



## Introduction

This information provides details for chassis specifications for Volvo vehicles.

**Note:** We have attempted to cover as much information as possible. However, this information does not cover all the unique variations that a vehicle may present. Note that illustrations are typical but may not reflect all the variations of assembly.

All data provided is based on information that was current at time of release. However, **this information is subject to change without notice.**

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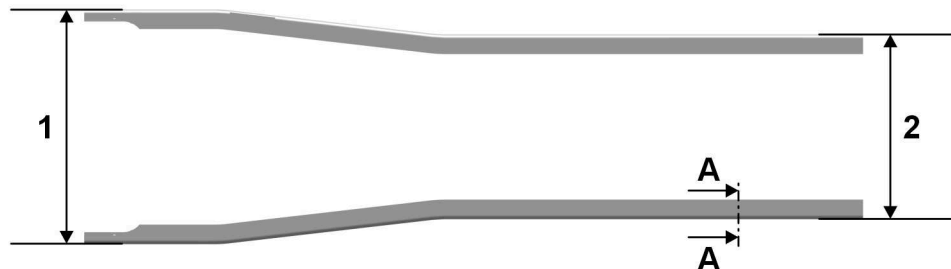
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# Frame Specifications

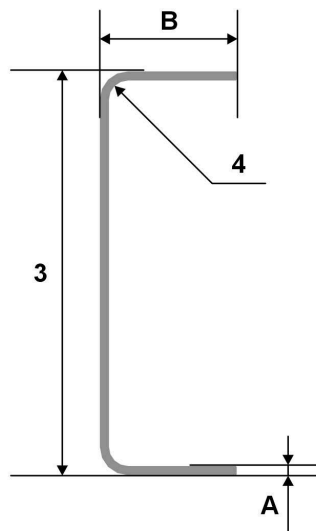
## Frame Rail

### Frame Rail Section Configurations

### Frame Rail Dimensions



T7202730



T7202731

<b>Frame Rail Thickness</b>	A	6 (0.23)		7 (0.28)		8 (0.31)		9.5 (0.37)
<b>Frame Rail Flange</b>	B	90 (3.54)		90 (3.54)		90 (3.54)		90 (3.54)
<b>Overall Frame Width (Front)</b>	1	1078 (42.44)		1080 (42.51)		1082 (42.59)		1085 (42.71)
<b>Overall Frame Width (Back)</b>	2	848 (33.38)		850 (33.46)		852 (33.54)		855 (33.66)
<b>Frame Rail Web</b>	3	266 (10.47)	300 (11.81)	266 (10.47)	300 (11.81)	266 (10.47)	300 (11.81)	300 (11.81)
<b>Frame Rail Radius</b>	4	12.5±1 (0.49±0.03)						

## Round-corner Frame

Frame Section Dimensions <sup>1</sup> mm (in)	Section Modulus	Resisting Bending Moment	Weight
	10 <sup>3</sup> mm <sup>3</sup> (in <sup>3</sup> )	10 <sup>3</sup> Nm (lbs-in)	(lbs/in)
6 x 90 x 266 (0.23 x 3.54 x 10.47)	11.6	1,390	1.1
7 x 90 x 266 (0.27 x 3.54 x 10.47)	13.3	1,600	1.27
8 x 90 x 266 (0.31 x 3.54 x 10.47)	15	1,810	1.44
6 x 90 x 300 (0.23 x 3.54 x 11.81)	13.7	1,640	1.18
7 x 90 x 300 (0.27 x 3.54 x 11.81)	15.7	1,880	1.37
7 x 90 x 300 (*) (0.27 x 3.54 x 11.81)	15.7	1727	1.37
8 x 90 x 300 (0.31 x 3.54 x 11.81)	17.7	2,120	1.56
9.5 x 90 x 300 (0.37 x 3.54 x 11.81)	20.6	2,470	1.84

<sup>1</sup> Note: all figures are with rounded corners.

## Frame Rails

Material ..... 827.3 MPa (120,000 psi) yield heat treated steel

(\*) Material ..... 758.4 MPa (110,000 psi) yield heat treated HSLA (High-strength low-alloy) steel

Frame rail end taper (for tractor) ..... 27°

Frame rail straight end cut (for rigid).

## Tightening Torques, Frame Rail Bolts

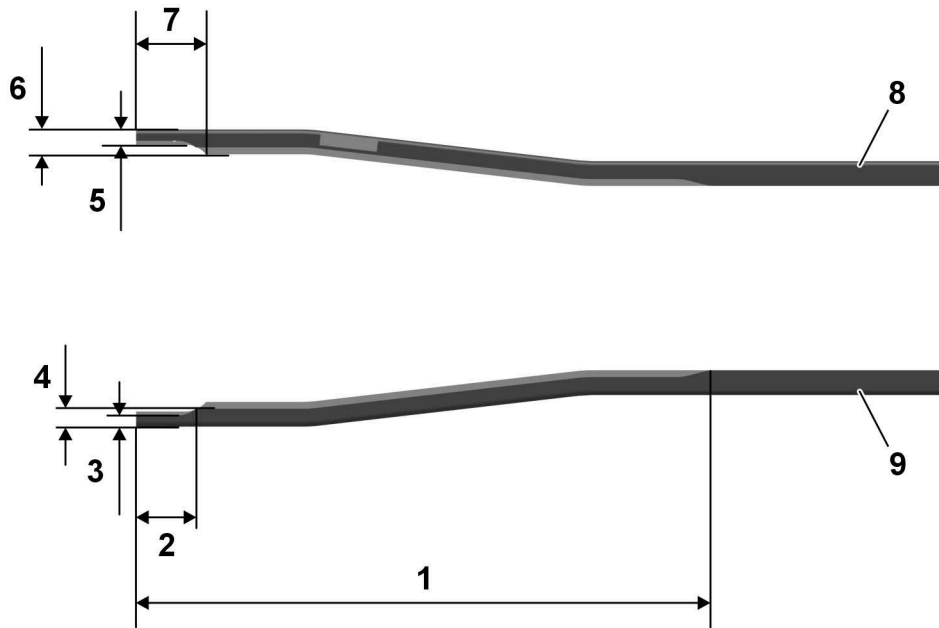
(for property class 10.9 bolts (Grade 8) and property class 10 nuts)

Thread	Level		
	Low in Nm (ft-lbs)	Medium in Nm (ft-lbs)	High in Nm (ft-lbs)
M5	6 ± 1 (4.4 ± 0.73)	7.5 ± 1.2 (5.53 ± 0.88)	9 ± 1.5 (6.63 ± 1.10)
M6	10 ± 1.5 (7.37 ± 1.10)	12 ± 2 (8.85 ± 1.47)	15 ± 2.5 (11.06 ± 1.84)
M7	20 ± 3 (14.75 ± 2.21)	22 ± 3 (16.22 ± 2.21)	24 ± 4 (17.70 ± 2.95)
M8	25 ± 4 (18.43 ± 2.95)	30 ± 5 (22.12 ± 3.68)	35 ± 6 (25.81 ± 4.42)
M10	50 ± 8 (36.87 ± 5.90)	60 ± 10 (44.25 ± 7.37)	70 ± 12 (51.62 ± 8.85)
M12	85 ± 15 (62.69 ± 11.06)	105 ± 20 (77.44 ± 14.75)	125 ± 20 (92.19 ± 14.75)
M14	150 ± 25 (110.63 ± 18.43)	175 ± 30 (129.07 ± 22.12)	200 ± 30 (147.51 ± 22.12)
M16	230 ± 35 (169.63 ± 25.81)	275 ± 45 (202.82 ± 33.19)	320 ± 50 (236.01 ± 36.87)
M18	310 ± 50 (288.64 ± 36.87)	360 ± 55 (265.52 ± 40.56)	410 ± 60 (302.40 ± 44.25)
M20	450 ± 70 (331.90 ± 51.62)	540 ± 90 (398.28 ± 66.38)	630 ± 100 (464.66 ± 73.75)
M22	610 ± 100 (449.91 ± 73.75)	730 ± 120 (538.42 ± 88.50)	850 ± 140 (626.92 ± 103.25)
M24	750 ± 120 (553.17 ± 88.50)	900 ± 140 (663.80 ± 103.25)	1050 ± 160 (774.44 ± 118)

Proper frame bolt thread engagement ..... Max. 13 mm past nut, min. two (2) threads

# Frame Rail Cutouts

90 mm (3.54 in) Flange



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The frame has stepped cut-outs on the flange, the below table shows the dimensions of the cut-outs with reference to the front end of the frame.

8. RHS frame

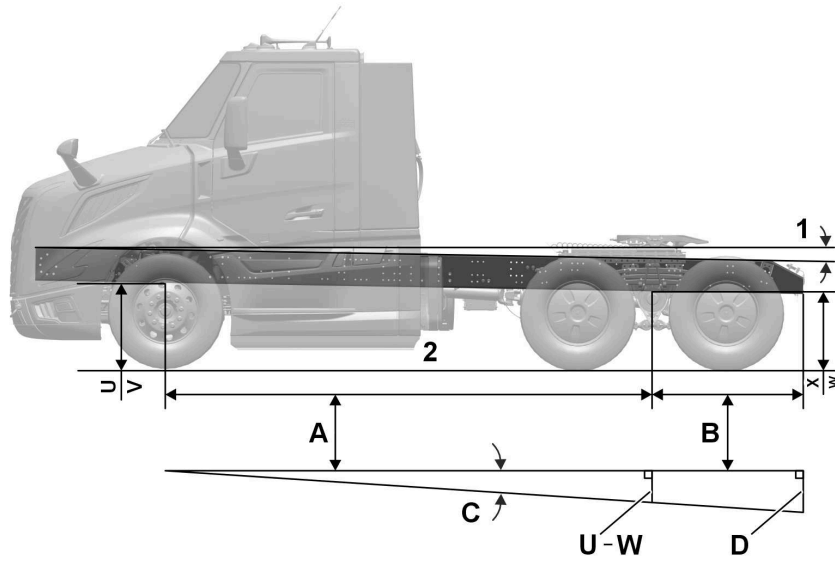
9. LHS frame

SI no.	Frame cut-out location	Description	Dimensions in mm
1	Upper flange	Length of the second cut-out	2085
2	Upper flange	Length of the first cut-out	200
3	Upper flange	Width of the first cut-out	41
4	Upper flange	Width of the second cut-out	49
5	Lower flange	Width of the frame first cut-out	55
6	Lower flange	Width of the frame	90
7	Lower flange	Length of the frame cut-out	248

# Frame Rake and Height Calculation

## Negative Frame Rake

**Note:** This calculation is used when the "U" variable is greater than the "W" variable.



T7205016

Negative Frame Rake

- 1 Negative frame rake angle
- 2 Ground
- A Wheelbase
- B Rear frame overhang
- C Frame rake angle
- D Relative distance of the rear frame edge to ground
- U Light; for variables, see Front Suspension information.
- V Loaded; for variables, see Front Suspension information.
- W Light; for variables, see Rear Suspension information.
- X Loaded; for variables, see Rear Suspension information.

**To Calculate Frame Rake Angle**

$$\text{TAN (Frame Rake Angle) = } \frac{\text{U - W}}{\text{Wheelbase}} \text{ Light Load}$$

**To Calculate Frame Height to Ground At Rear of Frame**

1. Distance "D" = TAN (Frame Rake Angle) x (Wheelbase + Rear Frame Overhang)
2. Frame Height to Ground (To Top of Frame) = (U - "D") + 300 (where 300 is Frame Rail Depth)

**Notes**

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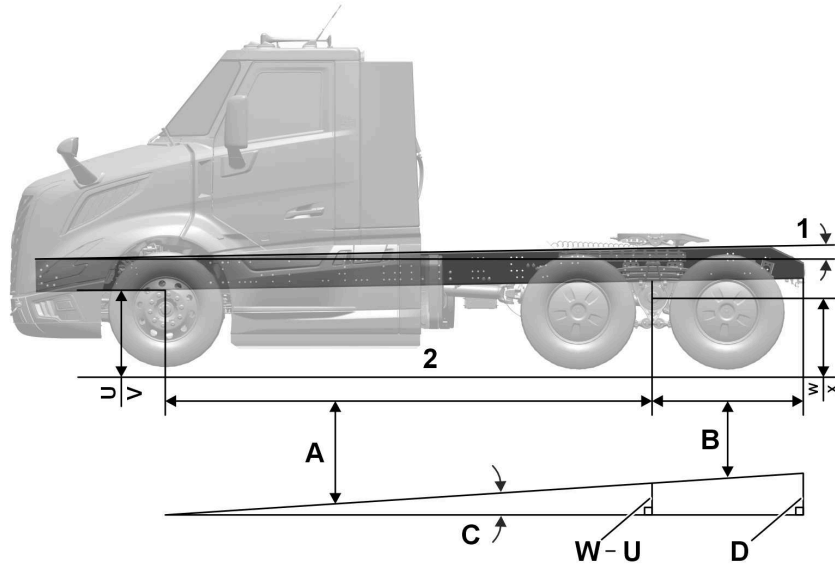
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# Positive Frame Rake

**Note:** This calculation is used when the "W" variable is greater than the "U" variable.



T7205017

Positive Frame Rake

- 1 Positive frame rake angle
- 2 Ground
- A Wheelbase
- B Rear frame overhang
- C Frame rake angle
- D Relative distance of rear frame edge to ground
- U Light for variables, see Front Suspension information.
- V Loaded for variables, see Front Suspension information.
- W Light for variables, see Rear Suspension information.
- X Loaded for variables, see Rear Suspension information.

