Body Builder, General Guidelines and Certification
VNL
Section 0

Introduction

The information in this document was developed to assist our customers throughout the body planning and installation process. This information will assist with the required specifications and guidelines for completion for your specific applications.

The information in this document does not include every unique situation that you may encounter when working on Volvo vehicles. Volvo Trucks North America cannot possibly know, evaluate or advise someone on all the types of work that can be done on a Volvo vehicle and all the appropriate ways to do such work. This includes all of the possible consequences of performing such work in a certain manner. Therefore, any situations or methods of working on a Volvo vehicle that are not addressed in this document are not necessarily approved by Volvo Trucks North America.

In the event that you require additional assistance, please contact Volvo Body Builder Support at 877-770-7575.

Unless otherwise stated, following the recommendations listed in this document does not automatically guarantee compliance with applicable government regulations. Compliance with applicable government regulations is your responsibility as the party making the additions/modifications. Please be advised that the Volvo Trucks North America vehicle warranty does not apply to any Volvo vehicle that has been modified in any way, which in Volvo's judgment might affect the vehicles stability or reliability. The information, specifications and illustrations in this document are based on information that was current at the time of publication. Note that illustrations are typical and may not reflect the exact arrangement of every component installed on a specific vehicle.

Contents:

Glossary

Gross Axle Weight Rating (GAWR)	The maximum rated capacity is measured at the ground for a given axle system consisting of the axle, springs, wheels and tires. May also be influenced by the frame capacity. GAWR is determined by the least rated component in the system.
Gross Vehicle Weight (GVW)	The in-service vehicle weight, including chassis, body, add-on equipment and cargo.
Gross Vehicle Weight Rating (GVWR)	The manufacturer's maximum rated GVW for any given vehicle. GVWR is frequently the sum of the GAWRs. However, it may be downrated for braking or handling considerations.
Payload Weight	The actual weight of the cargo carried by a vehicle.
Tare Weight	The weight of a truck fully equipped and ready for service, minus any payload. Also called curb weight or empty weight. All trucks begin with a tare weight for the standard chassis, to which weights are added for optional equipment, fuel, body and equipment, plus driver and passengers.

Abbrevations

BPMU	Battery Power Management Unit
DESS	Dual Energy Storage System
SESS	Single Energy Storage System
ECI	External Charging Interface
HSB	High-Side Battery (24V)
LSB	Low-Side Battery (12V)
MDS	Maintenance Disconnect Switch
UC	UltraCapacitor
ESM	Engine Start Module

Notes

Security disclaimer

It is the responsibility of the body builder to ensure adequate cybersecurity of the bodywork electronics equipment added to the vehicle. For example, the integrity and authenticity of any wireless data communication. The body builder is also responsible for fulfilling UN R155 vehicle type approval work (when applicable, considering national regulations) for additional electronics added to the vehicle. Also note that Volvo UN R155 approval for the base vehicle is not valid if non-supported data communication network connections are used, see the below above.

WARNING

It is strictly forbidden to connect additional devices to internal data communication networks (CAN, LIN, Ethernet, etc.). This could severely affect the drivability of the truck. Volvo only allows data communication network connections for bodywork devices on the dedicated external data communication connectors that are intended for it:
- The BB CAN connector.
- The FMS connector.

All other connections or methods of access to the internal data communication networks are prohibited.

General Guidelines

Certification Label

The “Certification Label” must be part of the vehicle at all times. It shows the vehicle's serial number, the gross vehicle weight rating (GVWR), and the front and rear gross axle weight ratings (GAWR).

Gross vehicle weight (GVW) is the weight of the original equipped vehicle and all items added to it after it has left the factory. This includes bodies, winches, booms, the driver and all occupants, plus the load the vehicle is carrying. The GVW must not exceed the total of the front and rear axle weight ratings.

The vehicle certification label also shows the tire size and recommended tire inflation pressures for the tires originally supplied with the vehicle. The tires on the vehicle must be of the proper size and must be properly inflated for the load being carried.

Incomplete Vehicle Document

The “Incomplete Vehicle Document” is issued with a temporary certification label, in place of the final certification label, when the vehicle is sent to a body builder for completion.

If several manufacturers are involved in the process of completing the vehicle, each manufacturer must issue a temporary certification label that shows to what legal standard the vehicle currently conforms.

The final manufacturer must issue the permanent certification label certifying that the vehicle conforms to FMVSS standards (as required by 49 CFR Part 567) that are in effect at the time of final manufacture of the incomplete vehicle.

If the vehicle is altered from its original build specifications, the certification label must be updated to reflect the changes (also see Service Bulletin, “Electrical Guidelines”, “Brake Modification Guidelines”, page 7 , “Air-braked Vehicles”, page 8 and “Air-operated Accessories”, page 9).

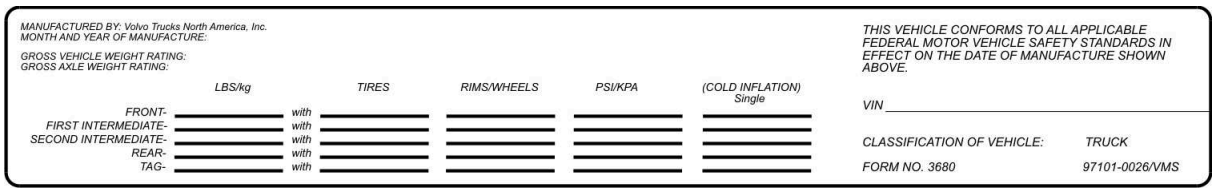

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Fig. 1 Typical Vehicle Certification Label (USA)

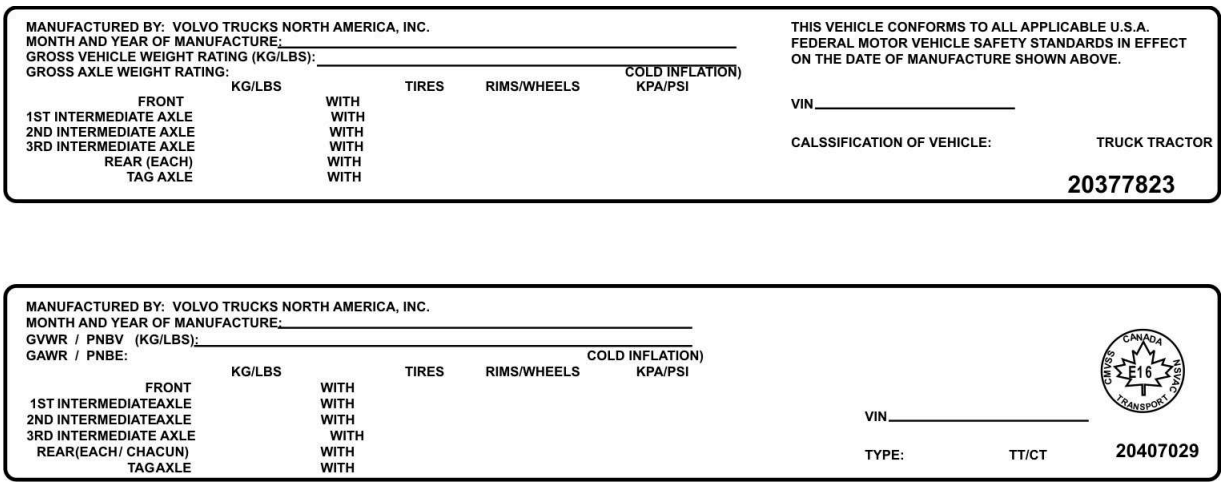

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Fig. 2 Typical Complete Vehicle Label

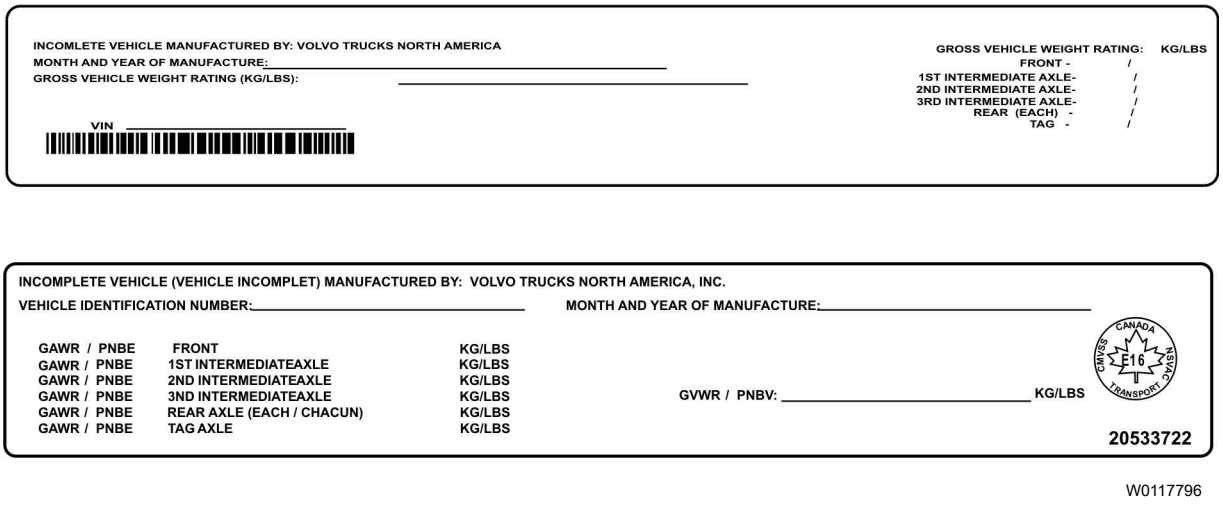

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Fig. 3 Typical Incomplete Vehicle Label

Center of Gravity

The vertical center of gravity of the completed vehicle has a direct effect on the vehicle's stopping distance capability. As the vertical center of gravity increases or the wheelbase decreases, additional weight is transferred to the front axle during a stop, adversely affecting the stopping distance.

VTNA requires that trucks built shall have a center of gravity height/wheelbase ratio of 0.50 or less when loaded to a weight not exceeding GVWR* distributed proportionately to, but not exceeding GVWR,* and a center of gravity height not exceeding 1778 mm (70 in.) on single rear axle vehicle or 1905 mm (75 in.) on tandem rear axle vehicles.

As a guide, the vertical center of gravity height of the incomplete vehicle, as manufactured by VTNA, may be assumed to be the distance from the ground to the top of the frame side rail measured at the longitudinal midpoint of the vehicle in the unladen condition for single axle vehicles and laden condition for tandem axle vehicles.

The frame rail height may be calculated from the chassis diagrams in this document. Also, if you are measuring an unloaded chassis, you may assume the loaded frame rail height to be approximately two inches lower than the bare chassis.

Vehicles completed as trucks could require a vertical center of gravity lower than the recommendations above based on the stability considerations of certain vocational body and/or usage situations. The above recommendations consider only vehicle brake performance. If higher vertical center of gravity limitations are required for a specific vocational body or application, contact VTNA or submit all chassis specifications along with body and payload information in a request for advice to: Product Information Dept./Sales Engineering.

*GVWR and GAWR are indicated on the cover of the Incomplete Vehicle Document.

Vehicle GVWR and GAWRs

The representation as to conformity of the complete vehicle to FMVSS-121 provided in the Incomplete Vehicle Document has a condition that the GVWR and the GAWR of the completed vehicle shall be identical to the ratings designated on the front cover of the Incomplete Vehicle Document for the vehicle. The brake system on each incomplete vehicle manufactured by Volvo Trucks North America (VTNA) is designed to comply with FMVSS-121 when loaded to a specific completed vehicle GVWR distributed proportionately to specific GAWR. Revised vehicle GVWR or GAWR, or the addition of axles to the vehicle will change loading conditions and can adversely affect compliance to FMVSS-121.

Brake Modification Guidelines

Final stage manufacturers should note that in order to rely on the representations as to conformity to “FMVSS-121, Brake Systems” (as provided in the “Incomplete Vehicle Document”, which accompanies each Volvo incomplete vehicle), each of the conditions and instructions of applicable FMVSS-121 statements in the Incomplete Vehicle Document must be followed.

If the final stage manufacturer chooses not to follow each of these instructions and conditions listed in the Incomplete Vehicle Document, he must assume full responsibility for conformity of the vehicle to FMVSS-121.

Final stage manufacturers should also note that the instructions provided are for the assistance of final stage manufacturers who choose to certify the completed vehicle to FMVSS-121 independently of and without reliance on the conformity representations provided in the Incomplete Vehicle Document.

Air-braked Vehicles

⚠ DANGER

Pneumatic components store compressed air and can separate violently during disassembly or removal. Before servicing any part of the pneumatic (air) system, completely release the air pressure. Failure to do so can result in serious personal injury or death.

