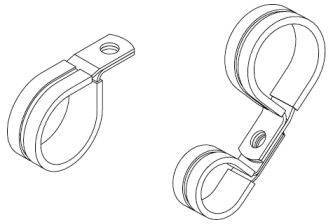


FIGURE 11-1. Clamp and Butterfly Clamp

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)

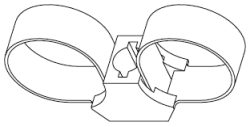


FIGURE 11-2. Butterfly Tie

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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. These straps must be UV stable.

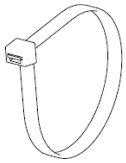


FIGURE 11-3. Tie Strap

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°).

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.

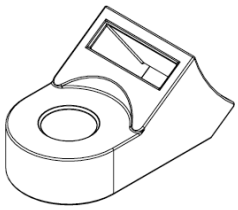


FIGURE 11-4. Heavy Duty (HD) Mount

Excess of material: More than 3 inches of slack for every 14-inch section of hose routing, except for air conditioner hoses. See section 4.1.3 for air conditioner hose requirements.

Shortness of material: Less than 1 inch of slack on a 14-inch section of hose routing.

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ROUTING REQUIREMENTS

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.

Don’t bend wires or use tie straps within 3 inches (75 mm) of (connected) wire connectors or plugs.

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 14 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, tmsn, etc.) mounted standoffs at intervals not exceeding 14 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 14 inches (356 mm). Heater wires with a secondary covering shall be covered with con- voluted tubing whether they are in bundles or not.

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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 (KW part number K344-813), another section of hose, or plastic sheathing (KW 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 14 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.

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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-inch (25.4) 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 11-1. Exhaust – System Clearance

Description	Shielded	Unshielded
Coolant hoses, HVAC hoses & tubing, and electrical wires within 15in of the turbo and/or over 15in from the turbo	2in minimum	3in minimum
Fuel Hoses • Withing 15in of the turbo • Over 15in from the turbo	n/a 2in minimum	4in minimum 3in minimum
Fuel Tanks and Hydraulic Tanks • Crossing Tank • Parallel to Tank • End of Tank • Aluminum/Ceramic-Coated Exhaust Pipe Crossing Tank	n/a n/a n/a n/a	2in minimum 2in minimum 1in minimum 1.5in minimum
Air Hose • Nylon • Wire Braid	3in minimum 2in minimum	8in minimum 3in minimum

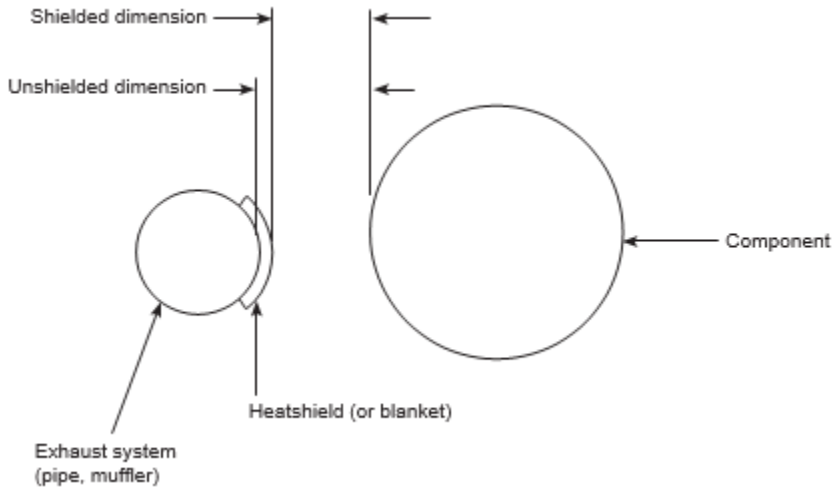


FIGURE 11-5. Definitions of Measurements

APPENDIX A 01/2022

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 Figure A–1.

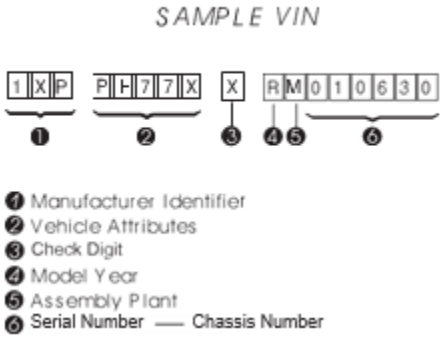


Figure A-1. Vehicle Identification Number (VIN)

The model year (4) is designated by an alphanumeric code in the tenth character position in the VIN. See Table A-1 and Figure A–1.

Table A-1. Model Year (Code) Designation

Code	Year
5	2005
6	2006
7	2007
8	2008
9	2009
A	2010
B	2011
C	2012
D	2013
E	2014
F	2015
G	2016
H	2017
J	2018
K	2019
L	2021
M	2022

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VIN Location

The VIN is marked on the Incomplete Vehicle Certification Label (on trucks). It is located either on the driver's door edge or door frame. See Figure A–2.

Chassis Number Locations

The Chassis Number comprises the last six characters of the VIN and is shown in multiple locations on the vehicle.