**To Calculate Frame Rake Angle**

$$\text{TAN (Frame Rake Angle) = } \frac{W - U}{\text{Wheelbase}} \text{ Light Load}$$

**To Calculate Frame Height to Ground At Rear of Frame**

1. Distance "D" = TAN (Frame Rake Angle) x (Wheelbase + Rear Frame Overhang)
2. Frame Height to Ground (To Top of Frame) = (U + "D") + 300 (where 300 is Frame Rail Depth)

**Notes**

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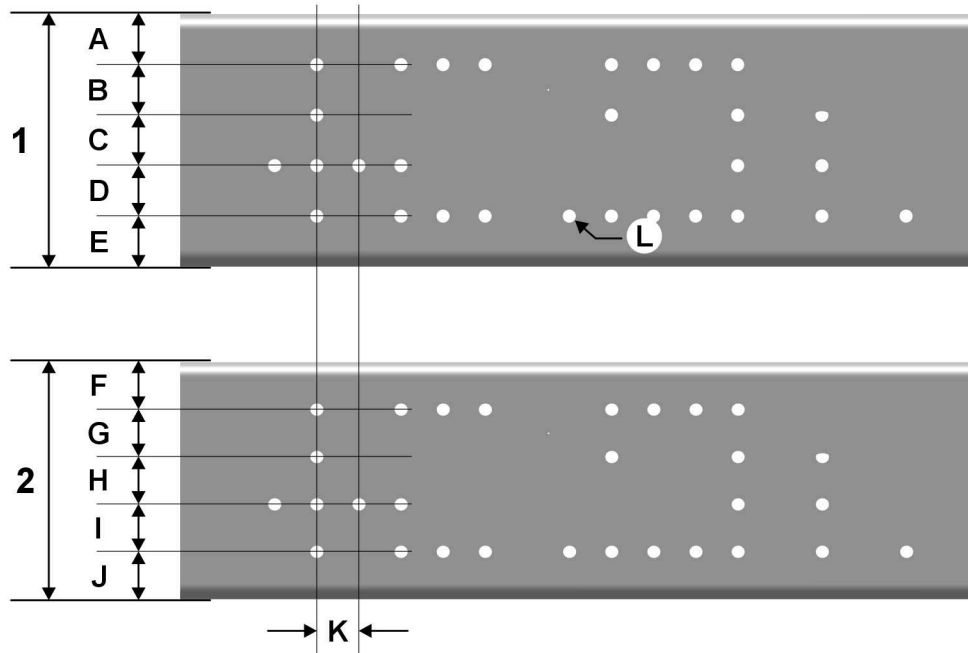
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# Bolt Hole Patterns

Hole spacing rear of the second bend ..... 60 mm (2.26 in) (vertical) x 50 mm (1.97 in) (horizontal)



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**1** 300 mm (2.36 in)

**2** 266 mm (2.36 in)

**A** 60 mm (2.36 in)

**B** 60 mm (2.36 in)

**C** 60 mm (2.36 in)

**D** 60 mm (2.36 in)

**E** 60 mm (2.36 in)

**F** 43 mm (1.69 in)

**G** 60 mm (2.36 in)

**H** 60 mm (2.36 in)

**I** 60 mm (2.36 in)

**J** 43 mm (1.69 in)

**K** 50 mm (1.97 in)

**L** 15.5 mm (0.61 in)

**Note:** The hole size for this spacing must be 15.5 mm (0.61 in) diameter.

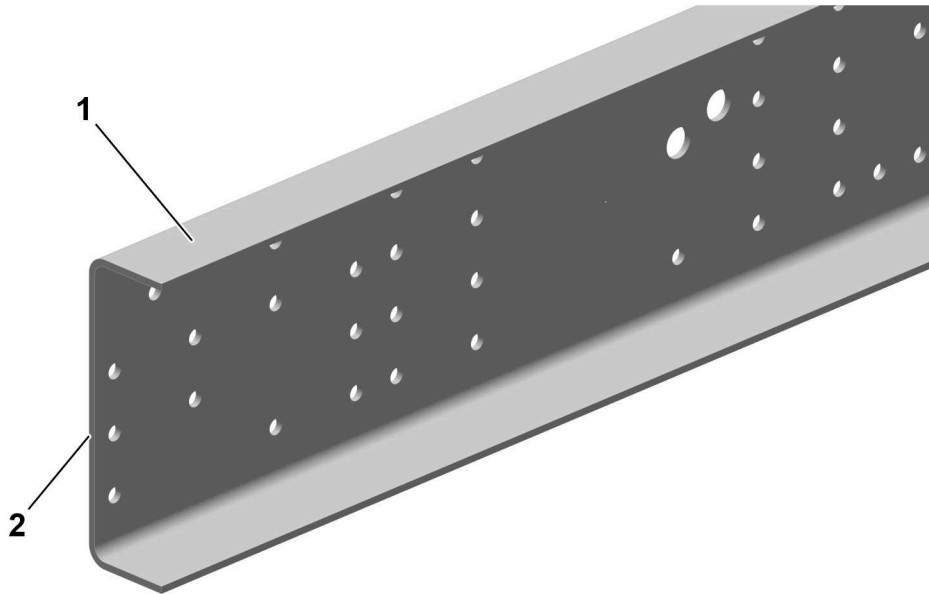
# Frame Design and Function

## Frame

The truck frame is the backbone of the truck. Its primary function is to provide structural support to the truck and its components. Since all truck components are directly or indirectly attached to the frame, the satisfactory operation of the truck depends on the proper frame alignment and integrity.

The frame also functions as a mounting platform for the body and equipment to be used. It transmits the loads imposed by these attachments to the ground through the suspension and axles. The interaction of the body and frame is critical to the performance and life of the truck, and is a major focus of the following information.

The most common type of frame used in trucks today is the steel C-channel (see illustration below). The steel channel frame is popular because components can be attached to it easily, and it exhibits high strength compared to other shapes. It is easy to modify and is compatible with several types of reinforcements. Channels are available in a wide variety of shapes and sizes making it easy to specify an optimum size for a particular application.



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### "C" Channel Frame

- 1 Flange
- 2 Web

## Yield Strength

Section modulus can provide an accurate comparison of relative load-carrying capability based on the shape of a frame section. However, we must also compare the strengths of the various materials that are used in truck frames.

The material chosen for the frame depends on the strength required for the application. There are three types of steel commonly used in truck frames today:

- Low Carbon or Mild Steel: 30,000 – 50,000 psi
- High Strength Low Alloy: 50,000 – 110,000 psi
- Heat Treated: 120,000 psi

The strength of the steel used is expressed as the yield strength. This value, expressed in pounds per square inch (psi), is the maximum stress the material can withstand without experiencing permanent deformation or damage.

For example, if a test bar 1 in x 1 in (1 in<sup>2</sup> vertical frame) is pulled to its limit without permanent set and the load is 22,679 kg (50,000 lb), the material is said to have a yield strength of 344,737 kPa (50,000 psi).

Yield strength, like section modulus, is subject to interpretation. Some truck manufacturers list the tensile or ultimate strength of their frame material. Using the example above, the test bar would be pulled until it broke, which would occur at a load of 31,751 kg (70,000 lb). This would indicate a tensile or ultimate strength of 482,633 kPa (70,000 psi). But this number has little relevance in truck frames, since loading must be kept below the yield strength to keep the frame from being permanently bent.

Another strength number called “Rated Yield Strength” is used by some truck manufacturers, particularly for a steel called “Van 80.” When tested, Van 80 will yield at 551,580 kPa (80,000 psi); however, the manufacturer rates it as “equivalent to 758,423 kPa (110,000 psi)” based on the fatigue strength of the material.

The yield strength of the steel is determined in a testing laboratory, by subjecting samples to tensile tests.

## Resisting Bending Moment

Section modulus numbers compare the relative load-carrying ability of various frame section shapes without regard to frame material. Yield strength information compares the strength per unit area of frame material without regard to its shape.

Resisting Bending Moment (RBM) provides a method to compare the actual load-carrying capability of frames of various shapes and materials.

The resisting bending moment (RBM) is defined as the yield strength (S) multiplied by the section modulus (Z).

**Formula:  $RBM = S \times Z$**

The RBM is important because it represents the maximum bending moment that the frame rail can withstand without permanent deformation or damage. The RBM is expressed in inch pounds per rail.

For truck frames that have vertical frames that vary from front to rear (for example, drop center frames), RBM is based on the Section Modulus of the frame at the back of the cab. When RBM is calculated for an aluminum frame with steel reinforcement, the yield strength of the aluminum is used for the calculation, since the aluminum is the lower strength material. When the RBM calculation is made for a steel frame with a steel reinforcement (each with a different yield strength), the yield strength and dimensions of the material with the lower yield strength number are used for the calculation.

The actual bending moment and its units (in-lb) represent a physical characteristic of the frame. It is a load multiplied by a distance from a support point (an axle) that the frame can carry without permanently bending. For example, a typical fifth wheel load is 22,000 lb and may be 12 in ahead of the rear axle center line. Mathematically, the 22,000 lb force has a “moment” — or lever arm — of 12 in that is trying to bend the frame. This means that the frame must **Resist a Bending Moment** of 22,000 x 12 or 264,000 for two rails or 132,000 per rail.

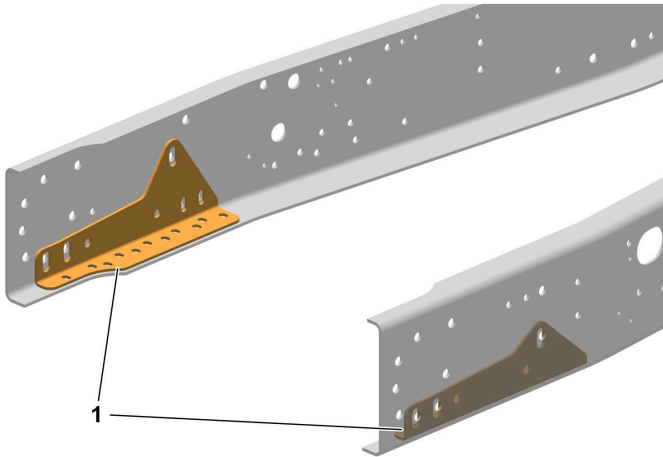
A frame with an RBM higher than the actual bending moment would be specified to allow for extra forces put on the frame when the truck encounters rough roads and to assure long-term resistance to fatigue as the frame is loaded and unloaded over the lifetime of the truck.

# Frame Reinforcements

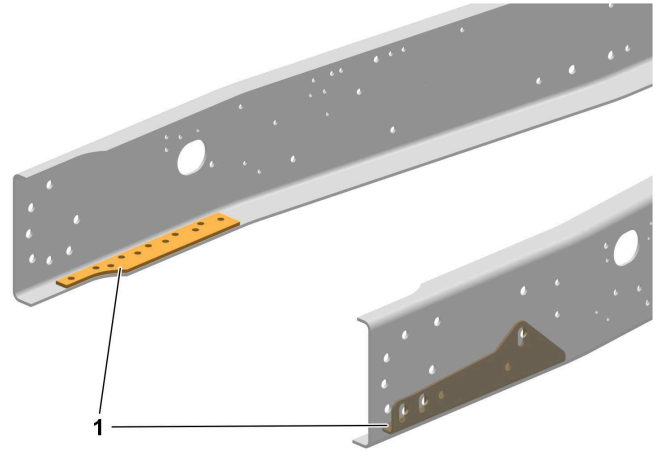
Most trucks are built with frame rails that are strong enough to handle average loads, such as those imposed by a van body or platform body. When bodies or equipment are installed that cause the stresses in the frame to exceed the manufacturers recommendations, additional reinforcement of the frame is necessary. Reinforcements that could be used include double channels, fish plates, "L" shapes, and angle reinforcements.

These reinforcements could be combined to provide additional strength when required.

## VNL, VNR – Tractor



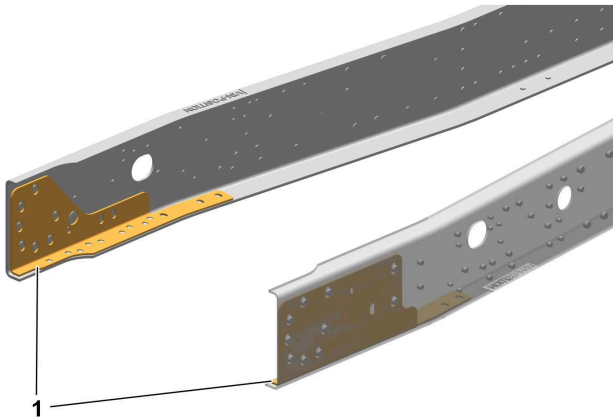
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### 1. Frame Reinforcements

## VNR – Rigid



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### 1. Frame Reinforcements

*Notes*

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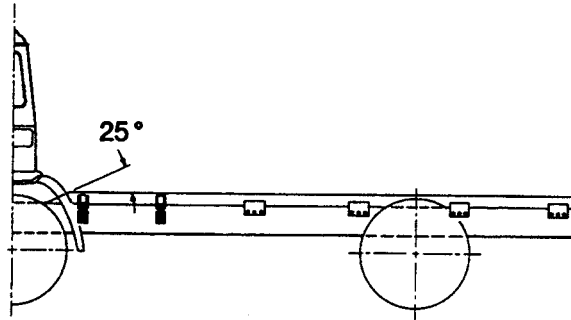
# Subframes



## CAUTION

It is the sole responsibility of the body builder to verify that the axle alignment is corrected after making modifications such as mounting a body, adding an axle or changing the wheelbase.

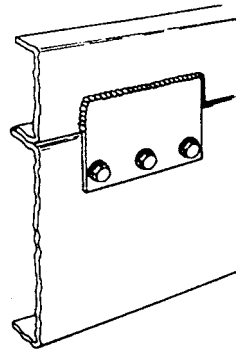
A subframe is an additional frame mounted on top of the existing truck frame (see Fig. 1 Subframe Installation). Of all the types of reinforcements used, the subframe is the easiest to install. However, the subframe does add considerable weight to the vehicle and it raises the height of the body and equipment being installed.



W9000301

Fig. 1 Subframe Installation

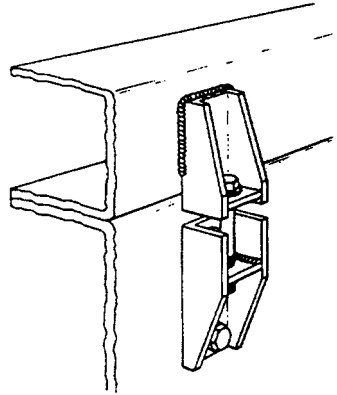
The subframe can be almost any shape, however the C-channel is the easiest shape to mount. The subframe usually extends from the rear edge of the cab back to the end of the frame. Except for the two front anchorages, subframes are rigidly attached to the truck frame by welding flat plates to the side of the subframe and bolting these plates to the web of the truck frame (see Fig. 2 Rigid Attachment).



W9000302

Fig. 2 Rigid Attachment

The two front attachments should allow longitudinal movement between the chassis and subframe (see Fig. 3 Subframe Mounting Allowing Longitudinal Movement). U-bolts could also be used at the front.



W9000303

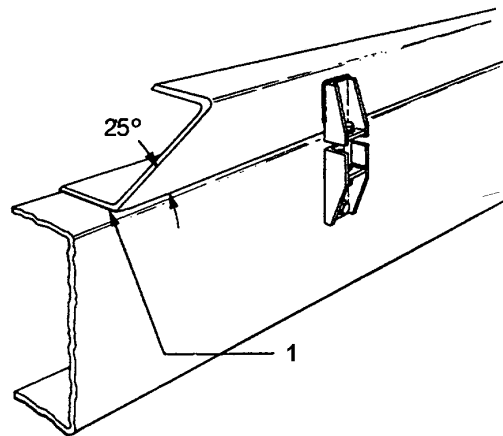
Fig. 3 Subframe Mounting Allowing Longitudinal Movement

The flat mounting plate bolts (as shown in Fig. 2 on page 16 ) should be match drilled. This type of attachment causes the subframe to act as one piece with the truck frame and results in a dramatic increase in section modulus.

**Note:** This type of reinforcement should not be confused with the C-channel longitudinal member found in most van, platform and other bodies. These types of bodies are normally attached to the frame with U-bolts, which allow the truck frame and body longitudinal member to act independently.

When cranes are mounted directly behind the cab, the rigid attaching plates shown (see in Fig. 2 on page 16 ) can be used the full length of the subframe.

The front end of the subframe should be tapered 25° (as shown in Fig. 4 End Tapering, Subframe) to reduce stress concentrations at the end and chamfered on the bottom leading edge to prevent chafing against the truck frame. An adequate number of cross members should also be installed in the subframe to prevent lateral movement.



W9000304

Fig. 4 End Tapering, Subframe

1 Chamfer Bottom Edge of Subframe

## Angle Reinforcements

Angle reinforcements are typically used when two sections of frame rail are joined together. They are not considered to be reinforcement but rather serve to reduce the stress in the joint where the two pieces of frame are joined.

Reinforcing angles can be made from 0.25 inch-thick steel plate bent 90° to form an angle. The bend radius should be large enough so that the angle does not rub against the inside corner of the frame rail. Both ends of the reinforcing angles must be tapered with angles of 20 – 30°. The reinforcing angles are welded in place over the frame splice. Care must be taken to ensure that the welds on the flanges are 0.20 inch minimum from the edge of the flanges.