Volvo air-brakes equipped with incomplete vehicle products, to the extent completed, comply with Federal Motor Vehicle Safety Standard 121, Air Brake Systems (specific completed vehicles exempt from the Standard or portions of the Standard are discussed below).

At the time of writing, FMVSS-121 is applicable to all current production air–brake equipped trucks with specific exceptions.

The statements contained in this section regarding FMVSS-121 compliance are accurate at the time of printing. However, these statements are not intended to replace the statements regarding FMVSS-121 in the Incomplete Vehicle Document. Therefore, that manual should be consulted for compliance conditions.

The following are components and characteristics of the completed vehicle, which are critical to the overall performance of air-braked vehicles. These items should be carefully considered in ordering a vehicle as well as planning vehicle completion by subsequent stage manufacturers to ensure compliance (final certification) of the completed vehicle to FMVSS-121 as well as completed vehicle integrity.

Air-operated Accessories

FMVSS-121 has a pressure build-up requirement, which states that the system pressure must build up from 586 to 689 kPa (85 to 100 PSI) in a specific time period under certain conditions. Therefore, the addition of any accessory or its associated plumbing, which increases the volume of air subject to the build-up requirement will increase the build-up time and may affect compliance with FMVSS-121.

The representation as to conformity of the completed vehicle to FMVSS-121 provided in the Incomplete Vehicle Document has the following conditions for air-operated accessories and its associated plumbing added to a vehicle by a subsequent stage manufacturer.

⚠ DANGER

Pneumatic components store compressed air and can separate violently during disassembly or removal. Before removing or replacing any part of the pneumatic (air) system, completely release the air pressure. Failure to do so can result in serious personal injury or death.

- No connections are made into:
  1 The air line tubing or fittings for the parking brake system
  2 The rear axle system (modulated spring brake system)
  3 The air supply and signal lines to the rear chassis relay valves
  4 The air delivery lines to the front axle brakes and quick release valve.
  .
- No connections are made between the check valve and the reservoir port for air supply.
- Additional reservoir volume must be added with Pusher and Tag Axles, Jifflox, etc. Added volume must be equal to 12 times the added brake chambers rated volume.
- Each added reservoir shall be capable of withstanding an internal hydrostatic pressure of five times the compressor cutout pressure — or 3,447 kPa (500 psi), whichever is greater — for 10 minutes.

Air for pneumatic accessories should be sourced directly from an air reservoir. If an unused reservoir tap is not available, fittings added to the system at the reservoir must not restrict air flow to any existing air lines. The following are to be observed when adding air accessories.

Electronic Control Units (ECUs)

ECUs are connected through the Databus. These ECUs consist of sophisticated electronics that can be permanently damaged if not treated properly (such as exposure to high temperatures).

To prevent serious damage to ECUs, please follow these important guidelines:

⚠ CAUTION

Possible damage to electronic components. Turn the vehicle ignition switch Off before disconnecting or connecting any electrical components. Failure to de-energize circuits may result in electronic equipment damage.

Welding

Welding anywhere on the truck chassis requires that certain precautionary measures be taken. This is required to prevent damage to electrical, as well as electronic systems, wiring harness and components.

CAUTION

Welding on trucks can permanently damage the vehicle electrical system/components, due to the voltage and current spikes that normally occur when welding. It is preferable to avoid welding; however, if welding must be done on any structure on or in contact with the vehicle, disconnect the electrical connectors at the rear of the instrument cluster and follow the recommendations below:

Before welding on the vehicle:

1 Disconnect the power to the vehicle.

2 Disconnect both the positive (+) and negative (-) battery cables. Disconnect the negative cable first. (When reconnecting, connect the positive cable first.)

Note: Disconnect the other ECU grounds from the battery before disconnecting the main ground (to avoid damage to the ECUs).

3 Disconnect the engine/starter ground from the chassis.

4 Disconnect the power wiring harness and vehicle interface wiring harness at the Engine Control Module (ECM).

5 Disconnect all electronically controlled modules and devices, including:

- Governor Controls
- Shutdown/Warning Electronics
- Starter and Ignition Controls
- Engine and Vehicle ECUs
- Transmission ECU
- Electronic braking system (EBS) ECUs
- Chassis ECU
- Electronic Speedometer/Tachometer

(This prevents the possibility of alternate paths for induced voltage and currents being created and damaging those components.)

6 Disconnect the electrical connectors at the rear of the instrument cluster.

7 Attach the welder ground cable as close as possible to the weld (no more than 60 cm (24 in.) from the part being welded).

8 Do not connect the welder ground cable to the engine ECU or the ECU cooling plate.

CAUTION

DO NOT weld on the engine or engine components. Welding on the engine or components mounted on the engine can cause serious damage to the Engine ECU and other electrical components.

There are certain basic common sense rules also to be followed when welding, including (but not limited to):

- Welding cables should not be allowed to lie on/near or cross over any electrical wiring or electronic component during the welding procedure.
- After the welding process has been completed and the welded parts have cooled, inspect wiring and components for possible shorts or damage, which would allow the possibility of drawing excessive currents or cause short circuits when the batteries are reconnected.

DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. Clean up fuel spills immediately.

DANGER

Exhaust gases contain deadly poison. When testing a vehicle with the engine running, conduct the test outdoors or use a properly vented exhaust hose.

WARNING

Keep yourself and your test equipment clear of all moving or hot engine parts. A hot engine can cause serious burns or can permanently damage test equipment.

DANGER

Pneumatic components store compressed air and can separate violently during disassembly or removal. Before servicing any part of the pneumatic (air) system, completely release the air pressure. Failure to do so can result in serious personal injury or death.

Battery Charging Precaution

When charging the truck, either a 12V charger or 24V charger may be used, so long as the correct method is used. Incorrect use of the charger will severely damage the system. Only use the charging methods outlined in “Charging specifications”, page 13 .

CAUTION

Attempting to start the vehicle using methods other than the ones described in this section of the document may cause electrical damage to the vehicle.

Note: Trucks are equipped with a External Charging Interface (ECI), which is located on the left side of the cab.

Note: In the event of an extremely low state of charge, a charger in Smart Charge mode may not be able to charge the batteries. In this case, use a charger with Power Supply mode activated to charge the batteries up to a normal level.

Note: Battery charging must be performed only using the dedicated external charging interface. Do not attempt to connect the charger or external power source directly to the batteries and ultracapacitor (if equipped).

CAUTION

Ensure there are no loose connections between the battery charger and charging interface.

CAUTION

DO NOT use battery chargers with high "boosting" capability. These produce a high voltage that could cause damage to the vehicle electrical and electronic components.

WARNING

Remember that batteries contain a hydrogen and oxygen mixture, which is highly explosive. A spark, which could occur when you connect the cables incorrectly could be enough to cause the battery to explode and injure you and damage the truck. The battery contains sulfuric acid, which can cause serious chemical burns. If you get any acid in your eyes, skin or clothes - rinse with large quantities of water. If you get any splashes in your eyes, seek medical attention immediately.

CAUTION

The battery contains acid, which is corrosive and poisonous. It is thus important that the battery is handled in an environmentally compatible manner.

WARNING

Always wear eye protection when working around batteries to prevent the risk of injury due to contact with sulfuric acid or an explosion.

WARNING

Battery posts, terminals and related accessories contain lead compounds, chemicals known to the state of California to cause cancer and reproductive harm. Wash hands after handling.

- To avoid the risk of arcing/electrocution, do not connect the charger directly to the UC/ESM.
- The ECI can be identified by the red cap which states 12V, only 12V chargers may be connected to the ECI.
- Ensure there are no loose connections between the charging source and the ECI studs.
- Replace the ECI top cover once the charging process is complete. This protects the ECI studs from dust and water.

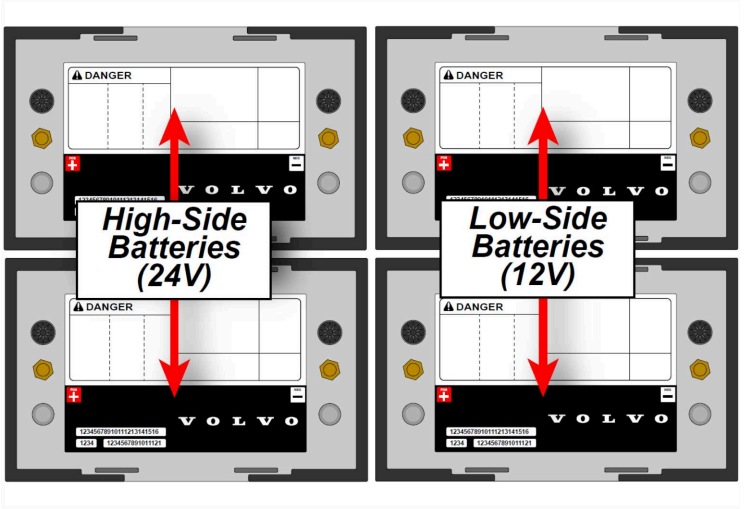
Note: In the event of an extremely low state of charge, a charger in Smart Charge mode may not be able to charge the batteries. In this case, use a charger with Power Supply mode activated to charge the batteries up to a normal level.

Note: The BPMU requires a minimum of 10V in order to supply power and provide battery equalization. Refer to “”, page 14 if the HSBs are measuring at less than 10V.

Note: The BPMU requires a minimum of 10V in order to supply power and provide battery equalization. Refer to “”, page 16 if the HSBs are measuring at 10V or more.

Battery orientation

The High-Side Battery (HSB), located on the left side, operates at 24V, while the Low-Side Battery (LSB), located on the right side, operates at 12V, providing different voltage levels for specific requirements.



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Charging specifications

In case of unexpected battery drain due to long parking or low usage of the vehicle, connecting an energy source to the Charging Interface is the recommended with various methods:

- Using external 12V source if High- Side Batteries is higher than 10V
- Using external 12V source if High- Side Batteries is lower than 10V
- Using external 24V Source
- Shore Power Charging

CAUTION

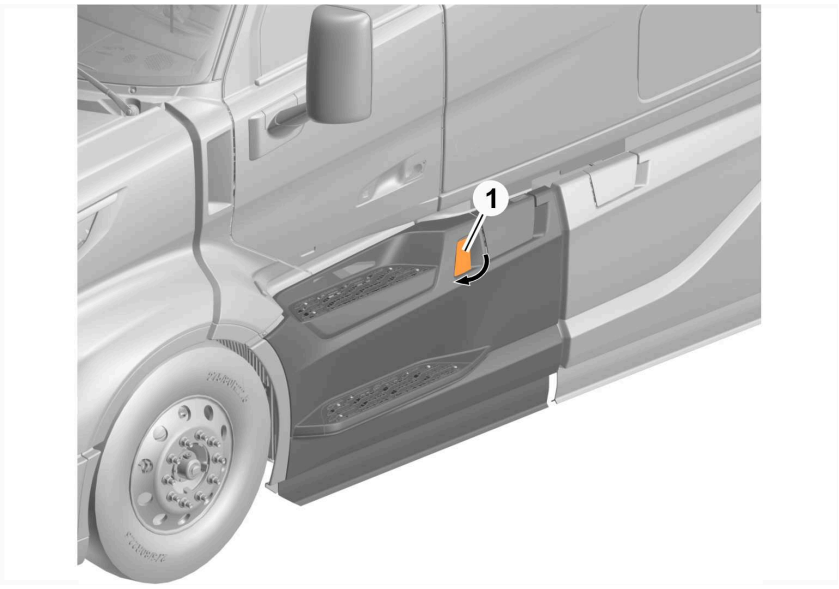
Jump starting or charging from another truck is not recommended. Damage to the batteries or electrical components can occur.

Battery Charging

12V charging

12V Charging – High Side Batteries are measuring 10V or higher

- Pull the lever (1) to open the chassis fairing (left-hand side).