- Left side of cab, back wall of cab: stamped plate. (Daycab)
- Left side of cab, back wall of sleeper: stamped plate. (Sleeper)
- Tire, Rim, and Weight Rating Data label.
- Major Components and Weights label.
- Noise Emission label.
- Paint Identification label.

VEHICLE IDENTIFICATION LABELS

Vehicle Identification Labels are located on the driver's side door edge or on either the driver's or passenger's side door frames. See Figure A-2. Labels include Vehicle Certification, Components and Weights, Tire/Rim and Weight Rating Data, Noise Emissions, and Paint Identification. Quantity and location of labels may differ based on Complete/Incomplete vehicle, and Single/Dual certification.

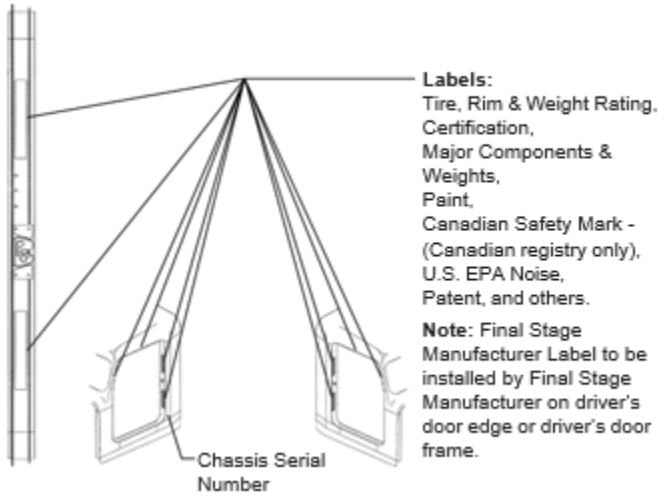


Figure A-2. Driver's Door and Door Frame Labels

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Tire/Rim and Weight Rating Data Label

The Tire/Rim and Weight Rating Data Label is used in conjunction with the Incomplete Vehicle Certification Label on Incomplete Vehicles. It contains chassis serial number and 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



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.

Incomplete Vehicle Certification Label

The Incomplete Vehicle Certification Label contains the chassis VIN, date of manufacture, and listing of applicable motor vehicle safety standards.

Components and Weights Label

The Major Components and Weights Label includes chassis weight and gross weight information, as well as model and serial numbers for the vehicle, engine, transmission, and axles.

Noise Emission Label

The Noise Emission Label contains the chassis serial number, date of manufacture, and information regarding US noise emission regulations. This label is not provided on Canadian registered vehicles.

Paint Identification Label

The Paint Identification Label contains the paint colors used by the factory to paint the truck. It lists frame, wheels, cab interior and exterior colors. This label is located either underneath the dash to the left of the steering column support, inside the glovebox, or on the passenger’s door frame.

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COMPONENT IDENTIFICATION

Each of the following components has their own identification label.

Engine Identification

The engine serial number is stamped on a plate located on the left front of the engine. For further information, please refer to the Engine Operation and Maintenance Manual (included in the glove compartment of each vehicle).

Transmission Identification

The transmission identification number is stamped on a tag affixed to the right forward side of the transmission case. It includes among other specifications the transmission model, serial, and part number.

Front Axle Identification

The front axle has an identification tag located on the front axle beam. It includes the axle model, part number and serial number.

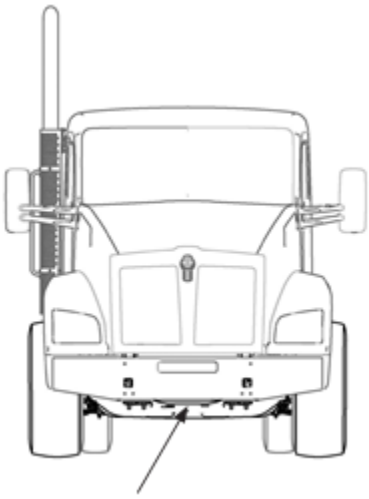


Figure A-3. Front Axle Identification

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Rear Axle Identification

The rear axle identification numbering system includes two labels or stamps.

1. **Axle Housing Number Tag** located on the left forward side of the housing arm. This tag identifies the axle housing.

2. **Axle Differential Carrier Identification** located on the top side of the differential carrier. The following information is either stamped, or marked with a metal tag: Model No., Carrier Production Assembly No., Carrier Assembly Serial No., Gear Ratio, Axle Specifications Number and OEM part number and country of origin.

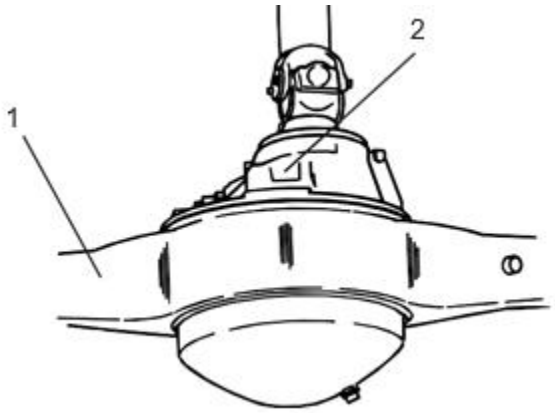


Figure A-4. Rear Axle Identification

NOTE

Illustrated identification tag locations are typical. Actual locations may vary by axle manufacturer and with single versus tandem axles.