### Notes

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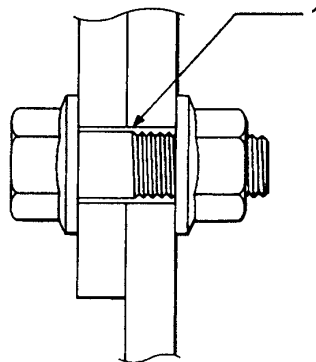
# Minimizing Frame Failure

Generally, frame failures can be minimized or eliminated by reducing the concentration of stress in small areas of the frame:

- 1 Use vehicles only for those purposes for which they were designed.
- 2 Follow recommended practices when mounting a body or equipment on a frame.
  - Do not drill holes in the frame rail flanges.
  - Space holes in the web section of a rail at least 50 mm (2 in) apart.
  - Use existing holes whenever possible.
  - New holes should be drilled as close as possible to the neutral axis of the web (halfway between the flanges) or on the same horizontal line as adjacent holes.
  - Do not drill holes with a plasma torch.
  - Do not cut notches in the rails.
  - Do not heat steel frame rails.
  - Avoid welding on the rails.
  - No more than four holes should exist on the same vertical line of the frame web face.
  - Any holes drilled in a reinforcement should be spaced at a distance equal to at least two times the thickness of the material being installed as measured from the edge of the reinforcement to the side of the hole being drilled.

## Bolted Attachments

All body and equipment mounting brackets should be bolted to the truck frame web area. Use SAE Grade 8 bolts 3/8" 9.5 mm or Property class 10.9 10 mm and larger. Hardened flat washers or flanged head nuts and bolts should be used on both sides. Holes should be drilled or reamed out and the diameter should not be more than 1/32 or 0.79 mm" oversized (see Fig. 5 Normal Bolted Attachment).

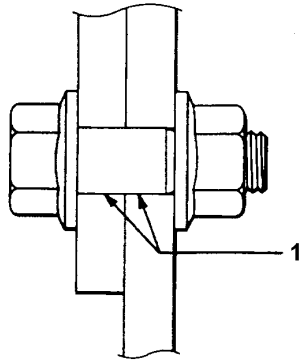


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Fig. 5 Normal Bolted Attachment

Mountings where alignment is critical or where high loads and stresses develop should utilize matched drilled bolting techniques.

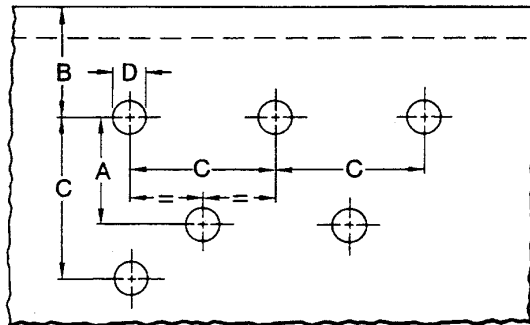
Matched drilled bolting requires the use of shoulder bolts, which are driven through slightly undersized mounting holes. The shank of the bolt should be long enough to penetrate both parts being joined. This technique assures good alignment of the mating parts and eliminates working between the mating parts if the bolts should loosen. The same grade and type of fasteners specified above are recommended for matched drilled bolting (see Fig. 6 Matched Drilled Bolted Attachment).



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Fig. 6 Matched Drilled Bolted Attachment

NEVER use a torch to cut out mounting holes. Caution should be taken to assure that air and electrical lines are protected when drilling. Mounting holes are not to be drilled in the upper or lower flanges of the frame rail except at the very end of the frame rail. Holes drilled in the frame may not exceed  $21/32$ " in diameter. Fig. 7 Minimum Spacing shows the minimum spacing allowed between bolt holes and the flanges of the frame.



W9000294

Fig. 7 Minimum Spacing

- A = Min.  $3 \times D$
- B = Min.  $3 \times D$ , min. 2.25 i
- C = Min.  $4 \times D$
- D = 0.66 in max.

# Welded Attachments

With one exception, welding of bodies, equipment or mounting brackets to the truck frame is strictly forbidden. The exception is that the rear hinge of a dump body or tilting flatbed body may be welded in place provided it is located at the very end of the frame and that the welding does not occur within 100 mm (4 in) of the edge of the rearmost spring hanger bracket.

When welding, care must always be taken to protect the electrical components of the vehicle. First, disconnect the negative battery cable. Then disconnect all cables from the alternator. Air and electrical lines must also be protected from damage during the welding process.

The negative or ground cable of the welding machine must be connected properly to the section of the vehicle under modification and should be as close as possible to this area. Connection of the ground cable to parts of the vehicle that will bring components, including bearings, into the welding circuit may result in damage to these components.

When welding on the truck frame is required, the following welding specifications are recommended:

**DC-Welding**    Electrode ESAB OD 48.00  
                      Phillips PH 35, ASEA Z4 or equivalent  
                      Arc Voltage 18 – 24 V, DC + Pole

**AC-Welding**    Electrode ESAB OK 48.15  
                      Phillips PH 36, ASEA Z22 or equivalent  
                      Arc Voltage 20 – 26 V; AC Minimum Idle Voltage on AC Current: 65 V

**Note:** The welding data refers to an OK 48.15 electrode. Consult information supplied by other manufacturers for different electrodes.

**MIG-Welding**    Filler Material: 125 1 0 1.0  
                      Gas: SK 203 CO + Argon, 80% Argon; 10 liters/min.

## Notes

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# Welding and Drilling

- 1 DO NOT drill frame side rail upper or lower flanges.
- 2 DO NOT weld steel side rails.



## CAUTION

Heating the suspension components and frame rail may weaken them. Hot surfaces can also cause serious burns.

- 3 When welding is performed anywhere on the vehicle, precautionary measures should be taken to prevent damage to electrical system wiring or components. Prior to welding, any parts, which would be damaged by excessive temperatures should be removed or adequately shielded. Also prior to welding, the battery cables should be disconnected at the battery.



## CAUTION

Welding on trucks can damage the vehicle electrical system/components due to the voltage and current spikes that normally occur when welding. It is preferable to avoid welding on an assembled truck. However, if any structure on or in contact with the vehicle must be welded, follow the recommendations below:

- Before welding on the vehicle, disconnect power to the component being welded.
  - Disconnect both the positive (+) and negative (-) battery cables. Disconnect the negative cable first. Reconnect the positive cable first. Vehicles equipped with battery “quick disconnect” must still have the cables removed directly at the battery.
  - Disconnect the engine/starter ground from the chassis. This connection is located outside the left-hand frame rail in the engine compartment. Disconnect the power wiring harness and vehicle interface wiring harness at the engine electronic control unit (ECU).
  - If vehicles are equipped with systems that have their own Electronic Control Units (ECUs), such as ABS brakes, vehicle electronic control unit, or instrument cluster disconnect each control unit at each electrical connection. This “opens” the circuit and will prevent transient voltage from reaching one ECU to another.
  - Attach the welder ground cable as close to the weld as possible (no more than 2 feet from the part being welded).
  - Do not connect the welder ground cable to the engine ECU or the ECU cooling plate.
  - Welding cables should not be allowed to lay 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.
- 4 Holes to mount brackets, out-riggers and supports, may be drilled in the vertical side rail web with the following restriction:
    - Material between edge of hole and inside of upper or lower flange must not be less than 51 mm (2.00 in.).
    - The minimum edge distance between any two holes up to 16 mm (5/8 in.) diameter must be 25 mm (1.0 in.). The minimum edge distance must be 1.5 times the diameter of the largest hole.
    - No holes are allowed with a diameter greater than 19 mm (0.75 in.).
    - Avoid a close vertical succession of fasteners.
    - All attaching fasteners, including flat washers, must be of high strength steel (Grade 8).

- 5 The frame and wheelbase should not be lengthened or shortened without the prior written approval of VTNA Engineering. Any deviation from the original vehicle specification will become the responsibility of the subsequent stage manufacturer or installer.

## Frame Rails and Cross members

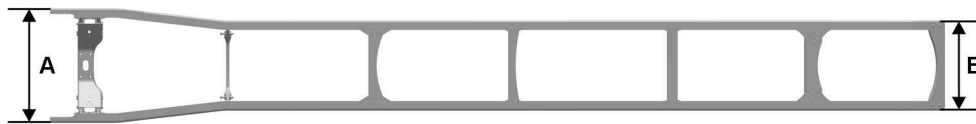
The frame for the VN (4) series has frame side member designs for vehicles produced by Volvo Trucks North America. The designs include two side member heights, three side member thicknesses, and a flared shape.

The frame height is constant for the entire length of the rail. The rail height is either 266 mm, called the Low Profile frame, or 300 mm, called the High-Profile frame. The low-profile frame may have a thickness of either 6 mm, 7 mm, or 8 mm. The high-profile height frame may have a thickness of 6 mm, 7 mm, 8 mm, or 9.5 mm. The rails of the frame are separated at the front edge by a distance of 1078 mm, 1080 mm, 1082 mm and 1085 mm (outside edges). From a position just rearward of the front engine cross member to a position just forward of the rear engine cross member, the rails are tapered closer together. From that point to the rear edge, the distance is 848 mm, 850 mm, 852 mm and 855 mm (inside edges).

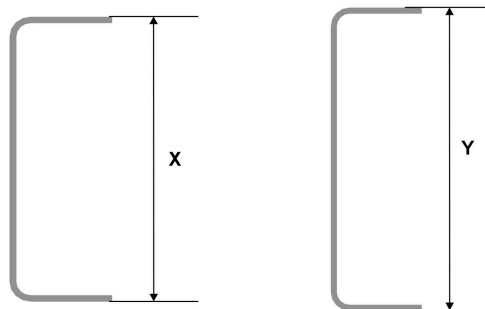
**Note:** Frame dimensions are specified in millimeters due to design. To obtain the approximate dimension in inches, multiply mm by 0.03937.

Because the frame rails are made of a high strength heat-treated steel, only the frame modifications detailed in this information are permitted, in order to ensure that the structural integrity of the rails is maintained.

With the new frame design, the allowable bolt hole patterns in the frame web are specified and must be strictly followed.



T7202733



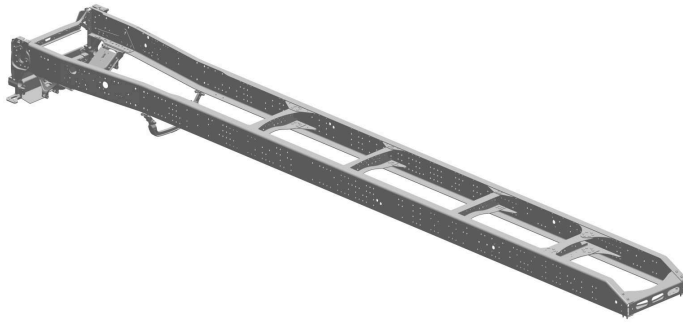
T7202734

**A** 1078 mm (42.44 in), 1080 mm (42.5 in), 1082 mm (42.59 in), 1085 mm (42.71 in)

**B** 848 mm (33.38 in), 850 mm (33.4 in), 852 mm (33.54 in), 855 mm (33.66 in)

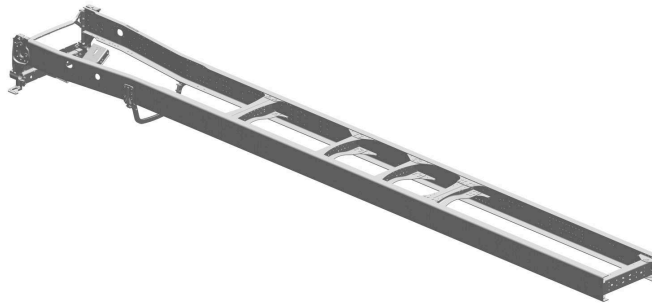
**X** 266 mm (10.48 in)

**Y** 300 mm (11.82 in)



T7202735

VNL, VNR – Frame rails with cross members (Tractor)



T7218192

VNR – Frame rails with cross members (Rigid)

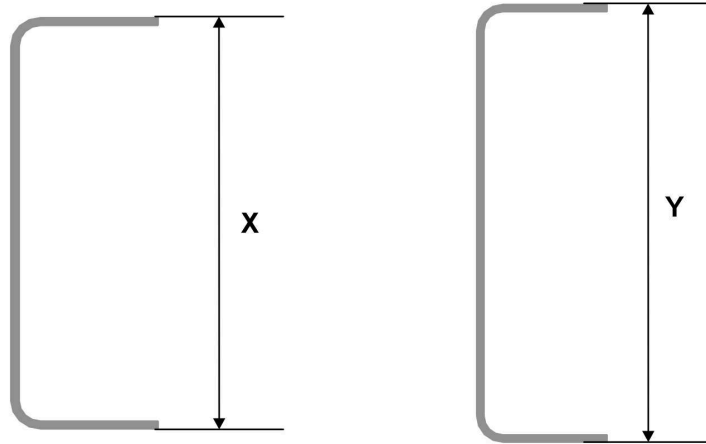
The frame consists of two steel side rails joined by several cross members. The frame for the VN (4) series models is made in various configurations to allow flexibility in adapting the frame for different transport requirements.

See the following design information:

- “Side Members”, page 25
- “Cross members”, page 27
- “Mounting Hardware and Brackets”, page 34
- “Fasteners”, page 34

# Side Members

The side members, or frame rails, are constructed of 840 MPA (120,000 psi) yield heat-treated steel. There are several combinations of side member height and thicknesses. The smaller height referred to as the Low Profile frame, has a web height of 266 mm and may be either 6 mm, 7 mm, 8 mm (VN (4)) thick. The larger height referred to as the High-Profile frame, has a height of 300 mm and may be either 6 mm, 7 mm, 8 mm or 9.5 mm thick.



T7202734

**X** 266 mm (10.48 in)

**Y** 300 mm (11.82 in)

These combinations of height and thickness provide for the variety of load and usage characteristics necessary to meet the hauling requirements of any tractor or truck. The flange width is a constant 90 mm for all combinations of web height and thickness.

Unlike previous frame designs, the side members are not an equal distance apart for their entire length. When viewed from the side, the side members appear straight. Viewed from above, the frame rails are flared outward from a point forward of the rear engine cross member. This design provides for increased lateral, vertical and torsional stiffness. The result is improved vehicle integrity, handling, accident avoidance and collision energy absorption. Widening the frame at the front also minimizes the need for cut outs in the frame flange to adapt the side members to various vendor engines.

Regardless of the frame rail height, thickness and length, the basic frame design and dimensions are the same. The front rail separation is 1080 mm, as measured from the outside of the frame rails, because the front cross member bolts to the outside of the rails. The separation at the rear end is 850 mm or 852 mm, as measured from the outside, because the closing cross member is bolted between the rails. The separation is a constant 836 mm at a point 1635 mm, as measured from the inside from the front.