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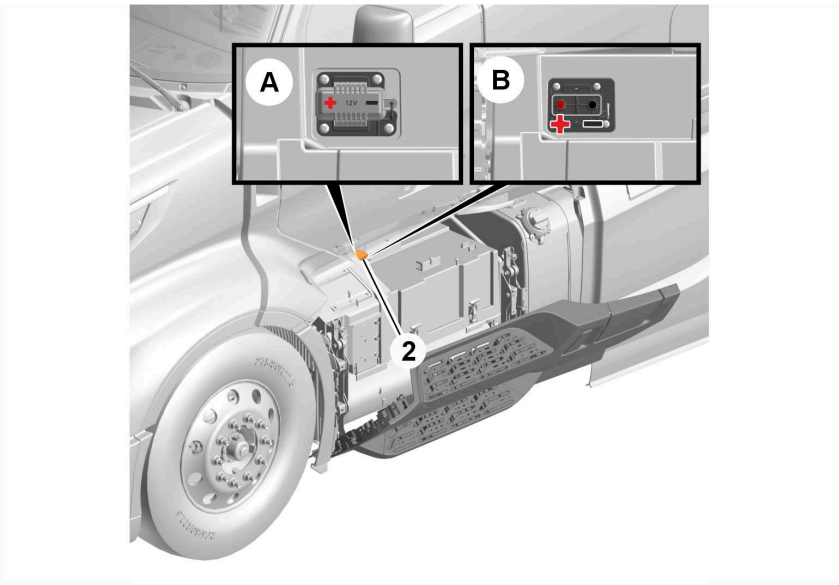
- Locate the charging interface (2) and remove the top cover (A)



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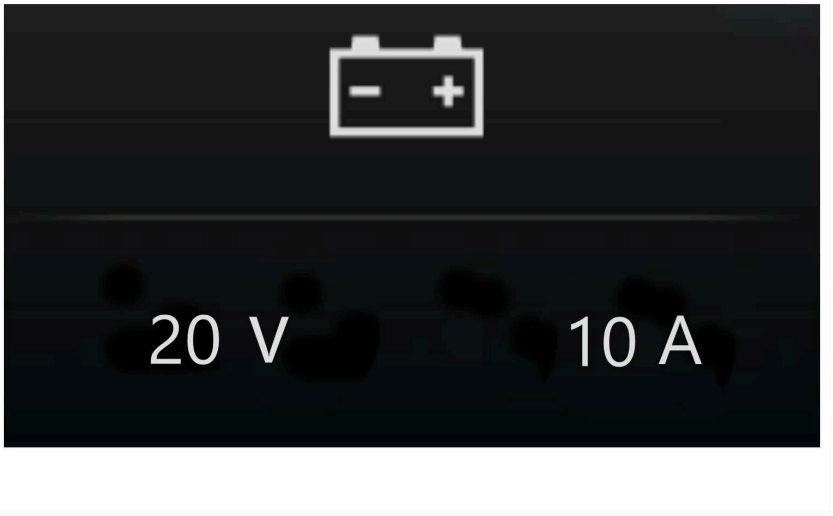
- Connect the external power source to positive (+) and negative (-) studs of the ECI (B). Refer markup on the top cover.
- Turn on the charger.

- Check the battery voltage on the instrument cluster display.



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- Start the truck once the following voltage conditions are met:

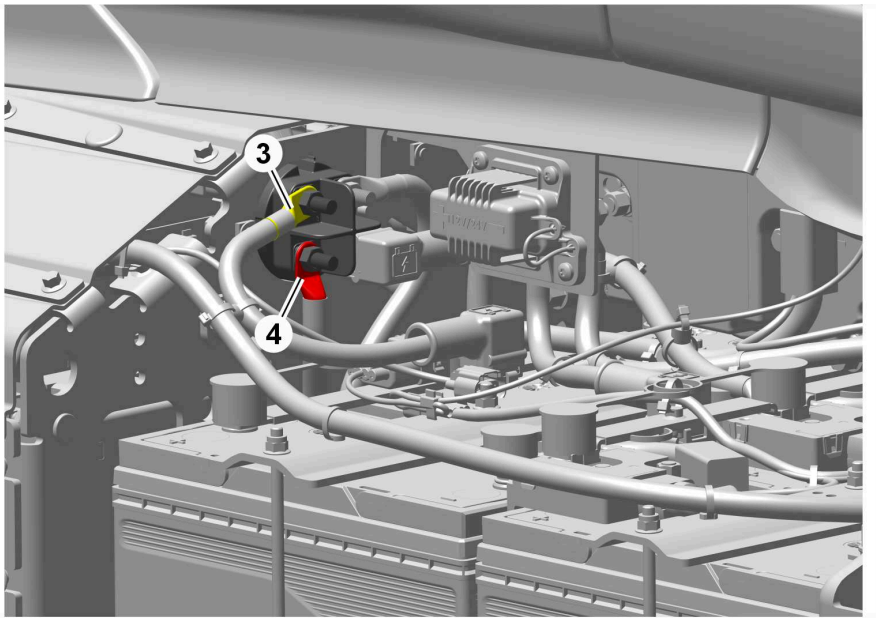
DESS: The UC/ESM will be ready to crank at 16V - 17V

SESS: The truck will require at least 20V to crank

- The truck must remain running or connected to the charger until the state of charge meter is at least 85% full.
- Once the state of charge reaches 85% or higher, the truck may be turned off or the charger removed.
- Ensure that the red ECI cap is replaced. The charging process is now complete.

12V Charging – High Side Batteries are measuring less than 10V

- Follow the procedure outlined in “”, page 14 to charge the LSBs
- Once the LSBs are completely charged, remove the positive and negative leads of the charger from the ECI.
- Connect the positive lead of the charger to the upper-outboard terminal located on the back of the MDS (3). This terminal can be identified by the yellow cable routed from the high-side battery bank
- Connect the negative lead of the charger to the bottom-outboard terminal located on the back of the MDS (4). This terminal can be identified by the red cable.



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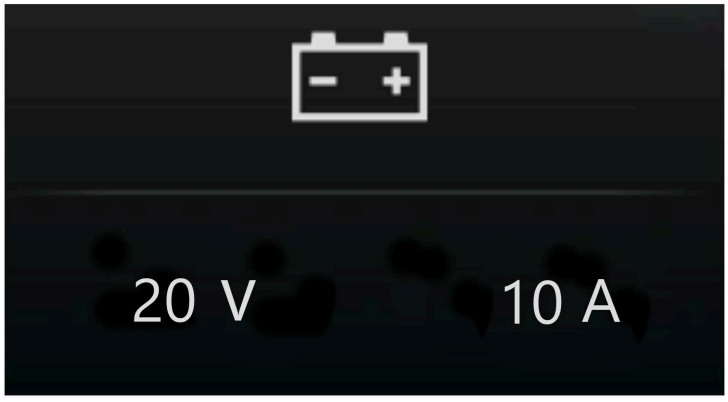
- Turn on the charger.
- Allow the HSBs to fully charge.
- Check the battery voltage on the instrument cluster display.



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- Start the truck once the following voltage conditions are met:

DESS: The UC/ESM will be ready to crank at 16V - 17V

SESS: The truck will require at least 20V to crank

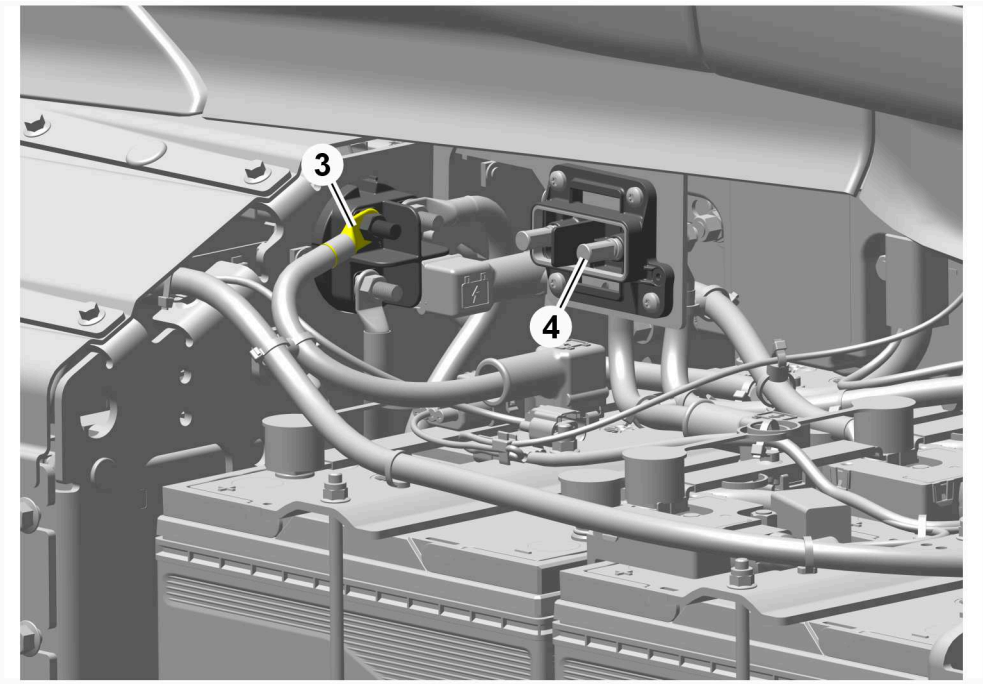
- The truck must remain running or connected to the charger until the state of charge meter is at least 85% full.
- Once the state of charge reaches 85% or higher, the truck may be turned off or the charger removed.
- The charging process is now complete.

Note: *SESS*: A minimum time of 30-60 minutes will be required to charge the batteries.
DESS: The UC/ESM should be fully charged and ready to crack within 1-5 minutes.

24V Charging

Note: Only negative ECI terminal (-) is used for 24v charging.
Do not connect the positive lead of the charger to the positive terminal (+)of the ECI

- Connect the positive lead of the charger to the upper-outboard terminal located on the back of the MDS (3).
This terminal can be identified by the yellow cable routed from the high-side battery bank
- Connect the ground lead of the charger to the negative terminal on the ECI port (4).



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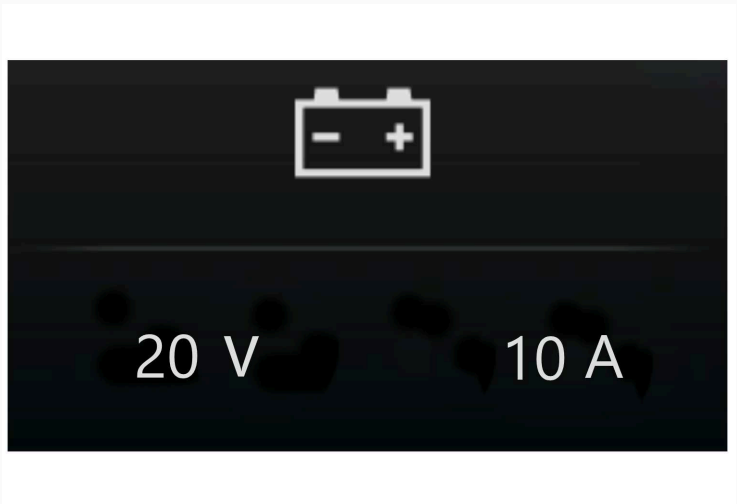
- Turn on the charger.
- Allow the HSBs to fully charge.
- Check the battery voltage on the instrument cluster display.



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- Start the truck once the following voltage conditions are met:

DESS: The UC/ESM will be ready to crank at 16V - 17V

SESS: The truck will require at least 20V to crank

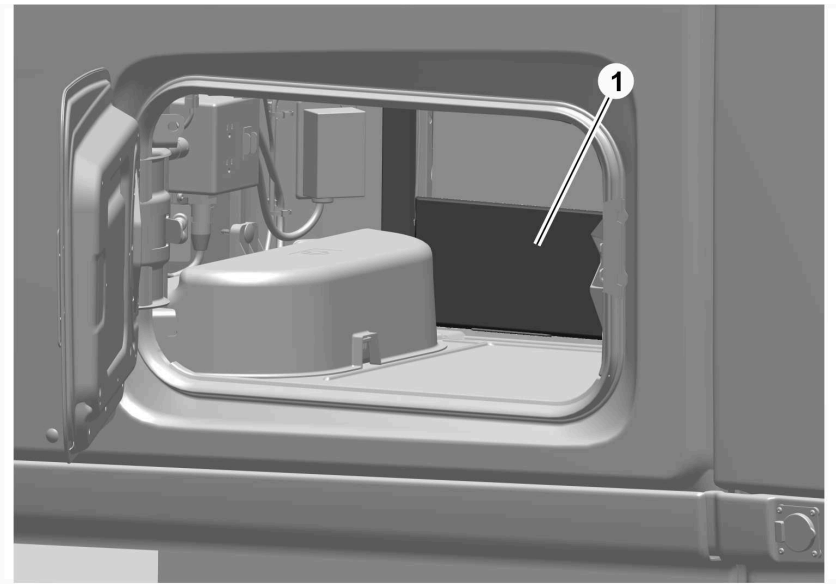
- The truck must remain running or connected to the charger until the state of charge meter is at least 85% full.
- Once the state of charge reaches 85% or higher, the truck may be turned off or the charger removed.
- The charging process is now complete.

Note: *SESS*: A minimum time of 30-60 minutes will be required to charge the batteries.
DESS: The UC/ESM should be fully charged and ready to crack within 1-5 minutes.