T7202733

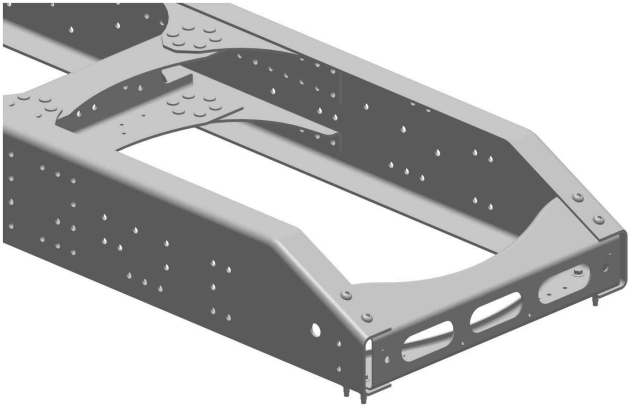
**A** 1080 mm (42.5 in)

**B** 850 mm (33.4 in)

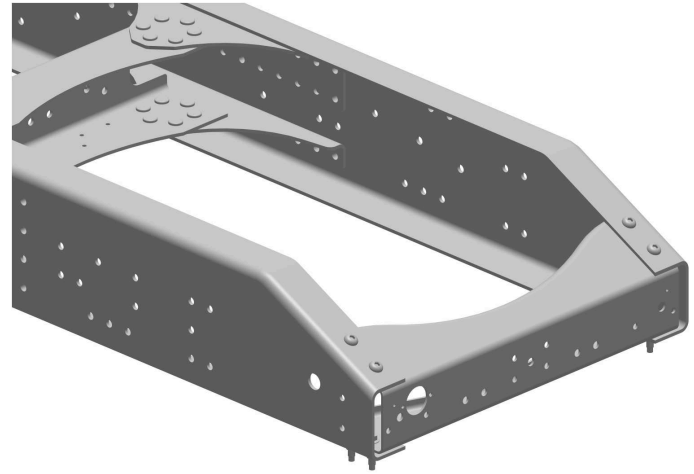
A standard hole pattern is designated for the frame rail web. These dimensions apply to the web behind the rear bend and forward of the rearmost suspension component for the rear axles.

The rear end of the frame is either cut straight or is tapered at a 27-degree angle. There are three different closing cross members to accompany the style of frame termination.

### VNL, VNR – Tractor



T7202736

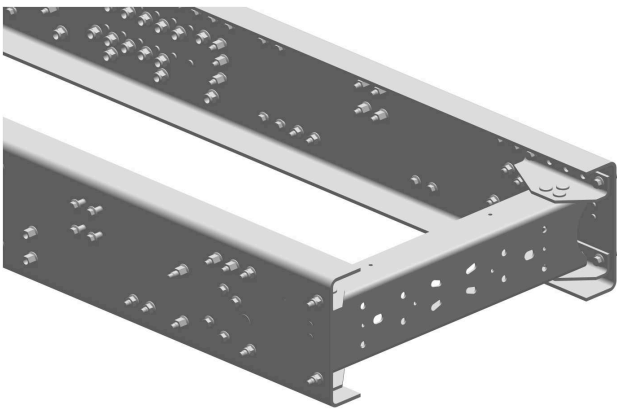


T7202796

Tapered frame end with tapered closing cross member

Tapered frame end with tapered closing cross member

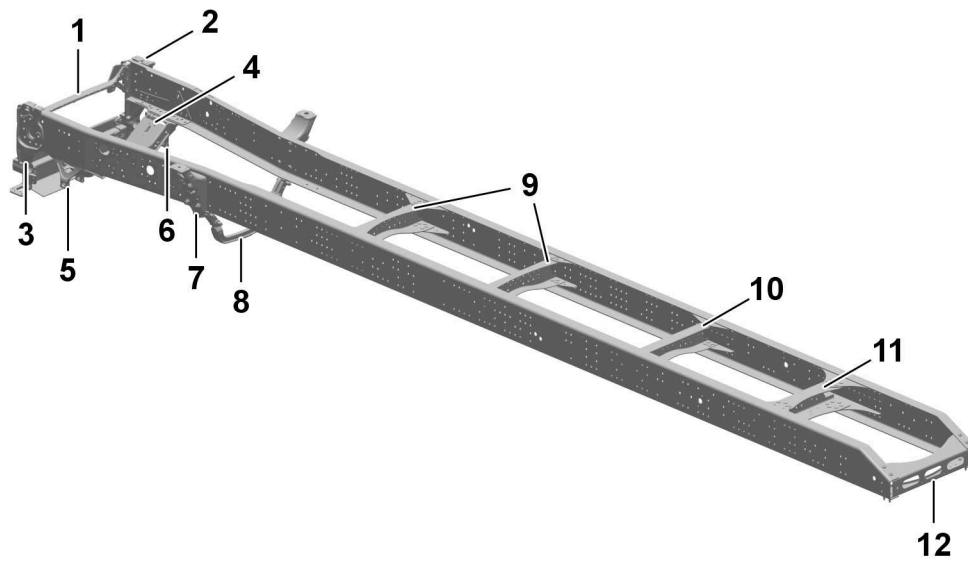
### VNR – Rigid



T7218184

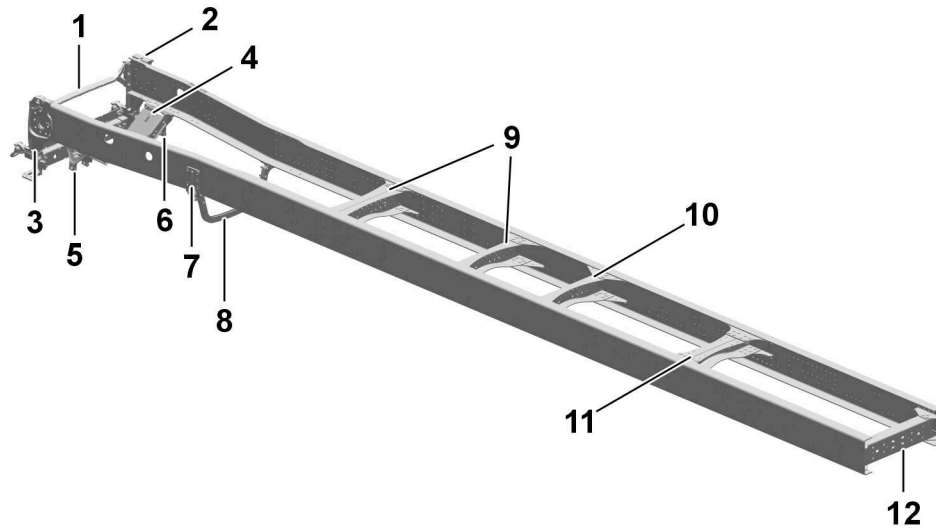
Straight frame end with straight cut closing cross member

# Cross members



T7202737

VNL, VNR – Frame and Cross members (Tractor)



T7218194

VNR – Frame and Cross members (Rigid)

- |      |                              |    |                              |
|------|------------------------------|----|------------------------------|
| 1    | Front Cross member           | 9  | Intermediate Cross member    |
| 2, 3 | Bumper Mounting Bracket      | 10 | Front-of-Axle Cross member   |
| 4    | Front Engine Cross member    | 11 | Rear Suspension Cross member |
| 5, 6 | Front Spring Hanger          | 12 | Closing Cross member         |
| 7    | Rear Engine Support Brackets |    |                              |
| 8    | Rear Engine Cross member     |    |                              |

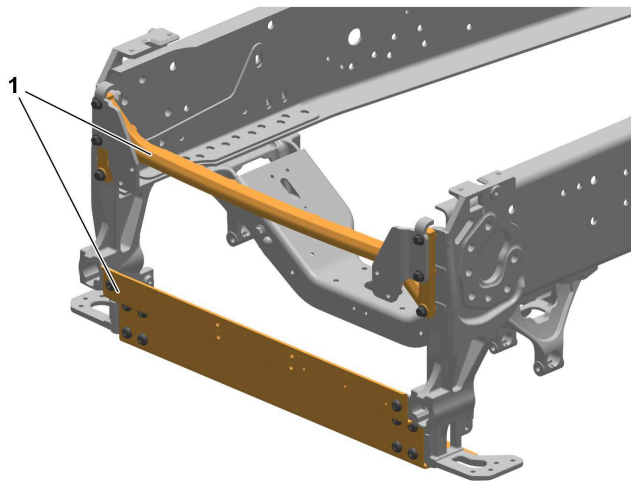
The cross members provide a high degree of torsional stiffness to the frame. They allow the vehicle to handle the side forces caused by turns and uneven road conditions. Improved cross member design and positioning for the VN (4) series models has resulted in reduced weight, enhanced frame stability, improved truck handling and reduced noise and vibration.

The cross member components are to be treated as a unit. Each consists of a beam and end plates. Where beams and end plates are riveted together, they must not be separated. The front engine cross member is an exception to this, in which case, the rivets are replaced by body bound bolts.

**Note:** The numbers in the cross member descriptions that follow refer to the numbers on the frame and cross member diagram at the beginning of the Cross members subsection.

## 1. Front Cross member

The front cross member connects the front ends of the side rails. It has patented aerodynamic teardrop design to allow maximum air flow to the radiator and charge air cooler. It is physically bolted to the front cross member and bumper mounting brackets, which are bolted to the side rails.



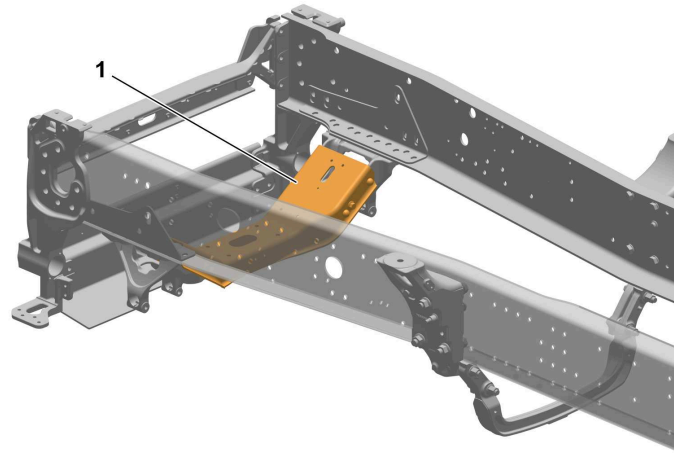
T7202738

1. Front cross member

## 4. Front Engine Cross member

The second cross member is the front engine cross member. It is riveted to the front spring hangers, which are bolted to the side members. It is designed to support the forward end of the front suspension and the front engine mount, which is a single point suspension at the center of the cross member. The cross member is universal in that it can accommodate engines made by Volvo or by other manufacturers. This cross member is simply rotated 180° from the Volvo engine position to adapt to other vendor engines.

Unique brackets have been designed for fitting each vendor engine to the VN (4) series engine mounts. Because the second cross member coincides with the spring hangers, it provides support against side-bending forces generated by driving in curves.

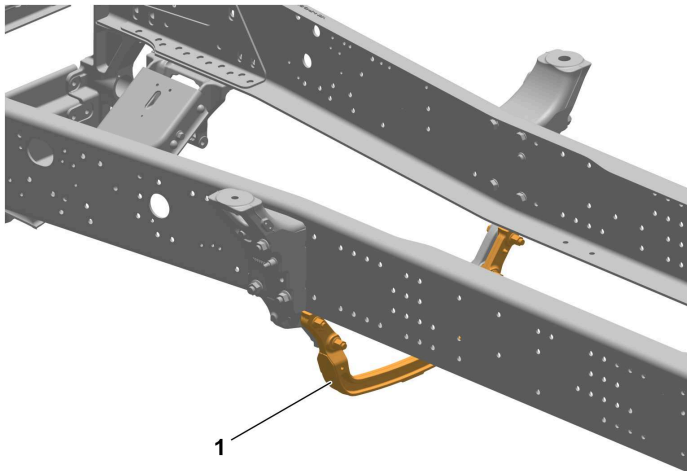


T7202739

1. Front engine cross member

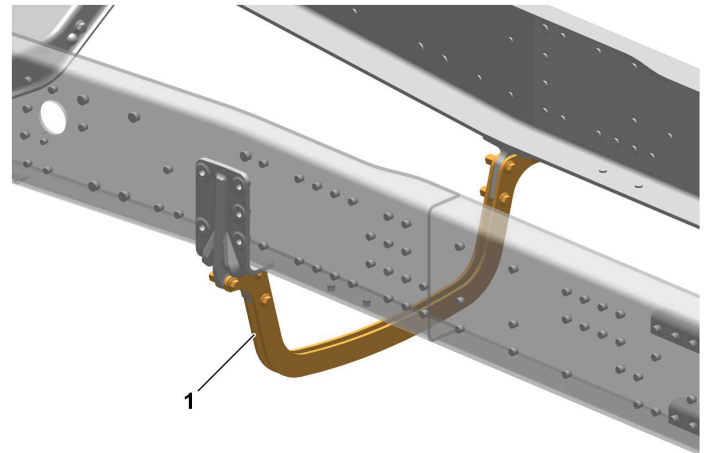
## 8. Rear Engine Cross member

The next cross member is the rear engine cross member. It is supported by the rear engine support brackets and provides support against side loads that occur during vehicle turning. This cross member is attached to the rear engine mounting brackets. If the vehicle is equipped with a Volvo transmission, the brackets are bolted to the engine flywheel housing. For vendor transmissions, the brackets are bolted to the clutch housing.



T7202740

1. Rear engine cross member (VNL, VNR – Tractor)



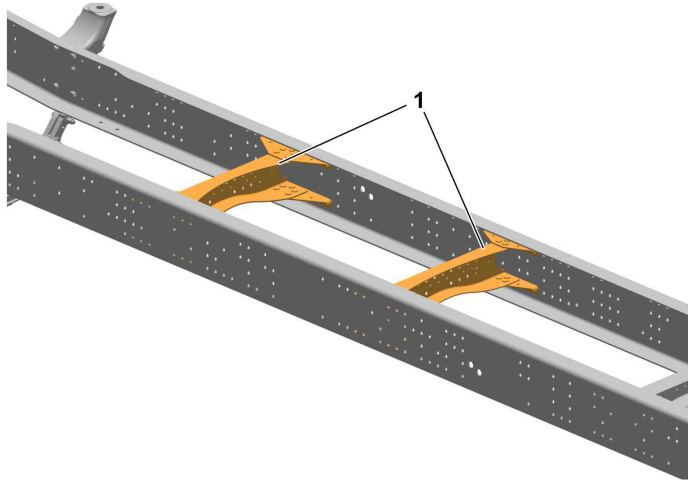
T7218193

1. Rear engine cross member (VNR – Rigid)

## 9. Intermediate Cross members

The intermediate cross member functions as the anchorage for the drive shaft center bearing mounting in addition to its normal function. Longer wheelbase vehicles may have one or two additional intermediate cross members installed.

The distance between the centre of the cross members must not exceed a maximum of 1524 mm (60 in). The cross member must be secured to the frame using HUCK fasteners or alternative fasteners can be used.

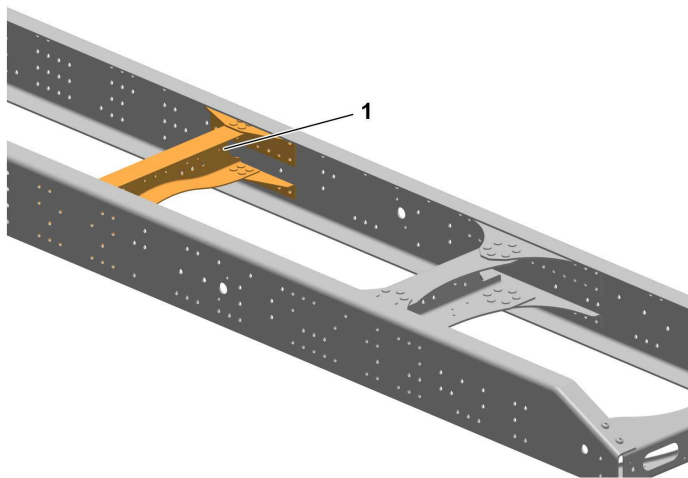


T7202741

1. Intermediate cross members

## 10. Front-of-Axle Cross member

The front-of-axle cross member exists mainly to provide support for the suspension system. This particular cross member is used on vehicles equipped with the Volvo Optimized Air Suspension, Volvo group gas suspension, Hendrickson HAS suspension air spring suspensions or Volvo group B-Ride/T-Ride leaf spring suspension. An aluminum front axle cross member is available for reduced weight.