Shore Power Charging

Note: This section is only applicable to 6-battery DESS trucks equipped with an inverter.

- Open the storage compartment on the passenger side of the truck to verify that the truck is equipped with an inverter (1)



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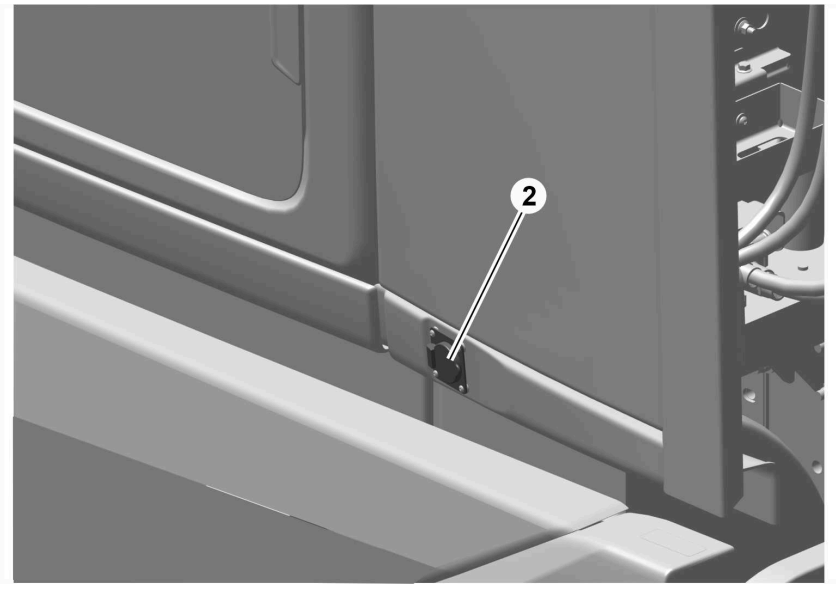
- Plug an HD power cord routed from the charging source into the shore power connector(2), located on the passenger side of the truck. The batteries will automatically begin to charge.



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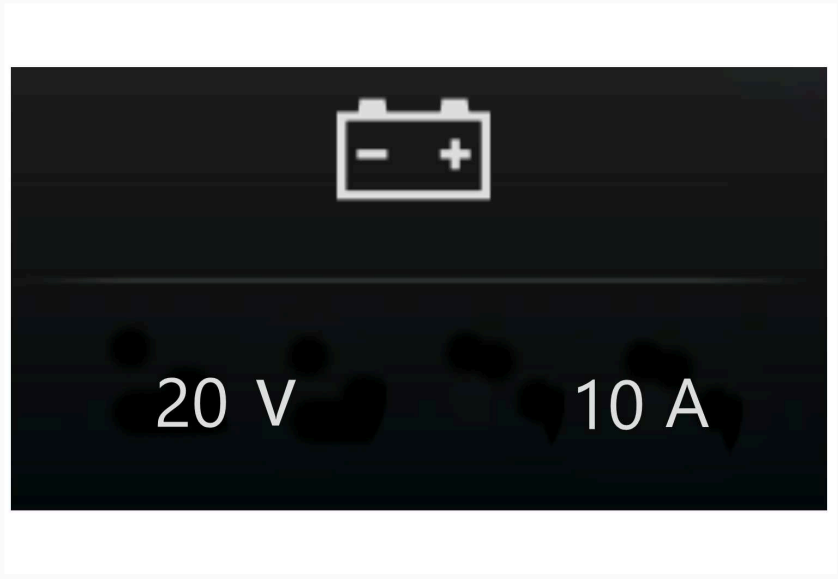
- Allow the batteries to fully charge.
- Allow the HSBs to fully charge.

- Check the battery voltage on the instrument cluster display.



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- The UC/ESM will be ready to crank at 16V - 17V.
- Start the truck once the voltage conditions is met
- The truck must remain running or connected to the charger until the state of charge meter is at least 85% full.
- Once the state of charge reaches 85% or higher, the truck may be turned off or the charger removed.
- The charging process is now complete.

Note: The UC/ESM should be fully charged and ready to crack within 1-5 minutes.

Charging Failure

Note: If the system fails to charge through the ECI, contact the nearby authorised Volvo dealer for further assistance.

Adding Electrical Equipment

Carefully determine the proper wire sizing and fuse requirements for each circuit to be added. Relays may be required for circuits with higher current flow.

Wire connections must not disturb or interfere with any existing systems or components within the vehicle.

For example, the J1939-1 and J2284 wires MUST NOT be cut or spliced for any connections. **These wires must not be tampered with.**

Data Link Wiring

SAE J1939–1

Backbone 1 (J1939-1) is the primary data link with a signal transfer speed of 500 kbit/s for communication between the vehicle control modules and the powertrain control modules.

If a connection is required to the J1939 data link, use the connector already supplied in the vehicle wiring harness. These will always be a twisted pair of red wires.

CAUTION

No modifications or connections should be made to wires Backbone 1 (red) or Backbone 2 (black). **These wires carry high-speed communications between the electronic systems in the vehicle. Any modification, connection or damage to these wires can result in the failure of the vehicles electronic systems.**

ISO J2284

Note: Vehicles with Volvo engines use the J1939 and J2284 data link.

Follow the same guidelines and precautions for the J1939/J2284 data link wiring.

Backbone 2 (J2284) is a dedicated diagnostic data link for powertrain control modules with a signal transfer speed of 500 kbit/s. Also, backbone 2 (J2284) is used by the service tool to reprogram the VMCU (Vehicle Master Control Unit), TGW (Telematic Gateway) and other control units.

CAUTION

If a circuit must be added to the electrical system, and will carry high currents or frequencies, route it in a location AWAY from wires to prevent mutual inductance from interfering with data link functions.

CAUTION

Wires MUST NOT be cut or spliced for any connections. These wires are used for the transmission of data for diagnostic messages and gauges. Modifying this circuit can cause these functions to fail.

The two backbones connect the control units and subnets to enable large amounts of information to always be available in the system.

On these backbones, the following data are available:

- Vehicle status data (for example, time, speed and fuel consumption)
- Powertrain control signals
- OBD (on-board diagnostics)
- Vehicle diagnostics according to ISO (International Organization for Standardization) 14229
- Status and control signals
- Software download.

Towing Procedure

General

Note: Use only designated lifting points to lift the vehicle.

Note: Always use suitable lifting devices, such as clevises and chassis guards, to avoid damaging the vehicle.

Note: Switch on the hazard lamps and parking lamps if the electrical system is functioning.

Note: During towing, the functional main switch (under driver side of the cab) should be in ON position and the hazard lamps should flash.

Towing instructions

It is important to consider the truck weight, position and condition of the truck before towing. This helps to know the type of tow truck and the equipment required for towing.

Procedure before towing

- Ensure that the parking brake is applied.
- Switch on the hazard lamps, if the electrical system is functioning.
- Switch off the Traction Control System (TCS).
- Turn off the key and remove it from the starter switch.
- Lock the cab.
- Release the parking brake. If the parking brake needs to be released mechanically, chock the wheels first and release it.

Towing procedure

Note: The steering does not have any servo effect if the engine is not running.

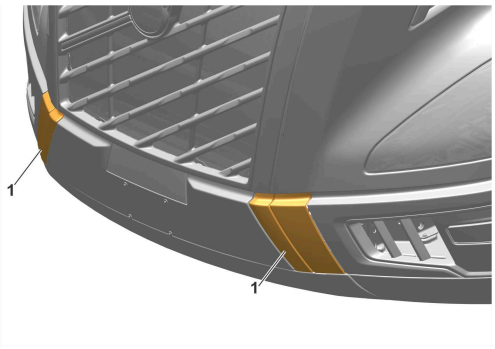
Note: The vehicle will not have air brakes when not powered up.

WARNING

The vehicle's towing hooks must only be used for towing. Incorrect use can lead to personal injury if the towing hook is loaded with a greater weight than it is designed for.

Use the towing hook for towing a vehicle. The towing hooks are designed to push in and lock with a ¼ rotation into the socket behind a cover on the left and right-hand sides of the bumper.

Remove the cover (1).



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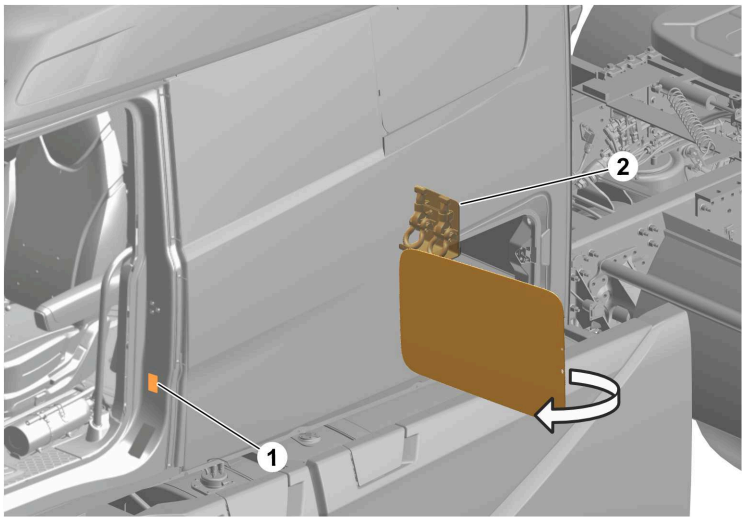
Push in and lock the towing hook with a ¼ rotation into the socket.

T0197749

The parking brake must be released during towing.
Use the vehicles towing hooks for towing. The truck is equipped with two towing hooks, each one of them may have half the gross weight of the truck applied from straight in front.

Tow hooks (Sleeper cab)

The tow hooks are stored in the storage compartment (left-hand side).
Press the switch (1) on the B-pillar to open the storage compartment. The storage compartments provide easy access to the dedicated tow hook (2) storage.



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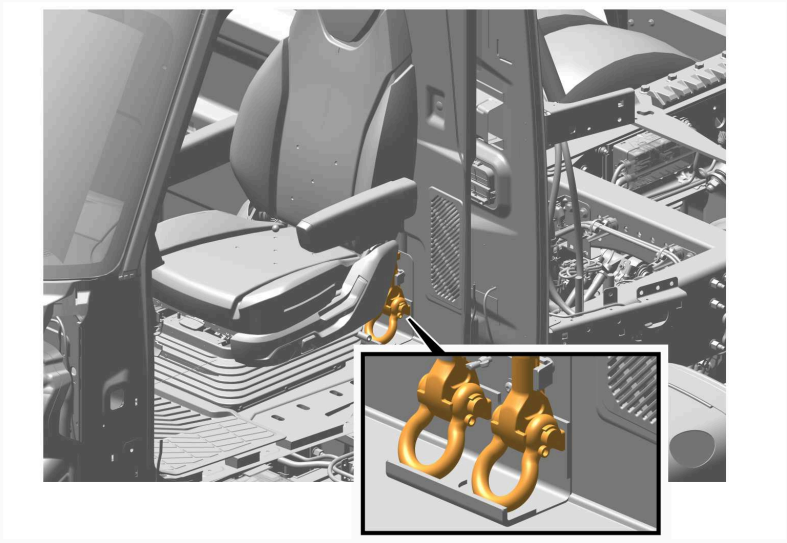
Tow hooks (Day cab)

The tow hooks are stored behind the passenger seat.



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WARNING

The vehicles towing hooks must only be used for towing. If the towing hook is loaded with more a greater weight than it is designed for, it can cause personal injury.

Maximum loading during lifting and towing

This information specifies the loading that can be applied while using a towing hook, towing hitch cross-member, axles and/or torque stay anchorages.

Single Towing Hook: The hook must not be loaded for more than the vehicle's gross weight.
Double Towing Hooks: Each hook must not be loaded for more than half the vehicle's gross weight.
Towing Hitch, Towing hitch cross member: Maximum 200 mm (7.8 inches) from center of member web.

Maximum loads on towing cross member are:

- Lengthways: 20 tons
- Vertically (lift): 7 tons
- Sideways: 17 tons

Axles, Front and Rear:

- Static loading, lengthways and vertically: two times axle loading
- Dynamic, e.g. during towing: One-time axle loading.

Air Suspension Vehicles, Front Torque Stays:

- Per side: max 5 tons
- Gross: max 9.5 tons

DANGER

Do not use the tow eyes to raise the front of the vehicle as the tow eyes can break.
Do not crawl under a vehicle suspended by tow eyes. Failure to follow these instructions may cause serious personal injury or death.

CAUTION

The towing hooks on the vehicle must only be used for towing.

Notes

Weight Distribution

Determining the weight distribution of a truck is an important calculation. It can indicate whether a truck is legally loaded, and can show whether any dangerous overloading might occur.

Weight distribution calculations are not difficult to perform; an understanding of the theory involved will make it easier to perform the calculations and correctly analyze each application.

Theory

The theory of weight distribution can be illustrated as follows:

Two men are painting a house. To get all of the material to the job in one trip, they put the paint and brushes in a box, set it on a ladder, and each pickup an end.

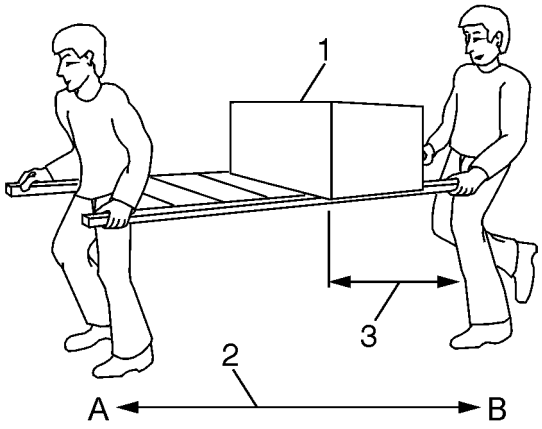

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Fig. 4 Weight Distribution Theory

1 Load
2 Total length
3 Distance from center of load to “B”

The ladder is 10 feet long. The box of supplies weighs 50 lb. The center of the box is located 3 feet from the man at position B. Intuitively, we know that man “B” is carrying more of the load because he is closer to it than man “A.” The amount of weight being carried by man “A” can be determined using the following formula:

$$\text{Weight at man "A"} = \frac{\text{Total weight x Distance from weight to man "B"}}{\text{Distance from man "A" to man "B"}}$$

$$\text{Weight at man "A"} = \frac{\text{50 lb x 3 feet}}{\text{10 feet}}$$

Weight at man “A” = 15 lb.

The weight carried by man “B” is obtained by subtracting the weight at man “A” from the total weight.

Weight at man “B” = Total weight – weight at man “A”

Weight at man “B” = 50 lb – 15 lb

Weight at man “B” = 35 lb

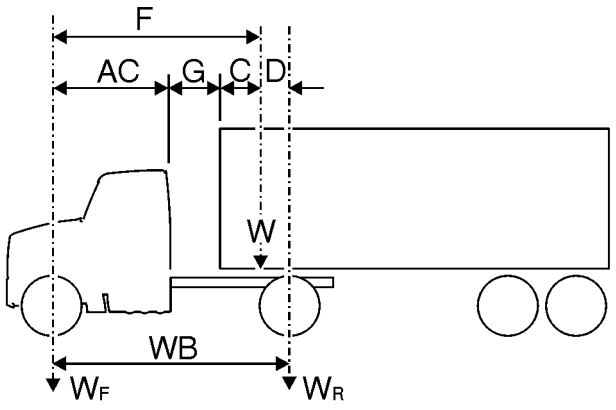
The percentage of weight transferred to each man can also be calculated.

% of weight at man “A” = 3/10 x 100% = 30%

The percentage of weight transferred to man “B” is found by subtracting the % weight at man “A” from 100%: 100% – 30% = 70%.

$$\%\ \text{of Weight at man "A"} = \frac{\text{Distance from weight to man "B"}}{\text{Distance from man "A" to man "B"}} \times 100$$

Weight Distribution Formulas



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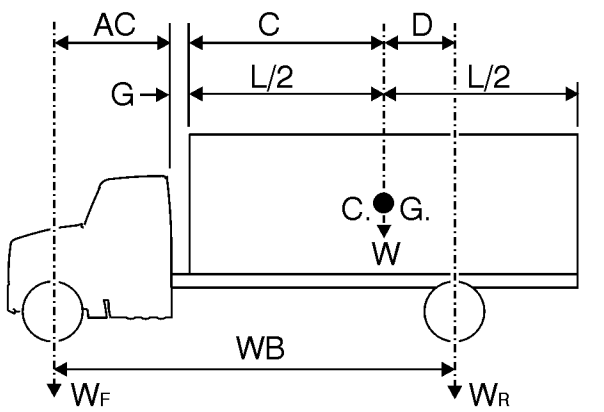

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AC Front axle to back-of-cab
G Gap between cab and body or trailer
CG Center of gravity of body and payload
C Front of body to CG, or front of trailer to king pin
D Distance CG or fifth wheel is ahead of rear axle
F Distance CG or fifth wheel is behind front axle
L Body length
WB Wheelbase
W Weight of body plus payload, or king pin load
W_F Portion of W transferred to front axle
W_R Portion of W transferred to rear axle

Basic Formulas			
a	$W \times D = W_F \times WB$	or	
b	$WB = F + D = AC + G + C + D$		
c	$W = W_F + W_R$		
d	Percent of W transferred to front axle =	$\frac{D}{WB}$	x 100
e	Percent of W transferred to rear axle =	$\frac{F}{WB}$	x 100

Sample Calculations					
$W_F =$	$\frac{W \times D}{WB}$	or	$W_R =$	$\frac{W \times F}{WB}$	
$W_R =$	$W - W_F$		W_F	$W - W_R$	

Weight Distribution Formulas (Text Descriptions)

$$\text{Weight transferred to Front Axle} = \frac{(\text{Total Weight}) \times (\text{Distance CG is ahead of Rear Axle})}{\text{Wheelbase})}$$

$$\text{Distance CG must be placed ahead of Rear Axle} = \frac{(\text{Weight transferred to Front Axle}) \times (\text{Wheelbase})}{(\text{Total Weight})}$$

$$\text{Wheelbase} = \frac{(\text{Total Weight}) \times (\text{Distance CG is ahead of Rear Axle})}{(\text{Weight to be transferred to Front Axle})}$$

$$\text{Total Weight} = \frac{(\text{Weight to be transferred to Front Axle}) \times (\text{Wheelbase})}{(\text{Distance CG is ahead of Rear Axle})}$$

$$\text{Weight transferred to Rear Axle} = \frac{(\text{Total Weight}) \times (\text{Distance CG is behind Front Axle})}{(\text{Wheelbase})}$$

$$\text{Distance CG must be placed behind Front Axle} = \frac{(\text{Weight transferred to Rear Axle}) \times (\text{Wheelbase})}{(\text{Total Weight})}$$

$$\text{Wheelbase} = \frac{(\text{Total Weight}) \times (\text{Distance CG is behind Rear Axle})}{(\text{Wheelbase})}$$

$$\text{Total Weight} = \frac{(\text{Weight to be transferred to Rear Axle}) \times (\text{Wheelbase})}{(\text{Distance CG is behind Front Axle})}$$

Note: Total Weight must always equal Weight transferred to Rear Axle plus Weight transferred to Front Axle.

Formulas for Lift Axles

Pusher Axles

Pusher Up		
WFA =	$\frac{DIS}{WB}$	x Pusher Tare Weight
WRA =	Tare Weight - WFA	
Pusher Down		
WFA =	$\frac{-(DIS)}{WB}$	x Pusher Pressure
WRA =	$\frac{-(WB - DIS)}{WB}$	x Pusher Pressure

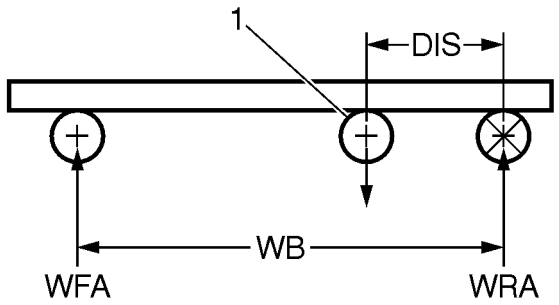

Fig. 5 Pusher Axle

Notes

Tag Axles

Tag Up		
WRA =	$\frac{WB + DIS)}{WB}$	x Tare Weight
WFA =	Tare Weight - WFA (will be Negative Number)	

Tag Down		
WRA =	$\frac{-(WB + DIS)}{WB}$	x Tag Pressure (Negative Pressure)
WFA =	$\frac{DIS}{WB}$	x Tag Pressure (Positive Number)

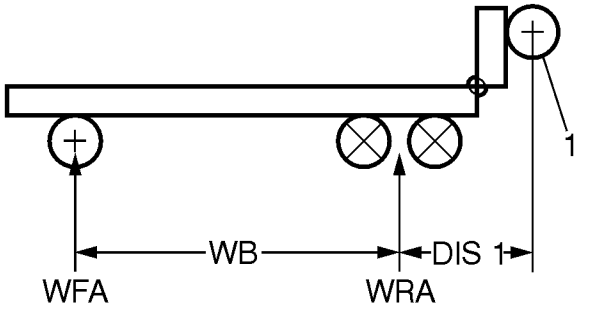

Fig. 6 Tag Axle

Notes

Boost-A-Load Axles

Boost Up		
WRA =	$\frac{(WB + DIS\#1)}{WB}$	x Tare Weight
WFA =	Tare Weight - WFA (will be Negative Number)	
Boost Down		
WRA =	$\frac{-(WB + DIS\#2)}{WB}$	x Boost Axle Pressure (Negative Number)
WFA =	$\frac{(DIS\#2)}{WB}$	x Boost Axle Pressure (Positive Number

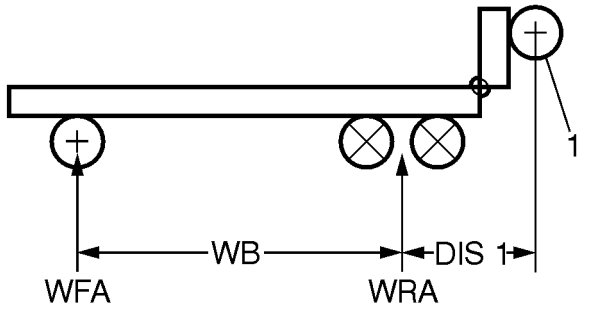

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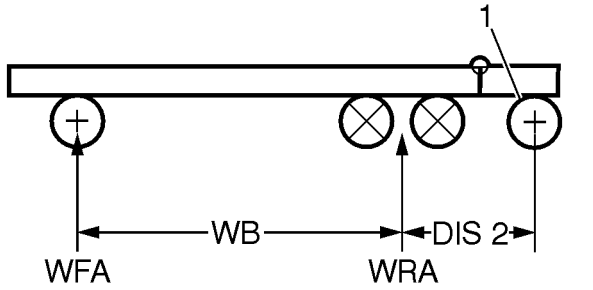
Fig. 7 Boost Axle



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Customer Information Worksheet

CUSTOMER	BRANCH OR DEALER		DATE
ADDRESS	QUANTITY	MODEL	ORDER NO.

STRAIGHT TRUCKS

Body Make:_____ Model:_____ Length:_____

Body Type: […] Dump …… […] Flat …… […] Van …… […] Tank …… […] Mixer …… […] Block …… […] Specialty_____

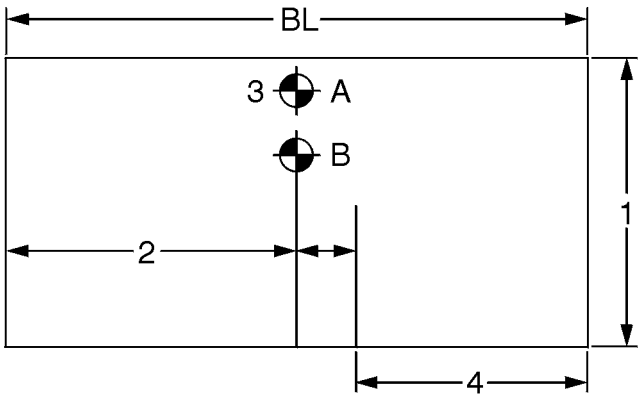
[…] Rear Refuse Loader …… […] Front Refuse Loader …… […] Side Refuse Loader …… […] Rolloff

Body Weight: _____lb Center of Gravity Location:_____

Additional Equipment: […] Snow Plow …… […] Tailgate …… […] Boom …… […] Frame-mounted Water Tank

[…] PTO …… […] Tag/Pusher Axle …… […] Wet (Hydraulic) Kit

Equipment Weight: _____lb Center of Gravity Location*:_____



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Body Height: 1_____
*Center of Gravity

Body (B 2_____

Payload (A) 3_____

Overhang Required 4_____

ALL TRUCKS

Commodity Hauled: _____ Payload Weight :_____lb

Operating Conditions:
[…] Increasing Loads …… […] Decreasing Loads
[…] One Way …… […] Both Ways …… […] Fully Loaded_____
Average Trip: _____miles Number of Round-trips Per Day: _____
Average Number of Stops: _____ Average Idling Time: _____