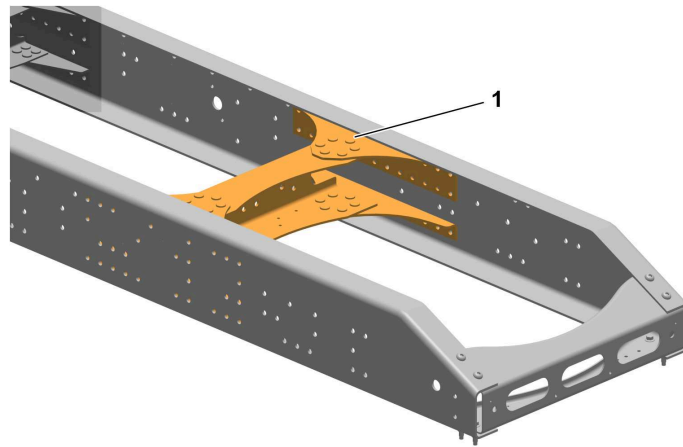
T7202742

1. Front of axle cross member

## 11. Rear Suspension Cross members

There are a variety of rear suspension cross members designed to accompany the axle suspension systems they support. Because of the higher stresses and loading taken up at the rear suspension, this cross member has larger flanges than the other cross members.

The rear suspension cross members shown at right are for 4 x 2, 6 x 2 and 6 x 4 with air spring suspension or leaf spring suspension.



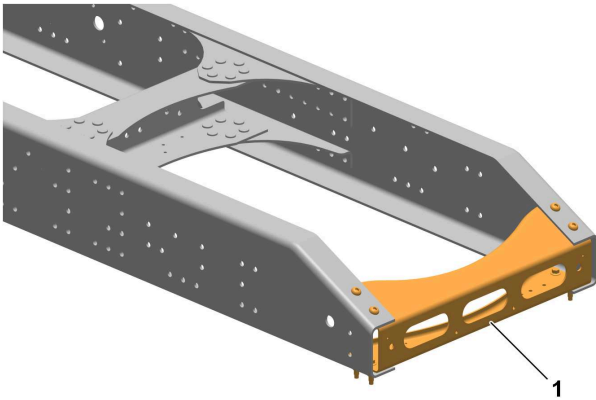
T7202743

1. Rear suspension cross member

## 12. Closing Cross member

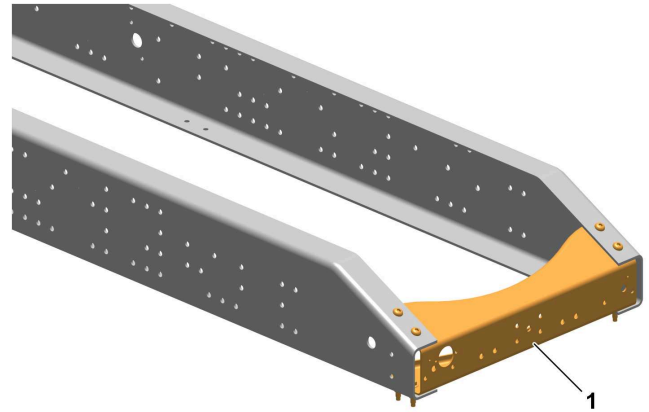
### VNL, VNR – Tapered closing cross member (Tractor)

The closing cross member keeps the separation of the frame rail ends fixed at 836 mm. The frame rail ends are tapered at a 27-degree angle. Based on the vehicle variant the design of the cross member varies.



T7202744

1. Closing cross member (Rear)

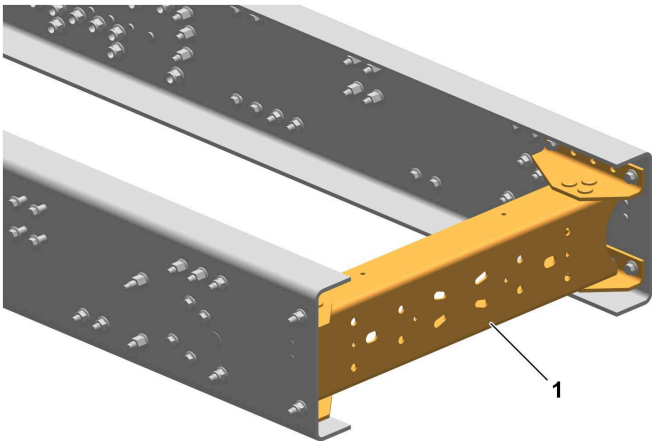


T7202829

1. Closing cross member (Rear)

### VNR – Straight cut closing cross member (Rigid)

The closing cross member keeps the separation of the frame rail ends fixed at 836 mm. The frame rail ends are cut straight.

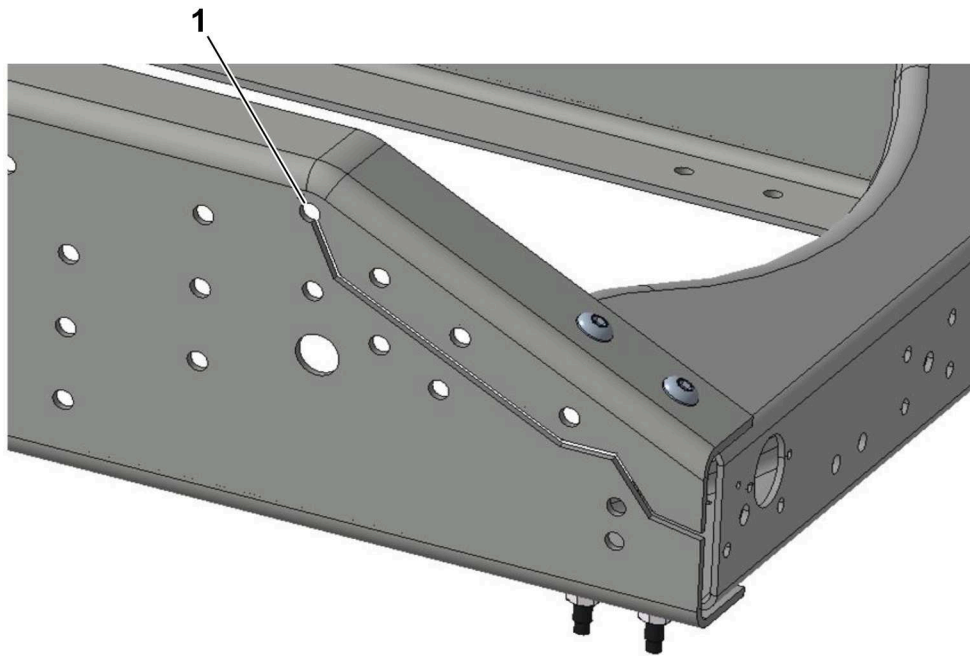


T7218136

1. Straight cut closing cross member (Rear)

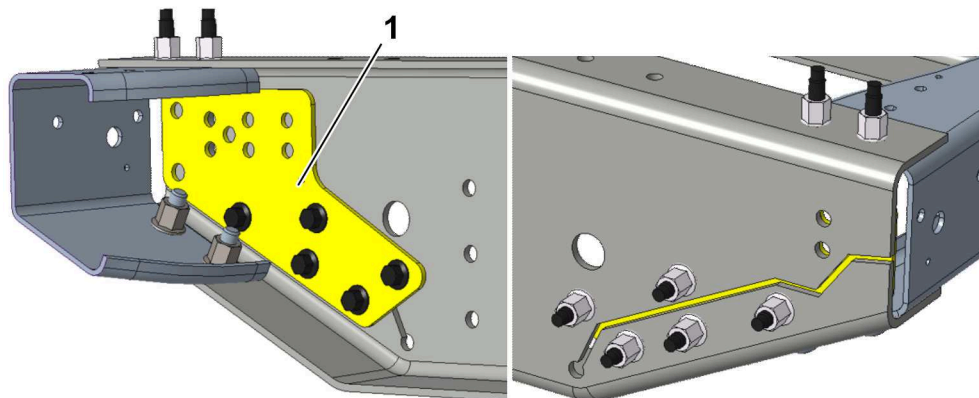
## Frame pivot hole (VNL)

The pivot hole is used to create a relief point when bending the rear taper frame. This hole is important to avoid any high-level deformation after bending the rear frame. This hole is created when plasma cutting the RFEC-B taper cut profile.



T7205787

1. Pivot hole location



T7205788

1. Reinforcement plate (Frame rear end)

# Mounting Hardware and Brackets

The engine mounting system consists of brackets constructed of ductile iron castings and rubber cushion isolators. With Volvo transmissions, the rear mount attaches to the engine flywheel housing. The rear mounts attach to the clutch housing on all vendor transmissions.

Various brackets have been designed to adapt the Volvo engine front isolators and cushions to vendor engines. The rubber cushions on the engine mounts are tuned to a precise vertical, longitudinal and lateral stiffness. The fine tuning of the mount cushions enhances truck performance by isolating engine vibrations and noise from the chassis cab. These cushions have the ability to dampen forces caused by frame distortion when driving off road or on poor roads. The front and rear cushions are designed differently to allow a higher degree of movement.

The engine mounts minimize the motion of the engine. In addition, they provide for easy service to the engine. These advantages apply to all of the engines available with the VN (4) series models.

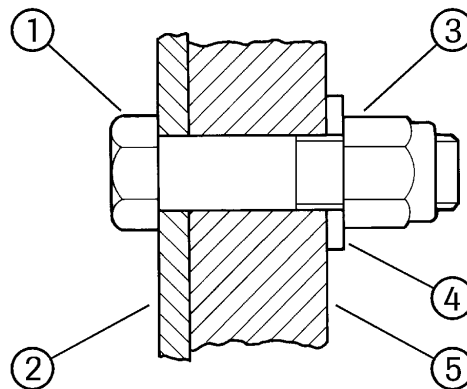
The fuel tank mountings are J-brackets that support and attach the fuel tank(s) to the chassis. Dual fuel tanks are stabilized by an additional crossover brace. They also support the steps up to the cab.

## Fasteners

The cross members are connected to the frame rails using metric flange bolts. The beams and end plates of individual cross members are either bolted to one another using metric flange bolts, or are riveted. Whenever replacement of metric flange bolts is necessary, they must be replaced with identical hardware. In cases where rivets are used to connect beams and end plates, they must not be disturbed because this will affect the structural integrity of the cross member.

Some cross member beams are riveted to the end plates. In cases where the rivets are accessible and must be removed, they should be replaced with a 16 mm body bound bolt. These special bolts are manufactured with a shank diameter that is slightly larger than the outer diameter of the thread so that the load is not placed on the threaded portion of the bolts.

To make proper use of body bound bolts, the holes that will be used must be reamed to a diameter of 0.79 mm (0.031 in) larger than the thread diameter. Proper joining of the cross member and end plates or brackets is accomplished when the shank of the body bound bolt is in complete contact with the cross member and inserts at least 2/3 of the way into the hole in the component on the nut side but does not extend out of the hole.



W7000383

- 1 Body bound bolt
- 2 Cross member
- 3 Elastic stop nut
- 4 Hardened flat washer
- 5 End plate or spring bracket

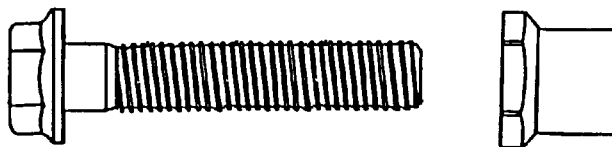
Some components are fastened to the frame using HUCK® Spin fasteners. If these fasteners must be replaced, metric flange bolts of the same size should be used.

Huck fasteners can usually be removed by using an air impact wrench.



## CAUTION

Possible component damage. Never mix HUCK® Spin fasteners and flange fasteners within a hole pattern. Mixing fastener types could cause the flange bolts to come loose.



W7000440

HUCK® Spin bolt and Collar

# Towing Procedure

## 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.

- Ensure that the parking brake is applied.
- Switch on the hazard lamps, if the electrical system is functioning.
- Switch off the TCS (Traction Control System).
- 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 Configurations



### WARNING

The steering does not have any servo effect if the engine is not running. 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  $\frac{1}{4}$  rotation into the socket behind a cover on the left and right hand sides of the bumper.

- 1 Remove the cover.
- 2 Push in and lock the towing hook with a  $\frac{1}{4}$  rotation into the socket



T7202805

1. Cover



T7202806

2. Tow hook

The parking brake must be released during towing.

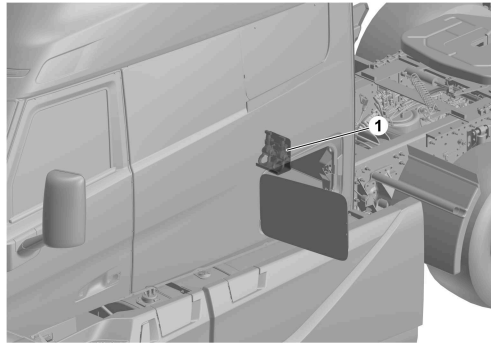
Use the vehicle's towing hooks for towing. The truck is equipped with two towing hooks, each one of them may have half the gross weight of the truck applied from straight in front.

Refer to Maximum Loading During Lifting and Towing for additional weight configurations.

### **Tow Hooks storage (Sleeper Cab)**

The tow hooks are stored in the storage compartment (left-hand side).

The storage compartments provide easy access to the dedicated tow hook (1) storage.

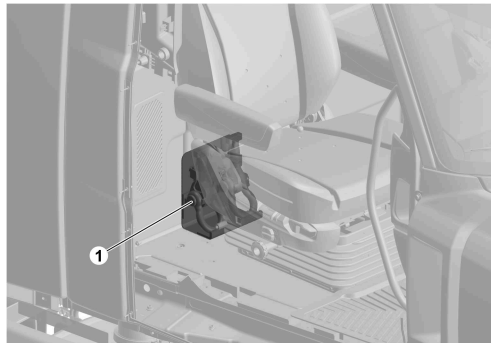


T7202807

1. Tow hook

### **Tow Hooks storage (Day Cab)**

The tow hooks are stored behind the passenger seat.



T7202808

1. Tow hook

## Maximum loading during lifting and towing

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

Single Towing Hook: The hook must not be loaded more than the vehicle's gross weight.

Double Towing Hooks: Each hook must not be loaded more than half the vehicle's gross weight.

Towing Hitch Cross member: maximum 200 mm (7.8 inches) from center of member web.

Maximum load on towing each of the two hooks is:

- 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; 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.

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

## Unloading

If circumstances allow, unload the vehicle before lifting the rear suspension.

The vehicle is unloaded to reduce the axle loading on the towing vehicle, limit the loading on the vehicles lifting points to minimize the risk of damage to the towing vehicle.

If it is not possible to unload the vehicle where it is, it can be towed a short distance to a suitable place where unloading can take place.

## Parking Brake Mechanical Release



### WARNING

Always install the wheel chocks, so that the vehicle cannot roll away. This is important, while working underneath the vehicle. Failure to install wheel chocks, may cause personal injury or death.

There are three ways to release the parking brake in an emergency:

- If there is no air in the brake system, use the Schrader valve located under the hood or the Schrader valve located on the APM (Air Production Modulator) discharge line to fill the reservoirs. Release the parking brake by using the EPB (Electronic Parking Brake) lever in the dashboard.
- If an electrical fault occurs and the air reservoirs have compressed air, manually release the parking brake by supplying compressed air into the Schrader Valves (Port 4.3 & 4.4) on the APM control block to release the parking brake.
- Mechanical release of the parking brake on all spring brake chambers. See procedures under Brake Chambers heading.

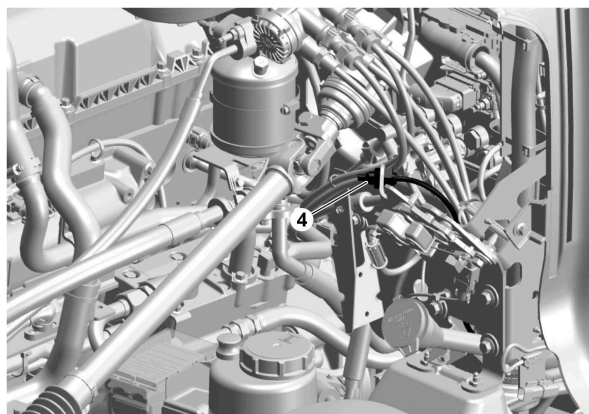
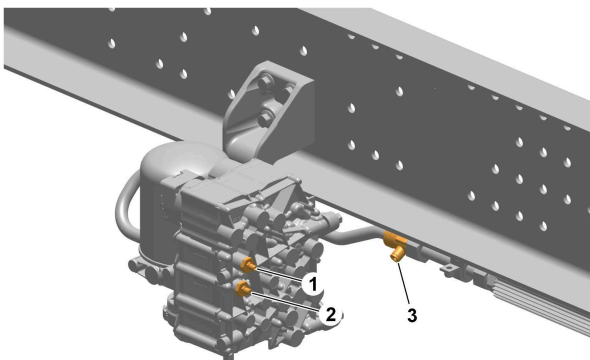
**Note:** The air pressure in the reservoirs must be a minimum of 100 psi (7 bar). The parking brakes apply automatically when the air pressure lowers to 32 psi (2.2 bar) for tractor and 41 psi (2.8 bar) for trailer.

**Note:** The Schrader valves (Port 4.3 and 4.4) must be supplied with a minimum of 60 psi (4 bar) air pressure from the external source to release the parking brakes.

#### Schrader Valve

#### Under the Hood

#### APM (Air Production Modulator)



T7202814

T7202815

- 1 Schrader Valve (Port 4.4) - External Air Fill (Trailer Air Supply)
- 2 Schrader Valve (Port 4.3) - External Air Fill (Tractor Parking Brake)
- 3 Schrader Valve, APM Discharge Line

4. Schrader Valve, Under the Hood

## Brake Chambers (Drum Brakes)

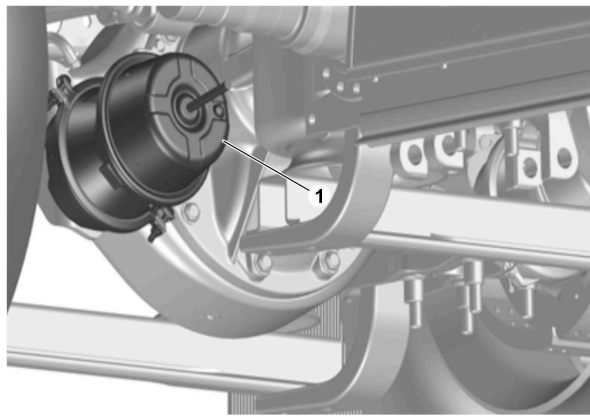
The parking brake can be released mechanically if compressed air is not available.

- Remove the cap on the end of the parking brake cylinder.
- Loosen the nut and remove the release screw from the parking brake cylinder.
- Secure the release screw in the slot provided.
- 1/4 turn the release screw and then securely tighten the nut.

When towing is completed,

- Remember to remove the release screw and nut from the slot and install it in the parking brake.
- Install the protective cap on the parking brake cylinder.

**Note:** Do not remove the split pins from designs, which have a split pin. Instead unscrew the screw and nut together.

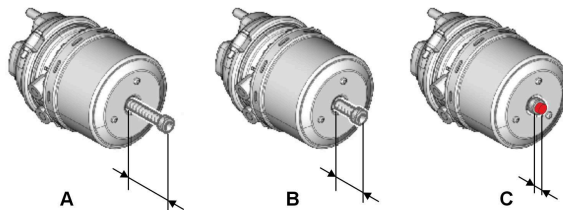


T7202817

### 1. Parking brake release screw

The brake cylinders have a release mechanism for the parking brake spring, which means that the release bolt does not come out of the brake cylinder.

When you start to release the parking brake manually, a red plastic plug comes out of the center of the nut. It is entirely out after three turns. A total of about 45 turns are needed to fully compress the parking brake spring. When the parking brake is fully reinstated, (spring released), the red plastic plug will return into the center of the nut.



T7202818

Release Screw	Description
A (Standard release)	The bolt head protrudes 80 mm from the surface of the brake cylinder.
B (Half release)	The bolt head protrudes 40 mm from the surface of the brake cylinder.
C (Parking brake release)	It takes 45 turns to fully release the parking brake. A red plastic plug comes out of the center of the nut.

**Note:** Always fill the parking brake tank with air when available, and release the parking brake, to reduce the amount of turning needed on the release mechanism nut. The nut should only be released in exceptional cases, with no air in the parking brake section.



### CAUTION

The maximum torque for the release mechanism nut is 47 Nm (34.67 ft-lbs).

## Towing the Vehicle From the Front

**Note:** During recovery, DO NOT pull from front axle. Pulling the front axle may cause damages to U-bolts clamp group.

When the vehicle is towed with the front suspension lifted, the steering lock must be released.

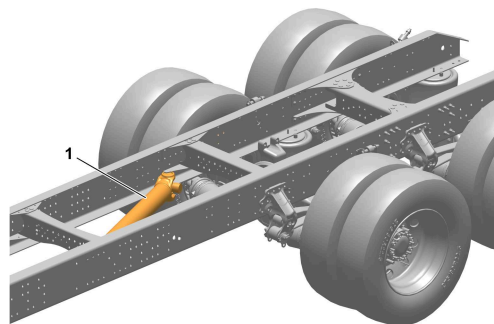


### CAUTION

During towing, when the driving wheels are in contact with the ground, the axle shafts or propeller shaft must always be removed.

If the axle shafts have to be removed, the hubs must have tight fitting covers installed. Sand and dirt could otherwise find their way in and cause considerable damage.

Disconnect the propeller shaft from the rear axle and fix it securely to the chassis, or remove the entire propeller shaft.



T7202819

1. Propeller shaft

**Note:** When the vehicle is towed with the front suspension lifted, a fault code for "abnormal sensor signal front" is set in the ABS system. This should be considered during the next service, when the ABS fault codes are checked.

The ABS fault code can be deleted with the service tool, refer to the service information for the ABS system.

## Lifting A Vehicle With Leaf Springs

### Method 1: Wheel Lift

This is the easiest method to tow the vehicle. Lifting at the wheels helps reduce the risk of possible damage to the axle, and suspension components during towing operations.

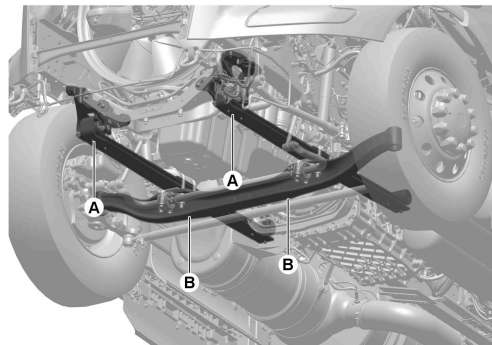


T7202823

### Method 2: Spring Eye And Hanger Lift Method

Lift behind the front spring anchorage to tow the vehicle.

If for any reason, you cannot lift the vehicle from the front using the front spring anchorage, use the front axle member to lift.



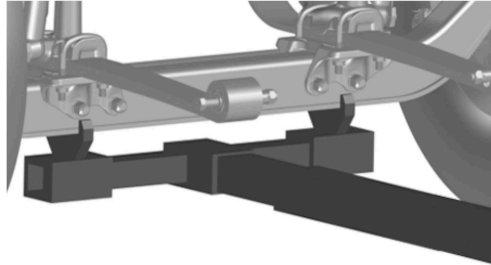
T7202824

- A. Lifting Point, Front Spring Anchorage
- B. Lifting Point, Front Axle Member

### Method 3: Axle Fork Lift

This is an alternative procedure to tow the vehicle. It requires standard tow forks and designated lift points depending on which axle is equipped on the vehicle.

- 1 Install the fork in the boom properly.
- 2 Position the proper tow forks directly under the axle, inside the axle clamp groups.
- 3 Prior to lifting the vehicle, ensure that the bottom axle plate is flat in the tow fork to minimize any gap between the bottom axle plate and the tow fork.



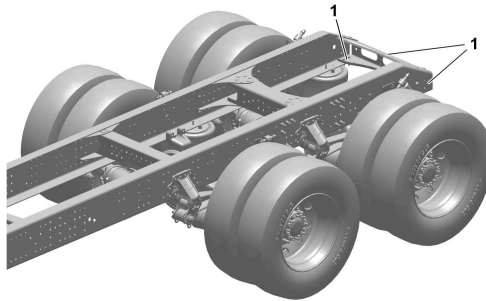
T7202825

### *Towing With The Rear Suspension Lifted*

**Note:** When the vehicle is towed with the rear suspension lifted, the steering wheel must be locked with the steering locked.

This method is preferred when the proper equipment is not available to perform the wheel lift method and is necessary for wreckers not equipped with an under axle lift system.

Lift underneath the towing hitch cross member. If the vehicle does not have a towing hitch cross member, use the chassis ends for lifting.



T7202826

#### 1. Cross Member Lifting Locations

## Lifting a Vehicle Rear Air Suspension

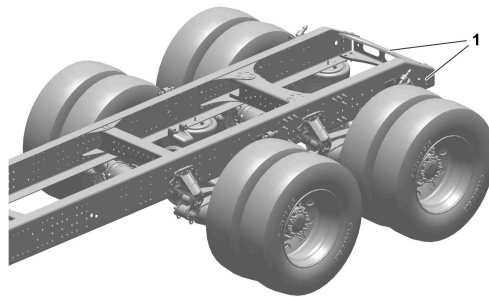
If possible, avoid lifting the rear of a truck with air springs. The consequence could be that the air bellows slide apart, unless you first secure the rear axle to the chassis. It then takes a lot of time to line up the air bellows again.

**Note:** If the rear axle is fixed to the chassis with straps etc. when the vehicle is lowered, the straps will burst when Automatic Ride Height control is activated later on.

If you have to lift the rear of the vehicle anyway, lift the towing hitch support cross member in the first instance. If the vehicle does not have a towing hitch support cross member, lift the chassis ends.

If you lift the vehicle by the chassis, the following applies:

- 1 The ignition lock must be in position I or II and the air suspension in "Automatic Ride Height" mode.
- 2 Lift the chassis until the wheels almost leave the ground. Take a rest until the air has drained out of the air bellows.
- 3 If possible, fix the rear axle to the chassis so that the air bellows can not slide apart.
- 4 Lift to the desired height.

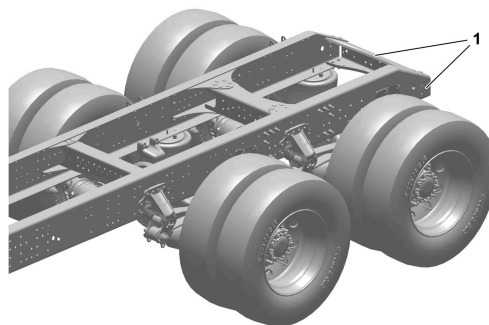


T7202827

1. Lifting points on rear suspension, with air springs

## Towing Backwards

- Use the towing hitch or the towing hitch cross member to lift the vehicle.
- If the vehicle does not have a towing hitch cross member, use the chassis end cross members for lifting.



T7202828

1. Tow from rear spring anchorage or trailer hitch hook

## Towing Sideways

**Note:** Use these methods for vehicle recovery only.

When towing sideways, select an attachment point close to the axle anchorage, such as a spring or torque stay anchorage. In other cases, the chassis could be subjected to such heavy loading that it could be bent.

## Notes

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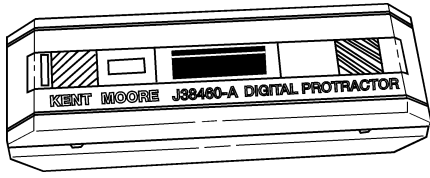
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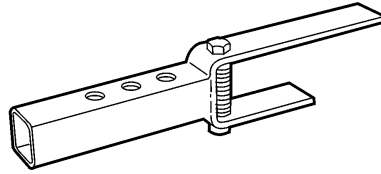
# Special Tools

For special tool ordering instructions, contact your local dealer.



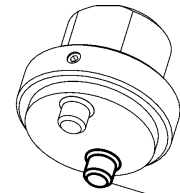
W7000708

J-38460-A Digital Protractor



W7001140

J-44771 Frame Rail Guide Support

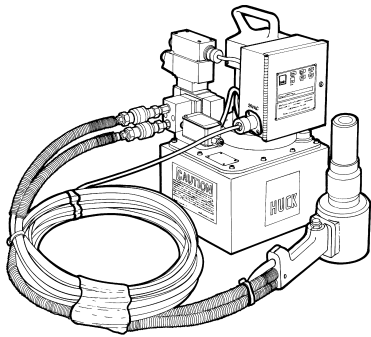


9809722

**9996791**

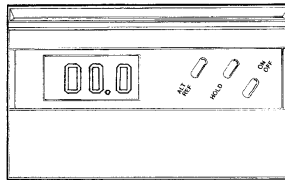
W7057090

9996791 Pin Tool



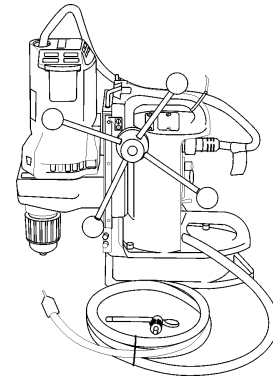
W0000397

HUCK® Manufacturing 940INTRKT



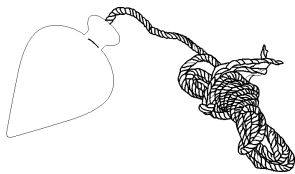
W0001875

Digital Angle Gauge



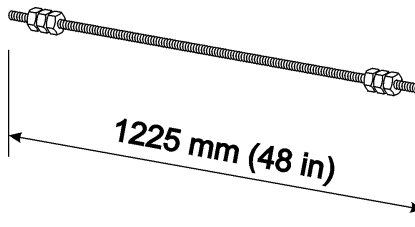
W0001876

Drill with Magnetic base



W0001877

Plum Bob



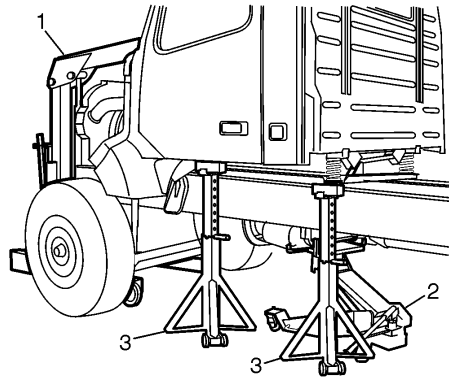
W0001878

Threaded rods

# Frame Rail, Replacement

## Removal

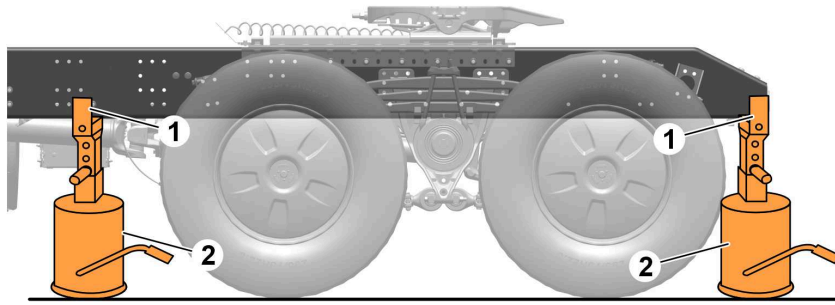
- 1 Park the vehicle on a level surface with transmission in neutral and the front wheels chocked. Raise the hood.
- 2 Remove the mounting screws from the top and bottom of the bumper.
- 3 Remove the support rods from the left and right sides of the bumper and remove the bumper.
- 4 Disconnect the headlamp and foglamp connectors and remove the hood spring.
- 5 Remove the hood splash shields on the left and right sides of the hood. Disconnect the hood restraint cylinders.
- 6 Remove the fasteners to the hood pivot and remove the hood.