Road Surface/ Grades:
[…] Concrete …… […] Asphalt …… […] Packed Dirt …… […] Gravel
[…] Sand …… […] Mud …… […] Loose Dirt
Maximum Starting Grade _____% Maximum Highway Grade _____%

Speed: Cruise Speed Desired on Highway _____mph Top Speed (Unloaded) _____mph

Operating Area: […] Interstate …… […] Primary Roads …… […] Other Roads
States Operating _____
Length Restrictions _____

Climate: Outside High Temp _____ Low_____ Altitude _____ft

Weight Limits: Front _____lb Rear _____lb Tag/Pusher _____lb
Total _____lb GVW/GCW Requested _____lb

Other Restrictions / Conditions

_____

_____

_____

Type of Service: […] Tractor Semi/Trailer …… […] Tractor Double Trailers …… […] Tractor Triple Trailers

[…] Straight Truck/PUP Trailer

Trailer: Make _____ Model _____ Length _____ft

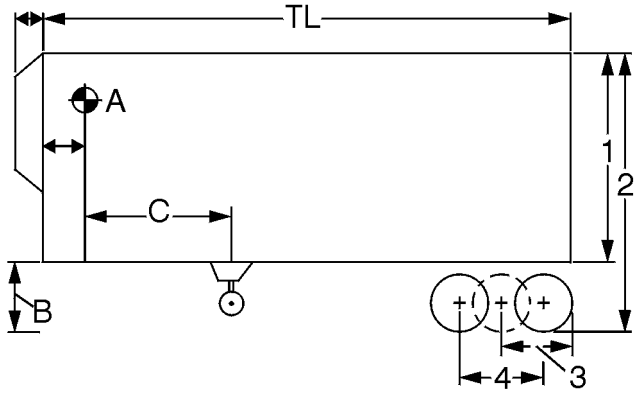
[…] Dry Van …… […] Refrigerated …… […] Flatbed …… […] Tank …… […] Dump

Capacity_____[…] Gallons …… […] Cu. Yards

Height _____in. Width _____in. Weight _____lb

King pin Location _____in. (front) Landing Gear Location _____in. (front)

Rear Trailer Axles _____in. (rear)



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Trailer Height	1_____
Overall Height	2_____
Trailer Axle Setting	3_____
Trailer Axle Spacing	4_____

Notes

Conversion Factors

Convert From:		To:		Multiply By:
Area				
Square Inch	in^2	Square millimeter	mm^2	645.16
Square foot	ft^2	Square meter	m^2	0.0929
Square millimeter	mm^2	Square Inch	in^2	0.0016
Square meter	m^2	Square foot	ft^2	10.7643
Flow (Volume Per Unit Time)				
Gallon (U.S.) per minute	gpm	Cubic meter per second	m^3/s	0.00006
Gallon (U.S.) per minute	gpm	Liter per minute	L/min	3.7854
Cubic meter per second	m^3/s	Gallon (U.S.) per minute	gpm	15850.3
Liter per minute	L/min	Gallon (U.S.) per minute	gpm	0.26417
Length				
Inch	in.	Millimeter	mm	25.4
Foot	ft	Meter	m	0.3048
Yard	yd	Meter	m	0.09144
Millimeter	mm	Inch	in	0.0394
Meter	m	Foot	ft	3.2808
Meter	m	Yard	yd	1.0936
Mass				
Pound	lb	Kilogram	kg	0.4536
Ton (U.S.)		Ton (metric, 2,204.6 lbs)		0.9072
Kilogram	kg	Pound	lb	2.2046
Ton (metric)		Ton (U.S.)		1.1023
Power				
Horsepower (550 ft-lb f/sec)	hp	Kilowatt	kW	0.7457
Kilowatt	kW	Horsepower (550 ft-lb f/sec)	hp	1.3910
Pressure				
Pound-Force per square inch	psi	Kilopascal	kPa	6.8948
Kilopascal	kPa	Pound-Force per square inch	psi	0.145
Temperature				
Degree Fahrenheit	°F	Degree Celsius	°C	5/9 (°F - 32)
Degree Celsius	°C	Degree Fahrenheit	°F	(9/5 °C) + 32
Velocity				
Miles per hour (U.S.)	mph	Kilometer per hour	km/h	1.6093
Kilometer per hour	km/h	Miles per hour (U.S.)	mph	0.6214

Convert From:		To:		Multiply By:
Volume				
Cubic inch	in^3	Cubic millimeter	mm^3	16387.06
Cubic inch	in^3	Cubic centimeter	cm^3	16.3871
Cubic foot	ft^3	Cubic meter	m^3	0.0283
Cubic yard	yd^3	Cubic meter	m^3	0.7646
Quart (U.S. liquid)	qt	Liter	L	0.9464
Gallon (U.S. liquid)	gal	Liter	L	3.7854
Liter	L	Quart (U.S. liquid)	qt	1.0566
Liter	L	Gallon (U.S. liquid)	gal	0.2642
Gallon (U.S. liquid)	gal	Cubic meter	m^3	0.0038
Cubic millimeter	mm^3	Cubic inch	in^3	0.00006
Cubic centimeter	cm^3	Cubic inch	in^3	0.061
Cubic meter	m^3	Cubic foot	ft^3	35.3357
Cubic meter	m^3	Cubic yard	yd^3	1.3079
Cubic meter	m^3	Gallon (U.S. liquid)	gal	263.1579

Notes

Chassis Diagrams

Chassis Diagrams, VNL

VNL 300, Truck, 4x2

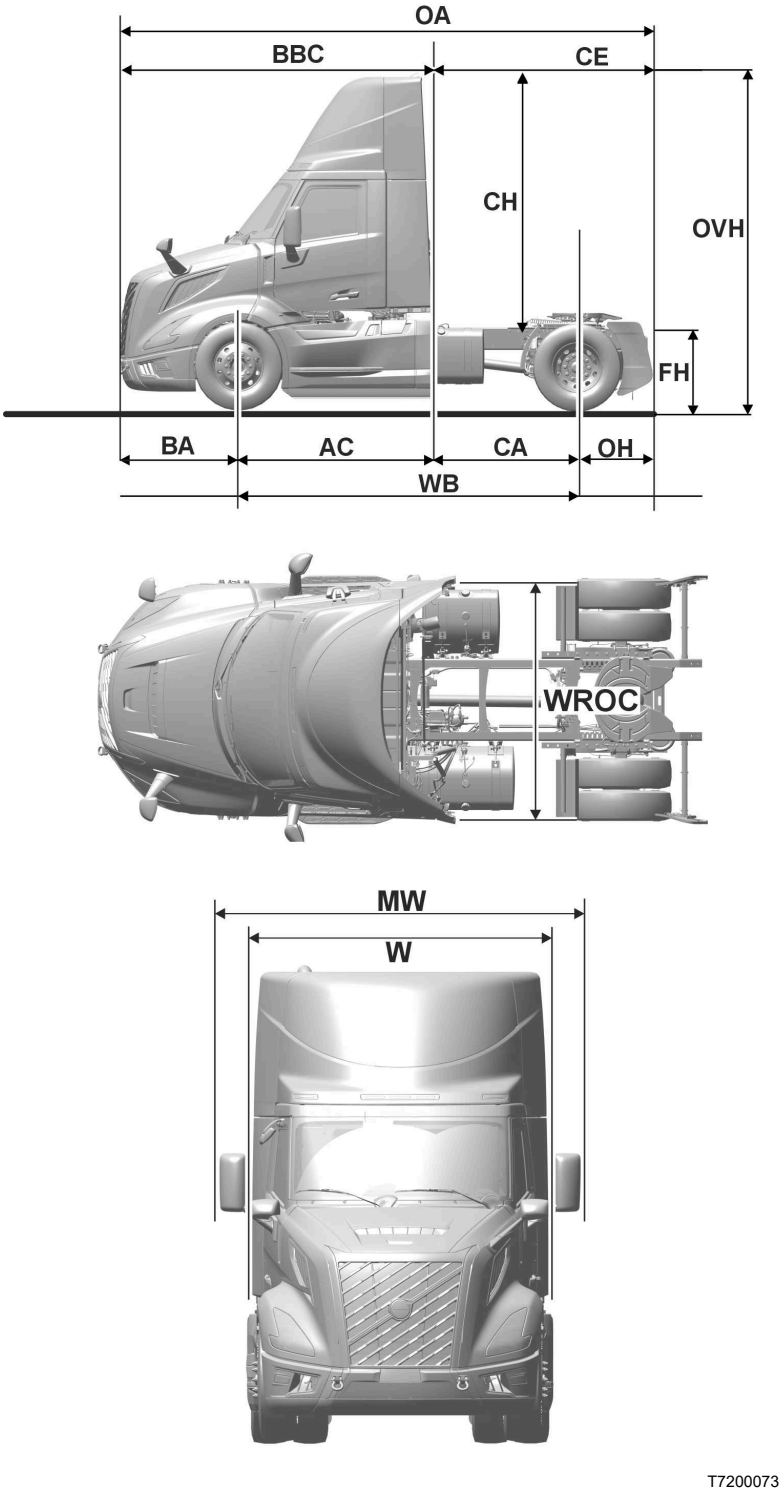


Fig. 8 VNL 300, CABH 155, CABL 150, 4x2

See **Fig. 8**		
Dimensions		
Description	**Drawing Reference**	**Dimension**
Bumper to Front Axle	BA	1427 mm
Wheelbase	WB	4335 mm
Overhang	OH	1460 mm
Overall Length	OA	7347 mm
Bumper to Back of Cab	BBC	2960 mm
Cab to Rear Axle	CA	2115 mm
Cab to Rear of Axle	AC	1785 mm
Cab to End of Frame	CE	2690 mm
Unladen Frame Height	FH	1026 mm
Cab Height	CH	3007 mm
Overall Height	OVH	4035 mm
Width of Rear of Cab	WROC	2576 mm
Mirror Width	MW	3034 mm
Cab Width	W	2065 mm
Bogie Spread	BS	1370 mm

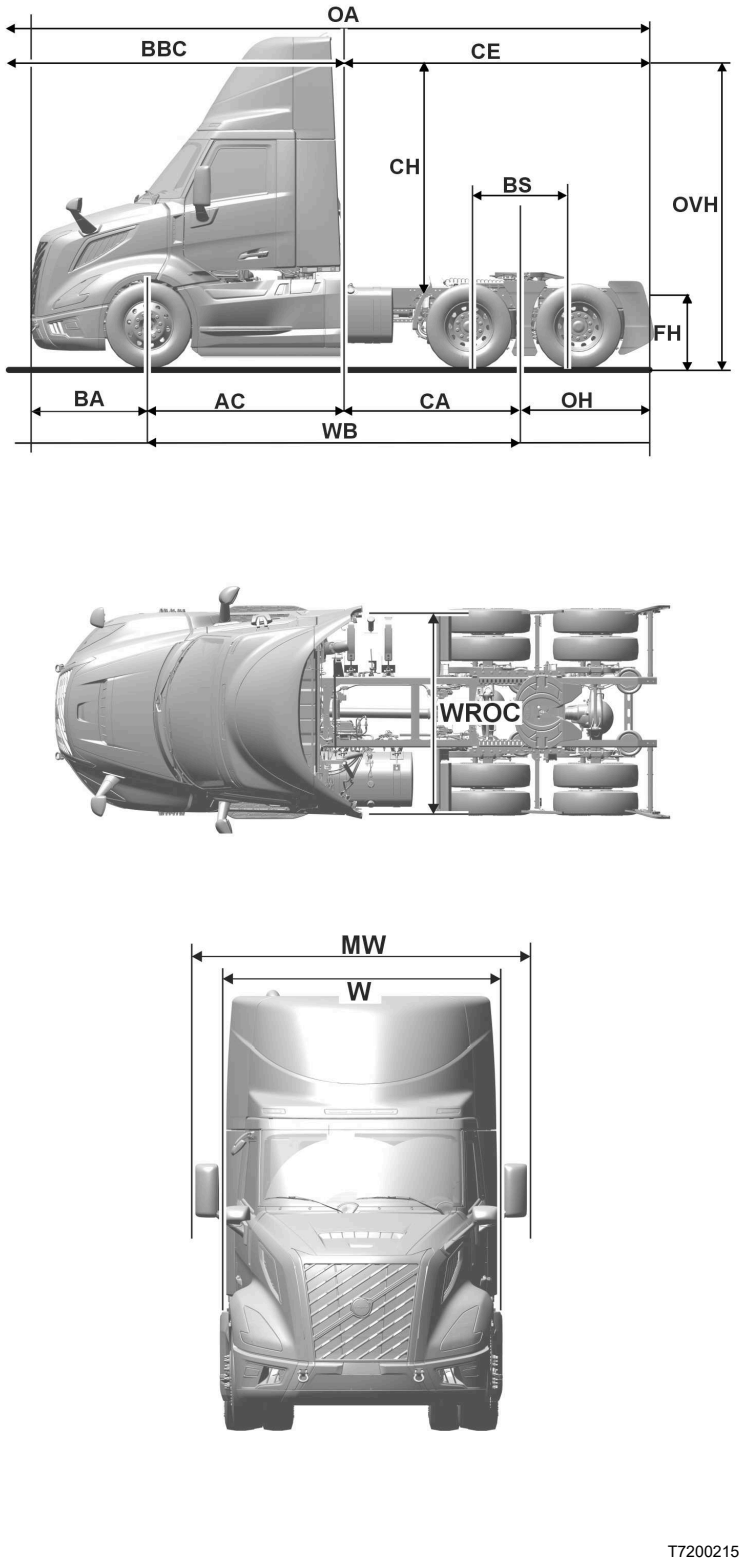
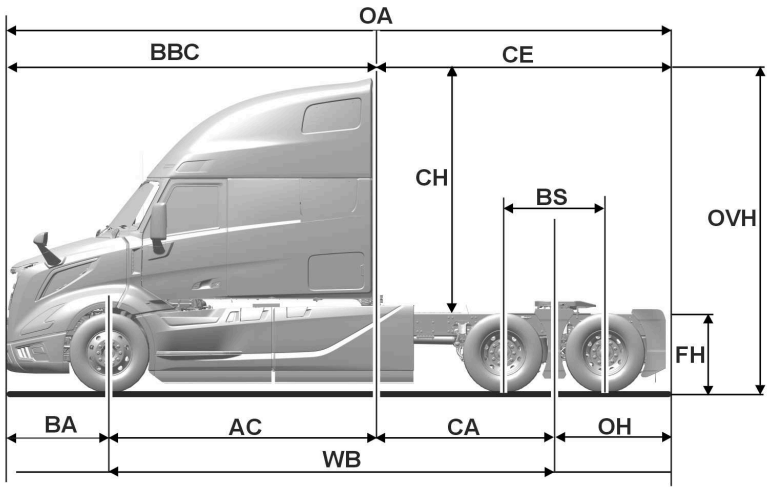