W7001177

- 1 Hoist
- 2 Transmission Jack
- 3 Jack Stand

- 7 Support the engine and transmission with a hoist and transmission jack.
- 8 Remove the battery box cover and disconnect the batteries.
- 9 Remove the battery hold-down strap and remove the batteries.
- 10 Remove the battery cable hold-down bracket to the frame rail and disconnect the windshield wiper fluid pump.
- 11 Disconnect the supply and return lines to the windshield washer reservoir. Remove the clamp that secures the drain valve pull cords to the air tanks.
- 12 Remove the air tank straps and the air tanks.



T7205018

- 1 Frame Rail Guide Support
- 2 Air Jack Stand

13 Remove the battery tray mounting bolts. Remove the battery and air tank support brackets.

**Note:** Some applications may require supporting the rear cab suspension.

14 Using tool J-44771, support the frame rail being removed with jack stands and frame rail guide supports, which are distributed equally throughout the length of the frame rail.

**Note:** A minimum of three jack stands and frame rail guide supports of adequate rating should be used for this procedure.

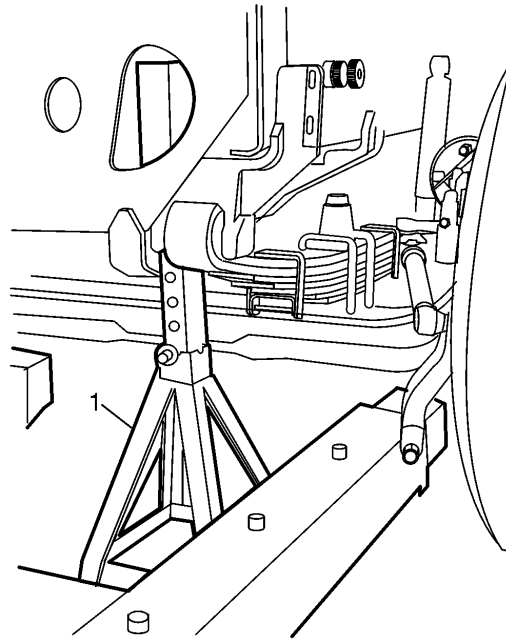
15 Disconnect the fuel supply and return line. Remove the fuel tank and fuel tank J- brackets.

16 Remove the inner fender splash shield and the lower bracket on the side of the vehicle being worked on.

17 Remove the fasteners to the front closing cross member and the fasteners to the tow hook on the side of the vehicle being worked on.

18 Remove the fasteners to the front spring hanger and remove the bumper support bracket.

**Note:** Support the front engine support cross member.

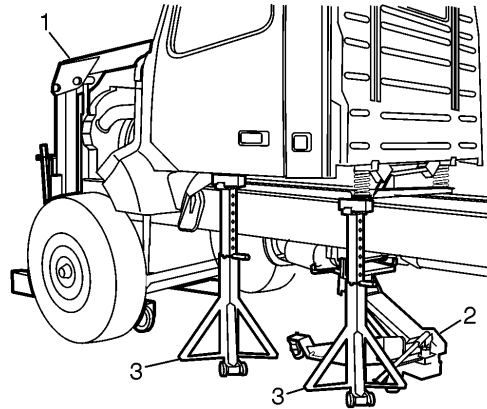


W7001185

#### 1 Jack Stand

- 19 Support the radiator with a jack stand. Remove the radiator support bracket and the lower radiator isolator mount on the side of the vehicle being worked on.
- 20 Remove the pitman arm from the steering gear.
- 21 Stabilize the steering gear and remove the fasteners that mount the steering gear.
- 22 Remove the front axle bump stop from the frame rail on the side of the vehicle being worked on.
- 23 Remove the Air Conditioning line support brackets inside the frame rail and remove the upper shock absorber bolt.

- 24 Remove the steering shaft carrier bearing bracket and/or the power steering reservoir bracket.
- 25 Remove the rear A/C line support bracket, the bulkhead fitting and the wheel speed sensor from the front brake.
- 26 Disconnect the hood release cable and remove the hood tube mount bracket.
- 27 Remove the ground wire and the ground stud located on the frame rail forward of the front cab support.
- 28 Remove any air valves, wiring and/or air line brackets under the cab inside and outside of the frame rail.

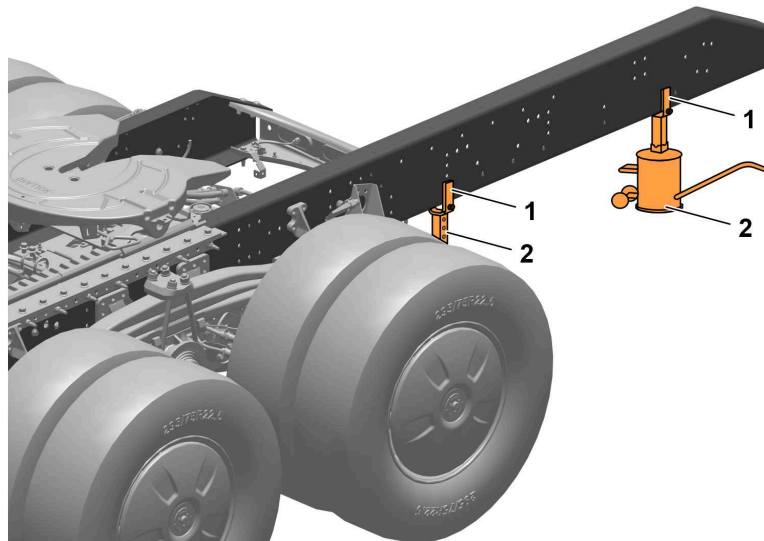


W7001177

- 1 Hoist
- 2 Transmission Jack
- 3 Jack Stand

- 29 Support the front of the cab with a jack stand and remove the front cab support.
- 30 Remove the lower spring pin on the rear spring hanger to the front axle using tool 9996791.
- 31 Remove the rear spring hanger on the front axle.
- 32 Remove the transmission mount bracket and the transmission cross member mounting bracket on the frame rail being removed.
- 33 Remove the fuel cooler and/or fuel water separator.
- 34 Remove the air dryer and/or purge tank.
- 35 Remove all the remaining clipping brackets from the wiring or air-line harnesses located inside and outside of the frame rail.
- 36 Remove any remaining air valves that are mounted inside or outside the frame rail.
- 37 Support the vertical exhaust pipe in place, then remove the support bracket for the exhaust.
- 38 Support the rear suspension cross member with a jack stand, then remove the upper shock brackets and the bump stops from the rear suspension.
- 39 Remove all existing fasteners from the rear suspension on the frame rail that is being removed.

- 40 Remove all existing fasteners to the cross members on the frame rail being removed.



T7205019

- 1 Frame Rail Guide Support
- 2 Air Jack Stand

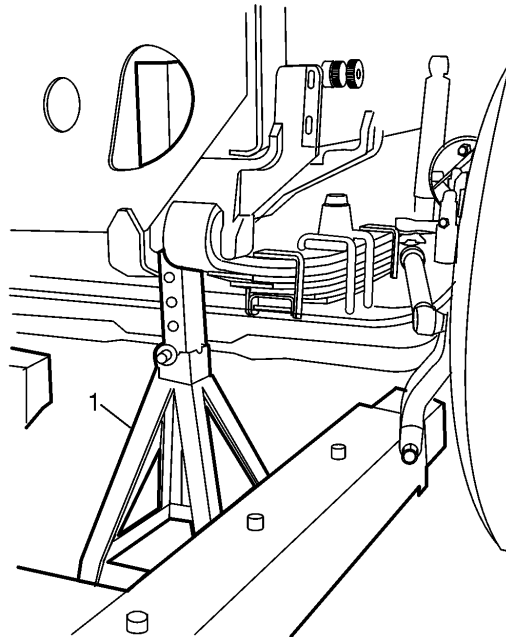
- 41 Slide and push the frame rail backward, while simultaneously moving the jack stands, one after the other, to the rear of the frame rail. This will adequately support the frame rail while it is being removed.

## Installation

**Note:** Do not tighten fasteners until they have been properly installed. This will help maintain proper frame alignment and will assist in obtaining proper height between the frame rails.

- 1 Slide and push the frame rail forward, while simultaneously moving the jack stands, one after the other, to the front of the frame rail. This will adequately support the frame rail while it is being replaced.
- 2 Install all fasteners and cross members on the frame rail being replaced.
- 3 Install fasteners from the rear suspension on the frame rail that is being replaced.
- 4 Install the upper shock brackets and the bump stops to the rear suspension.
- 5 Support the vertical exhaust pipe in place, then install the support bracket for the exhaust.
- 6 Install the air valves to the inside and outside of the frame rail.
- 7 Install all clipping brackets for the wiring or air-line harnesses to the inside and outside of the frame rail.
- 8 Once this step is complete, go back and tighten fasteners that have been installed from steps 1 through 7 as follows:  
M14:  $200 \pm 30$  Nm ( $147.51 \pm 22.12$  ft-lb)  
M16:  $320 \pm 50$  Nm ( $236.01 \pm 36.87$  ft-lb)
- 9 Install the fuel cooler and/or fuel water separator.
- 10 Install the air dryer and/or purge tank.
- 11 Install the transmission mount bracket and the transmission cross member mounting bracket on the frame rail being replaced.
- 12 Install the rear spring hanger on the front axle.

- 13 Install the lower spring pin on the rear spring hanger to the front axle using 9996791.
- 14 Install the front cab support.
- 15 Install any air valves, wiring and/or air line brackets under the cab inside and outside of the frame rail.
- 16 Install the ground wire and the ground stud located on the frame rail forward of the front cab support.
- 17 Connect the hood release cable and install the hood tube mount bracket.
- 18 Install the rear A/C line support bracket and remove the bulkhead fitting and wheel speed sensor from the front brake.
- 19 Install the steering shaft carrier bearing bracket and/or the power steering reservoir bracket.
- 20 Install the A/C line support bracket inside the frame rail and install the upper shock absorber bolt.
- 21 Install the front axle bump stop to the frame rail on the side of the vehicle being worked on.
- 22 Stabilize the steering gear and install the fasteners that mount the steering gear.
- 23 Install the pitman arm to the steering gear.



W7001185

#### 1 Jack Stand

- 24 Install the radiator support bracket and the lower radiator isolator mount.
- 25 Install the fasteners to the front spring hanger and reinstall the bumper support bracket.
- 26 Install the fasteners to the front closing cross member and the fasteners to the tow hook on the side of the vehicle being worked on.
- 27 Install the inner fender splash shield and the lower splash shield support bracket to the frame rail.
- 28 Install the battery tray mounting fasteners and install the battery and air tank support brackets.

- 29 Once this step is complete, go back and tighten fasteners that have been installed from steps 8 through 26, as follows:  
M14: 200 ± 30 Nm (47.51 ± 22.12 ft-lb)  
M16: 320 ± 50 Nm (236.01 ± 36.87 ft-lb)  
M20: 630 ± 100 Nm (464.66 ± 73.75 ft-lb)
- 30 Install the air tank straps and the air tanks.
- 31 Reconnect the supply and return lines to the windshield washer reservoir. Reinstall the clamp that secures the drain valve pull cords to the air tanks.
- 32 Install the battery cable hold down bracket to the frame rail and reconnect the windshield wiper fluid pump.
- 33 Install the battery hold down strap and remove the batteries.
- 34 Install the battery box cover and reconnect the batteries.
- 35 Reconnect the fuel supply and return line. Install the fuel tank and the fuel tank J- brackets.
- 36 Reinstall the engine and transmission. Reinstall the hoist and transmission jack.
- 37 Check the frame alignment and make sure everything is installed and properly tightened to specifications.
- 38 Install the fasteners to the hood pivot blocks and install the hood.
- 39 Install the hood splash shields on the left and right sides of the hood. Connect the hood restraint cylinders.
- 40 Connect the headlamp and foglamp connectors and install the hood spring.
- 41 Install the support rods from the left and right sides of the bumper and install the bumper.
- 42 Install the mounting screws from the top and bottom of the bumper.

## Notes

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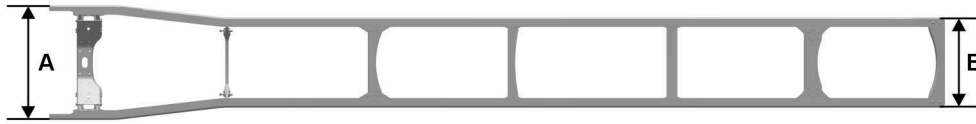
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# Frame Alignment, Checking



T7202733

**A** 1078 mm (42.44 in.), 1080 mm (42.5 in.), 1082 mm (42.59 in.) or 1085 mm (42.71 in.)

**B** 848 mm (33.38 in.), 850 mm (33.46 in.), 852 mm (33.54 in.) or 855 mm (33.66 in.)

- 1 Measure the distance between the outside edges of the front edge of the frame rails (A). The dimension must be 1078, 1080, 1082 or 1085  $\pm$  2 mm.
- 2 Measure the distance between the inside edges of the rear end of the frame rails (B). The dimension must be 848, 850, 852 or 855 +2.7/-4.6 .
- 3 Ensure the vehicle is on a level area of the shop floor.
- 4 Make a mark on the floor directly beneath the front lower edge of each frame rail, and one directly beneath the rear lower edge of each rail.
- 5 Move the vehicle away from the marks.
- 6 Refer to "Frame Alignment, Adjustment", page 55 . Measure from the mark for the front of the right frame rail to the rear of the left frame rail (this is dimension A).
- 7 Measure from the mark for the front of the left frame rail to the rear of the right frame rail (this is dimension B). This dimension must be the same as dimension A.
- 8 If any of the dimensions noted are not within tolerance, align the vehicle frame.