Fig. 9 VNL 300, CABH 155, CABL 150, 6x4

See **Fig. 9**		
Dimensions		
Description	**Drawing Reference**	**Dimension**
Bumper to Front Axle	BA	1427 mm
Wheelbase	WB	4335 mm
Overhang	OH	1585 mm
Overall Length	OA	7347 mm
Bumper to Back of Cab	BBC	3212 mm
Cab to Rear Axle	CA	2650 mm
Cab to Rear of Axle	AC	1785 mm
Cab to End of Frame	CE	4135 mm
Unladen Frame Height	FH	738 mm
Cab Height	CH	3007 mm
Overall Height	OVH	3745 mm
Width of Rear of Cab	WROC	2576 mm
Mirror Width	MW	3034 mm
Cab Width	W	2065 mm
Bogie Spread	BS	1370 mm



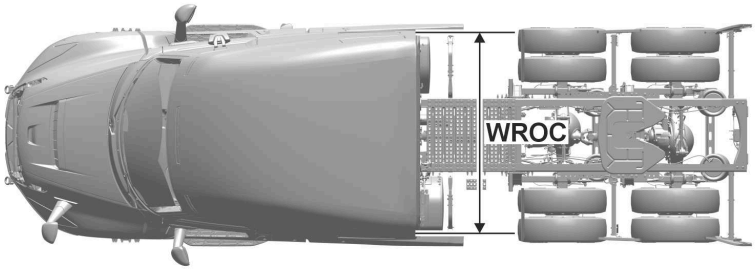


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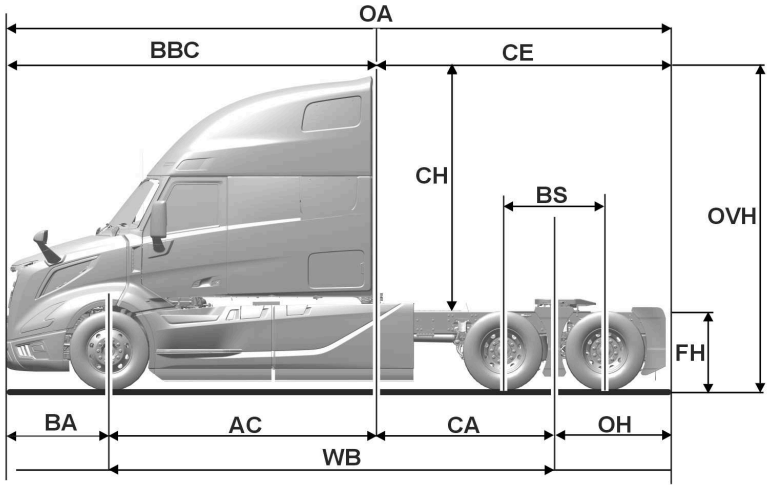
Fig. 10 VNL 440, CABH 200, CABL 230, 6x2

See **Fig. 10**		
Dimensions		
Description	**Drawing Reference**	**Dimension**
Bumper to Front Axle	BA	1408 mm
Wheelbase	WB	4872 mm
Overhang	OH	1473 mm
Overall Length	OA	7806 mm
Bumper to Back of Cab	BBC	4018 mm
Cab to Rear Axle	CA	2262 mm
Cab to Rear of Axle	AC	2610 mm
Cab to End of Frame	CE	3698 mm
Unladen Frame Height	FH	1089 mm
Cab Height	CH	2494 mm
Overall Height	OVH	3583 mm
Width of Rear of Cab	WROC	2580 mm
Mirror Width	MW	3034 mm
Cab Width	W	2065 mm
Bogie Spread	BS	1270 mm



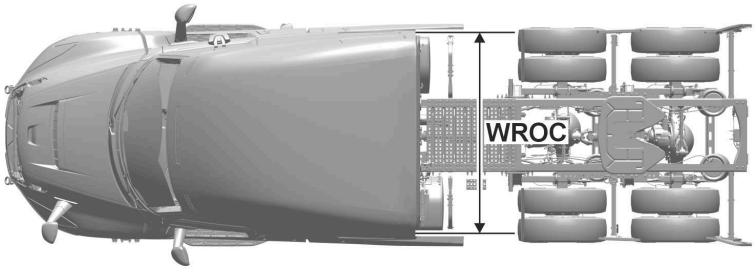


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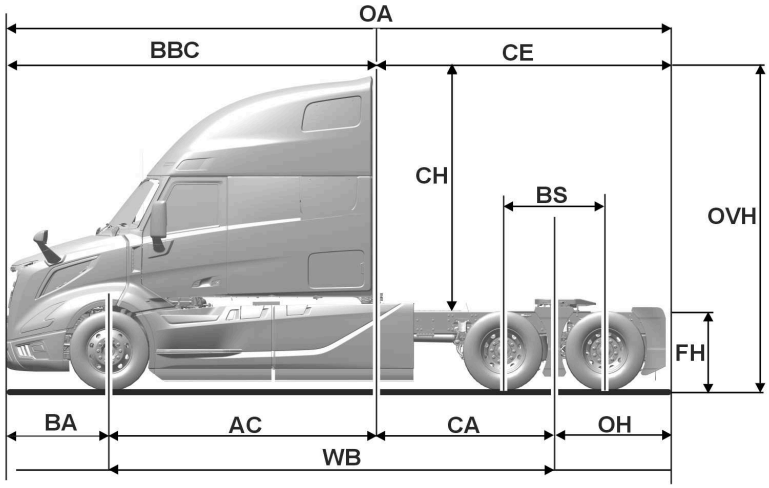
Fig. 11 VNL 440, CABH 200, CABL 230, 6x4

See **Fig. 11**		
Dimensions		
Description	**Drawing Reference**	**Dimension**
Bumper to Front Axle	BA	1427 mm
Wheelbase	WB	4985 mm
Overhang	OH	1460 mm
Overall Length	OA	7997 mm
Bumper to Back of Cab	BBC	4037 mm
Cab to Rear Axle	CA	2375 mm
Cab to Rear of Axle	AC	2610 mm
Cab to End of Frame	CE	3960 mm
Unladen Frame Height	FH	738 mm
Cab Height	CH	3007 mm
Overall Height	OVH	4032 mm
Width of Rear of Cab	WROC	2580 mm
Mirror Width	MW	3034 mm
Cab Width	W	2065 mm
Bogie Spread	BS	1370 mm



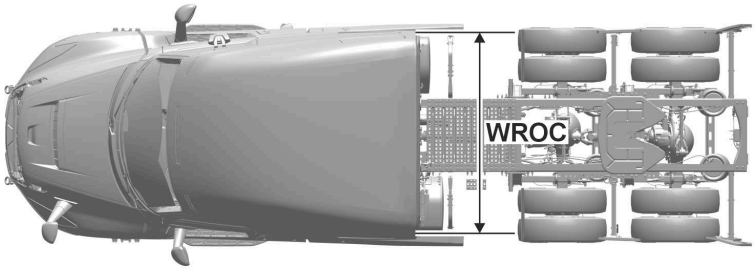


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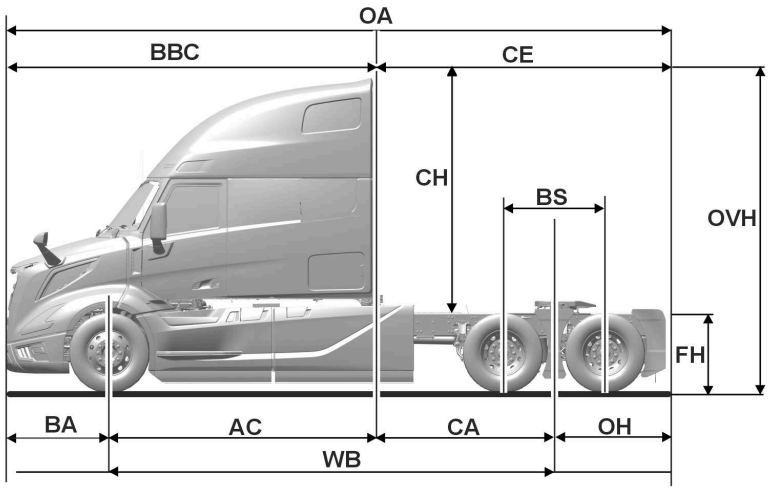
Fig. 12 VNL 640, CABH 200, CABL 290, 6x2

See **Fig. 12**		
Dimensions		
Description	**Drawing Reference**	**Dimension**
Bumper to Front Axle	BA	1408 mm
Wheelbase	WB	5272 mm
Overhang	OH	1473 mm
Overall Length	OA	8206 mm
Bumper to Back of Cab	BBC	4515 mm
Cab to Rear Axle	CA	2165 mm
Cab to Rear of Axle	AC	3107 mm
Cab to End of Frame	CE	3691 mm
Unladen Frame Height	FH	1089 mm
Cab Height	CH	2494 mm
Overall Height	OVH	3583 mm
Width of Rear of Cab	WROC	2576 mm
Mirror Width	MW	3034 mm
Cab Width	W	2065 mm
Bogie Spread	BS	1270 mm



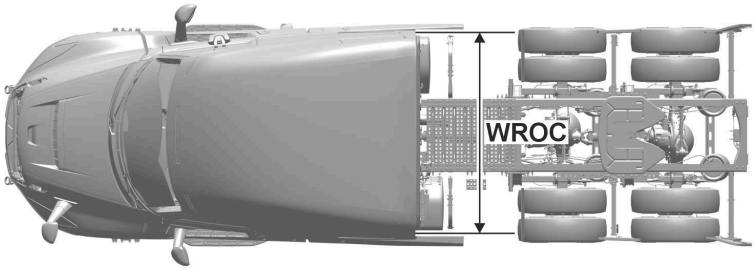


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Fig. 13 VNL 440, CABH 200, CABL 290, 6x4

See **Fig. 13**		
Dimensions		
Description	**Drawing Reference**	**Dimension**
Bumper to Front Axle	BA	1427 mm
Wheelbase	WB	5335 mm
Overhang	OH	1460 mm
Overall Length	OA	8347 mm
Bumper to Back of Cab	BBC	4534 mm
Cab to Rear Axle	CA	2913 mm
Cab to Rear of Axle	AC	2610 mm
Cab to End of Frame	CE	3813 mm
Unladen Frame Height	FH	1026 mm
Cab Height	CH	3023 mm
Overall Height	OVH	4049 mm
Width of Rear of Cab	WROC	2580 mm
Mirror Width	MW	3034 mm
Cab Width	W	2063 mm
Bogie Spread	BS	1370 mm

Fuel Tank Position

The Fuel Tank Position indicates the distance the fuel tanks are located from the front axle.

The fuel tank configurations are offered in driver, passenger or dual tank options. Dual fuel tanks may not always be symmetrical, depending on chassis configurations. However, different-sized fuel tanks on the driver side and passenger side may be chosen to make the chassis look symmetrical.

In addition, “D-shaped” tanks are available to shorten wheelbases with the same capacity fuel tank. The D-shaped tanks provide approximately a 10% shorter fuel tank, which reduces the overall fuel tank length by approximately three to seven inches.

Fuel tank lengths (Left-Hand Side and Right-Hand Side)

Capacity		Fuel Tank Length	
		D-shaped	
		26" dia.	
Gal.	Liters	Inches	mm
50	190	21.50	546.35
75	285	31.67	804.50
100	380	41.83	1062.70
125	475	52.00	1320.80
150	570	62.16	1579

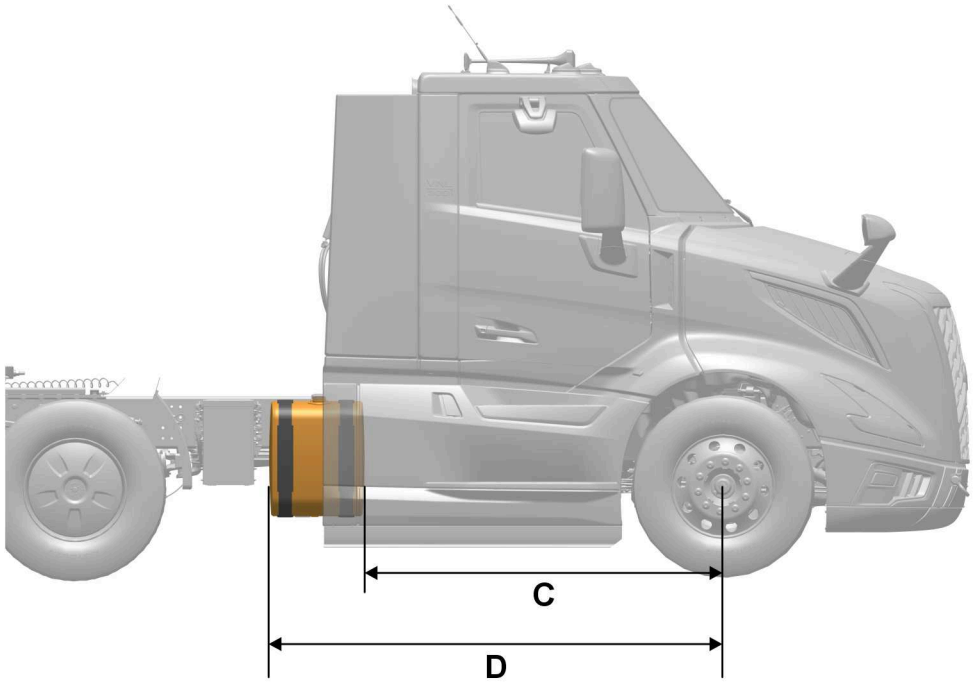
Fuel Tank Position (Right-Hand Side)

Volvo D13 Engine				
Model	Cab	Capacity gals (L)	Distance to Front Axle, in. (mm)	
			C	D
D-shaped Fuel Tanks				
VNL	150	50 (190)	80.98 (2057)	102.44 (2602)
		75 (285)	76.77 (1950)	108.42 (2754)
		100 (380)	76.77 (1950)	118.58 (3012)
		125 (475)	76.77 (1950)	128.74 (3270)
		150 (570)	76.77 (1950)	138.89 (3528)

Volvo D13 Engine				
Model	Cab	Capacity gals (L)	Distance to Front Axle, in. (mm)	
			C	D
D-shaped Fuel Tanks				
VNL	230	50 (190)	NA	NA
		75 (285)	76.77 (1950)	108.42 (2754)
		100 (380)	76.77 (1950)	118.58 (3012)
		125 (475)	76.77 (1950)	128.74 (3270)
		150 (570)	76.77 (1950)	138.89 (3528)

Volvo D13 Engine				
Model	Cab	Capacity gals (L)	Distance to Front Axle, in. (mm)	
			C	D
D-shaped Fuel Tanks				
VNL	290	50 (190)	NA	NA
		75 (285)	76.77 (1950)	108.42 (2754)
		100 (380)	76.77 (1950)	118.58 (3012)
		125 (475)	76.77 (1950)	128.74 (3270)
		150 (570)	76.77 (1950)	138.89 (3528)

Volvo D13 Engine				
Model	Cab	Capacity gals (L)	Distance to Front Axle, in. (mm)	
			C	D
D-shaped Fuel Tanks				
VNL	320	50 (190)	NA	NA
		75 (285)	76.77 (1950)	108.42 (2754)
		100 (380)	76.77 (1950)	118.58 (3012)
		125 (475)	76.77 (1950)	128.74 (3270)
		150 (570)	76.77 (1950)	138.89 (3528)



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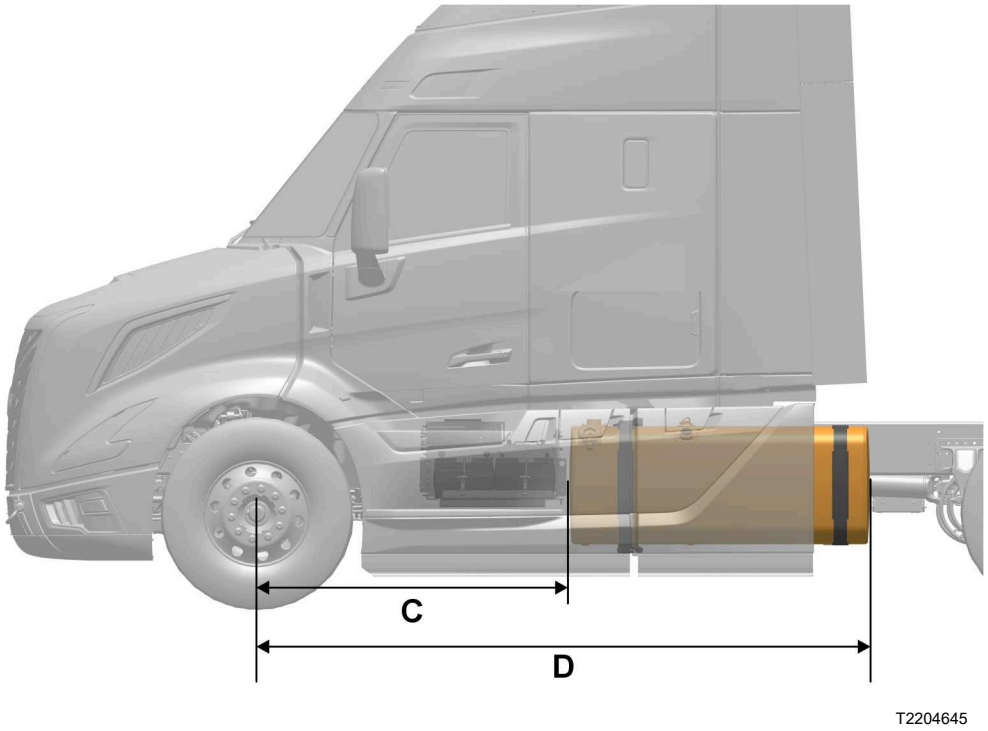
Note: Illustrations may differ slightly from the actual vehicle, based on variants, cab length and height, the position of the fuel tank changes.

Fuel Tank Position (Left-Hand Side)

Volvo D13 Engine				
With 4 or 6 Battery Box				
Model	Cab	Capacity gals (L)	Distance to Front Axle, in. (mm)	
			C	D
D-shaped Fuel Tanks				
VNL	150	50 (190)	NA	NA
		75 (285)	68.74 (1746)	114.48 (2908)
		100 (380)	68.74 (1746)	124.68 (3167)
		125 (475)	68.58 (1742)	134.84 (3425)
		150 (570)	68.74 (1746)	145 (3683)



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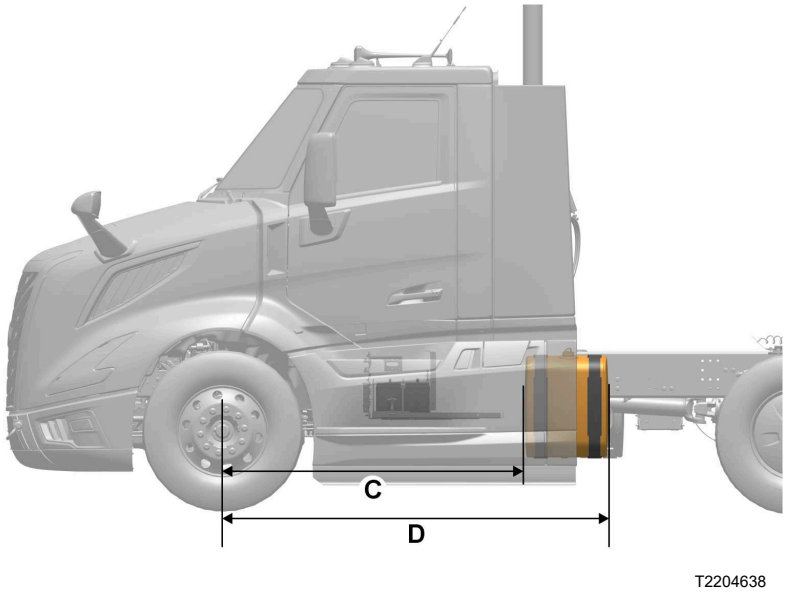
Fuel tank position with 4 to 6 batteries.

Volvo D13 Engine				
With 2 Battery Box				
Model	Cab	Capacity gals (L)	Distance to Front Axle, in. (mm)	
			C	D
D-shaped Fuel Tanks				
VNL	150	50 (190)	76.96 (1955)	98.46 (2501)
		75 (285)	73.03 (1855)	114.84 (2917)
		100 (380)	73.03 (1855)	114.84 (2917)
		125 (475)	73.03 (1855)	125 (3175)
		150 (570)	73.03 (1855)	135.15 (3433)

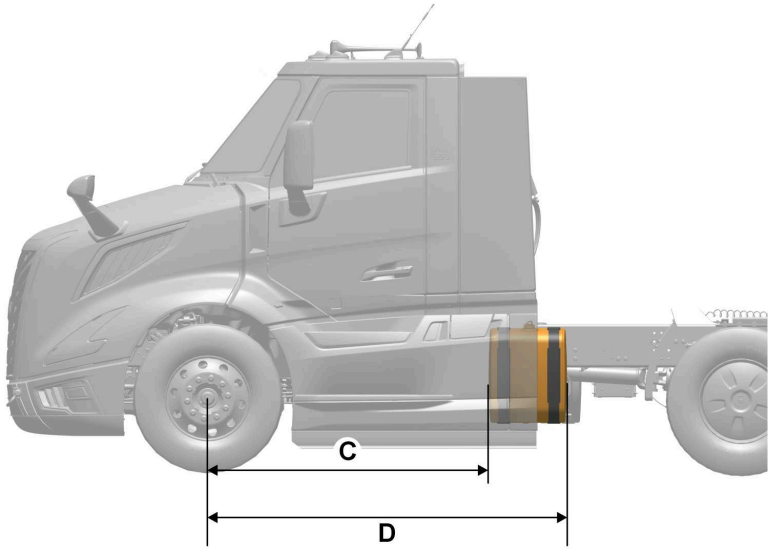


Fuel tank position with 2 batteries

Fuel tank position with 2 batteries.

Volvo D13 Engine				
Model	Cab	Capacity gals (L)	Distance to Front Axle, in. (mm)	
			C	D
D-shaped Fuel Tanks				
VNL	290	50 (190)	NA	NA
		75 (285)	68.74 (1746)	114.48 (2908)
		100 (380)	68.74 (1746)	124.68 (3167)
		125 (475)	68.58 (1742)	134.84 (3425)
		150 (570)	68.74 (1746)	145 (3683)

Volvo D13 Engine				
Model	Cab	Capacity gals (L)	Distance to Front Axle, in. (mm)	
			C	D
D-shaped Fuel Tanks				
VNL	320	50 (190)	NA	NA
		75 (285)	68.74 (1746)	114.48 (2908)
		100 (380)	68.74 (1746)	124.68 (3167)
		125 (475)	68.58 (1742)	134.84 (3425)
		150 (570)	68.74 (1746)	145 (3683)



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Note: Illustrations may differ slightly from the actual vehicle, based on variants, cab length and height, the position of the fuel tank changes.

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