## Notes

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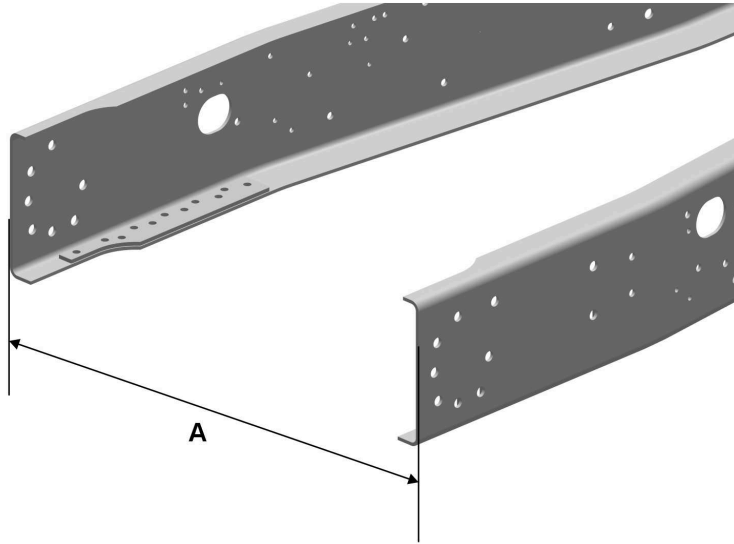
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# Frame Alignment, Adjustment

Total wheel vehicle alignment may be necessary.

- 1 Ensure all cross member mounting bolts are loose.
- 2 Remove the front bumper and any other obstructions to the front cross member.
- 3 Remove the front cross member and the bumper mounting brackets.



T7203594

**A** 1078 mm (42.44 in.), 1080 mm (42.5 in.), 1082 mm (42.59 in.) or 1085 mm (42.71 in.)

- 4 Insert a 1/2 in. (12 mm) threaded rod, approximately 48 in. (1200 mm) long, through the uppermost front cross member mounting bracket hole in one frame rail.
- 5 Run four nuts onto the rod so that they are between the frame rails.
- 6 Insert the rod through the uppermost hole in the other frame rail.
- 7 Run a single nut onto the rod on the outside of both rails.

## Notes

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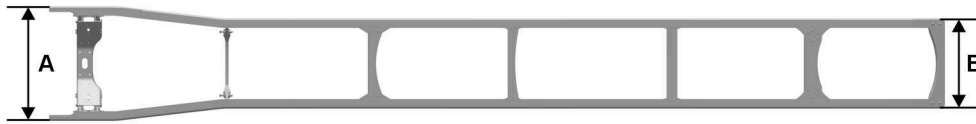
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- 8 Repeat the steps for inserting a threaded rod in the lowest front cross member mounting bracket hole.



T7202733

**A** 1078 mm (42.44 in.), 1080 mm (42.5 in.), 1082 mm (42.59 in.) or 1085 mm (42.71 in.)

**B** 848 mm (33.38 in.), 850 mm (33.46 in.), 852 mm (33.54 in.) or 855 mm (33.66 in.)

- 9 Adjust the position of the inner and outer nuts to set the distance between the front outer edges of the frame rails to 1078 , 1080, 1082 or 1085  $\pm$  2 mm.
- 10 Tighten the nuts while ensuring the distance between the rails remains at 1078 , 1080, 1082 or 1085  $\pm$  2 mm.
- 11 Refer to “Frame Alignment, Adjustment”, page 55 . Adjust the position of one of the rails until the crosswise dimension is the same both ways ( $A = B$ ).
- 12 Adjust the distance between the rear end of the rails until the distance between the inside edges is 848 , 850 , 852 or 855  $+2.7$  mm/ $-4.6$  mm .
- 13 Re-verify all dimensions. Readjust if necessary.
- 14 Tighten the mounting fasteners on all cross members. Refer to “Tightening Torques, Frame Rail Bolts”, page 5 .

## Notes

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# Intermediate Cross member, Replacement (Rivets Under the Frame Flange)

## Removal

- 1 Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.
- 2 Remove the closing cross member.
- 3 Remove the wiring harness supports between the closing and the intermediate cross members.
- 4 Remove the rear light bar.
- 5 Remove the intermediate cross member from the vehicle by sliding it out of the frame rail.

**Note:** Intermediate cross members with riveted beams (located forward of the rear suspension) suspension and closing cross members must be removed. See "Rear Suspension Cross member (Bogie), Replacement", page 62 .

## Installation

- 1 Install the intermediate cross member. Tighten fasteners to a torque of:  
200 ± 30 Nm (147.51 ± 22.12 ft-lb)
- 2 Install the wiring harness supports between the intermediate and the closing cross member. Tighten fasteners to a torque of:  
200 ± 30 Nm (147.51 ± 22.12 ft-lb)
- 3 Install the closing cross member. Tighten fasteners to a torque of:  
200 ± 30 Nm (147.51 ± 22.12 ft-lb)
- 4 Install the light bar. Tighten fasteners to a torque of:  
200 ± 30 Nm (147.51 ± 22.12 ft-lb)

## Notes

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# Intermediate Cross member, Replacement (Bolted and Exposed Rivets)

## Removal

- 1 Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.
- 2 Remove any equipment which obstructs cross member replacement.
- 3 Remove fasteners or rivets from the installed cross member beam. Remove the beam from the end plates.
- 4 If required, unbolt and remove the end plates from the frame rails.

## Installation

- 1 If required, bolt the new end plates to the frame rails. Do NOT tighten.
- 2 For bolted beams, bolt the new beam to the end plates. For riveted beams, bolt the beam to the end plates using body bound bolts. Perform body bound bolt installation in accordance with the procedure in this document.
- 3 Tighten the end plate-to-the frame rail fasteners. Tighten the beam-to-end plate fasteners. Tighten both fasteners as follows:  
M14:  $200 \pm 30$  Nm ( $147.51 \pm 22.12$  ft-lb)

# Intermediate Cross member, Replacement (Service Kit)

## Removal

- 1 Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.
- 2 Support the drive shaft with transmission jack.
- 3 Remove the four fasteners from cross member supporting the carrier bearing.
- 4 Remove all side plate fasteners.
- 5 Remove the cross member using acetylene torch, plasma cutter, cutting wheel or reciprocating saw.
- 6 Remove the parts from packaging.

## Notes

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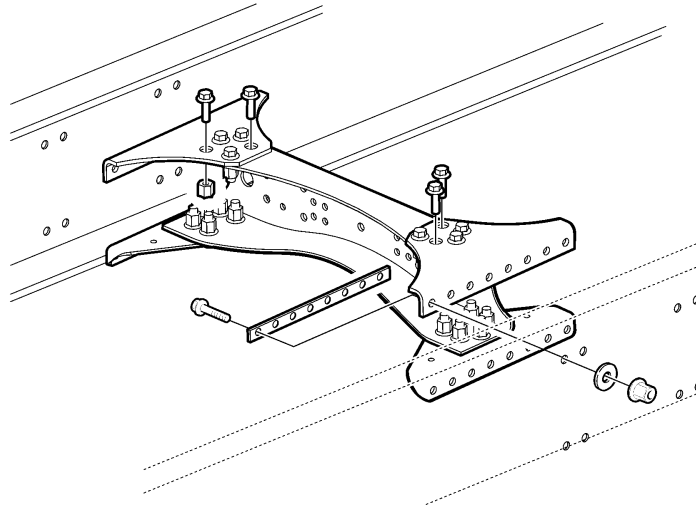
# Installation

- 1 Install top side plates using supplied fasteners in outermost positions.

**Note:** Secure remaining holes in webbing frame rail and vertical frame of cross member with removed fasteners.

**Note:** Be sure to install spacers under bolt heads.

**Note:** Place supplied vertical frame bolts into top side plate before securing.



W7036729

- 2 Put vertical frame in place. Hand tighten top side plate fasteners.
- 3 Install bottom side plates.  
**Note:** Torque  $200 \pm 30$  Nm.
- 4 Move driver side airline aside near cross member for fastener access.
- 5 Reinstall driver side airline into place.
- 6 Loosen the four carrier bracket fasteners.
- 7 Install drive shaft carrier to vertical frame in previous position.
- 8 Reposition carrier properly. Secure carrier bracket fasteners.
- 9 Remove jack from drive shaft.
- 10 Secure cab airline.

# Closing Cross member, Replacement

## Removal

- 1 Remove taillight assemblies and wiring harness clamps.
- 2 Remove closing cross member fasteners.



### WARNING

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate, which can result in serious personal injury.

- 3 For air suspension, disconnect and remove air line for left side rear air bag and remove left side upper shock absorber bracket. Also remove leveling valve assembly on 4x2 tractor.
- 4 Remove closing cross member.

## Installation

- 1 Place new closing cross member between the frame rails.
- 2 Install and tighten the cross member fasteners. Tighten fasteners to a torque of:  
M14: 200 ± 30 Nm (147.51 ± 22.12 ft-lb)
- 3 For air suspension, install upper shock absorber bracket and air line for left side rear air bag. On 4x2 tractor, install leveling valve assembly.
- 4 Install taillight assemblies and wiring harness clamps.

# Engine Cross member, Replacement (Rear)



### WARNING

Do not remove the coolant fill cap (or cap on the expansion tank) if the coolant is hot; wait until coolant temperature is less than 50° C (120° F). Otherwise, scalding steam or fluid may escape under pressure, which can cause serious injury.



### WARNING

Coolant may be combustible. Coolant leaked or spilled onto hot surfaces or electrical components can cause a fire. Clean up coolant spills immediately.



### WARNING

Use a hoist or get assistance when lifting components that weigh 23 kg (50 lb) or more. Make sure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct capacity. Make sure hooks are positioned correctly. Always use a spreader bar when necessary. The lifting hooks MUST NOT be side loaded. Failure to follow these warnings may result in personal injury.

# Removal

- 1 Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.
- 2 Remove the ABS modulator valves from the front engine cross member and/or the frame rails on both sides of the front engine cross member.
- 3 Support the frame rail on both sides of the front engine cross member and remove the front spring pins. This step is for VN (4) models only.
- 4 Support the front of the engine with a hoist.
- 5 Drain the coolant into a suitable container. Disconnect the lower radiator hose and air cooler hose. This step is for VN (4) models only.
- 6 Remove the fasteners that hold the front engine isolator mount to the front engine cross member.
- 7 Slowly raise the engine with the hoist to separate the isolator from the cross member.
- 8 Remove the fasteners that mount the front engine cross member to the spring hangers on the VN (4). For the VN (4) models, remove the fasteners that mount the spring hangers to the frame rail. For the VN (4) axle forward, remove the frame bracket on one side to assist in the removal of the front engine cross member. For the VN (4) axle back, remove the front engine mount isolator from the engine to assist with the removal of the front engine cross member.
- 9 Remove the front engine cross member.

# Installation

- 1 Install the front engine cross member.
- 2 Install the front engine mount isolator on the VN (4) axle back. Tighten fasteners to a torque of  $105 \pm 20$  Nm ( $78 \pm 13$  ft-lb). Install the frame bracket on the VN (4) axle forward, or install the spring hanger fasteners to the frame rail on the VN (4) models. Tighten fasteners to a torque of  $200 \pm 30$  Nm ( $147.51 \pm 22.12$  ft-lb).
- 3 Lower the engine and install the front engine mount isolator to the front engine cross member.
- 4 Connect the lower radiator hose and the air cooler hose on the VN (4) models. Fill the radiator with coolant.
- 5 Install the front spring pins on the VN (4) models. Tighten fasteners to a torque of:  
 $85 \pm 15$  Nm ( $63 \pm 11$  ft-lb)
- 6 Install the front ABS modulator valves. Tighten fasteners as follows:  
M10: tighten to a torque of  $70 \pm 12$  Nm ( $51.62 \pm 8.85$  ft-lb)

## Notes

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# Rear Suspension Cross member (Bogie), Replacement

## Removal

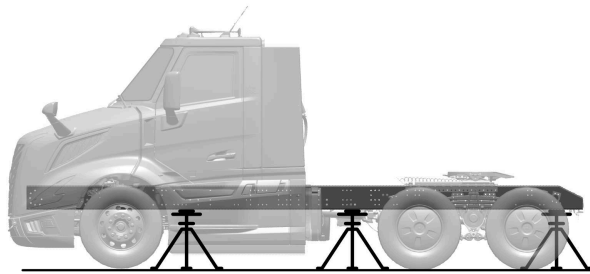
- 1 Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.
- 2 Remove the rear light bar and mud flaps.
- 3 Remove the closing cross member. See “Closing Cross member, Replacement”, page 60 .
- 4 Remove the wiring harness support brackets that are located between the rear suspension cross member and the closing cross members.
- 5 Remove the airline support brackets located under the rear suspension cross member.



### WARNING

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate, which can result in serious personal injury.

- 6 Remove the brake valves and brake hoses that are mounted to, or located at, the rear suspension. Also remove the Traction Control Valve (TCS) mounted to the frame rail if the vehicle is equipped with TCS.



T7205020

- 7 Using jack stands, support the nose of the first and second drive axles and the rear section of the frame rails.
- 8 Remove the bump stops and the upper shock brackets for the rear drive axle.
- 9 Remove the intermediate cross member. See “Intermediate Cross member, Replacement (Bolted and Exposed Rivets)”, page 58 .
- 10 Remove the fasteners for the spring hangers on the rear drive axle on trucks equipped with the Volvo Optimized Air Suspension.
- 11 Remove the remaining fasteners to the rear suspension (Bogie) cross member and remove the rear suspension (Bogie) cross member.

# Installation

- 1 Once this step is complete, go back and tighten fasteners that have been installed from steps 1 through 7 as follows:  
Install the rear suspension (Bogie) cross member. Install and tighten fasteners as follows:
- 2 M14: tighten to a torque of  $200 \pm 30$  Nm ( $147.51 \pm 22.12$  ft-lb)  
M16:  $320 \pm 50$  Nm ( $236.01 \pm 36.87$  ft-lb)
- 3 Install the fasteners to the spring hangers on the rear drive axle and apply proper torque on trucks equipped with the Volvo Optimized Air Suspension.
- 4 Install the intermediate cross member and tighten the fasteners to a torque of  $200 \pm 33$  Nm ( $148 \pm 24$  ft-lb).
- 5 Install the upper shock brackets and the bump stops and the tighten fasteners.
- 6 Install the brake valves and hoses located near the rear suspension cross member.
- 7 Install all the wiring harness and airlines mounting brackets.
- 8 Install the light bar and mud flaps.
- 9 Install the closing cross member. See "Closing Cross member, Replacement", page 60 .
- 10 Remove any supports for the frame rails and the drive axle.

## Notes

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# Rear Suspension Cross member (Bogie), Replacement (Aluminum)

## Removal

- 1 Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.
- 2 Remove the fasteners that mount the fifth wheel to the fifth-wheel angles and slide the fifth wheel forward out the way.
- 3 Jack up the truck and place jack stands under rear drive axle and frame.
- 4 Remove both right and left rear drive tires and wheels.
- 5 Remove the pneumatic valve package from the rear suspension cross member.

**Note:** It should not be necessary to disconnect any air lines from the valve package.

- 6 Place a jack stand under the nose of the rear drive axle housing to keep the front of the differential from dropping down when all of the Huck fasteners are removed.
- 7 Using the Huck removal tool, remove the Huck fasteners mounting the cross member from both sides of the frame rail. Remove fasteners mounting the cross member to the frame rails if not equipped with Huck fasteners.

**Note:** If some of the Huck fasteners are too long, you will need to use a right angle grinder to cut off some of the excess from the threaded end of the Huck fasteners.

- 8 Using a saw of adequate rating, cut through the vertical frame of the cross member being removed and remove the cross member.

**Note:** If an Aluminum cross member is being replaced by an Aluminum cross member, then there is no need to cut the vertical frame for removal; just unbolt the end caps and remove the cross member.

## Notes

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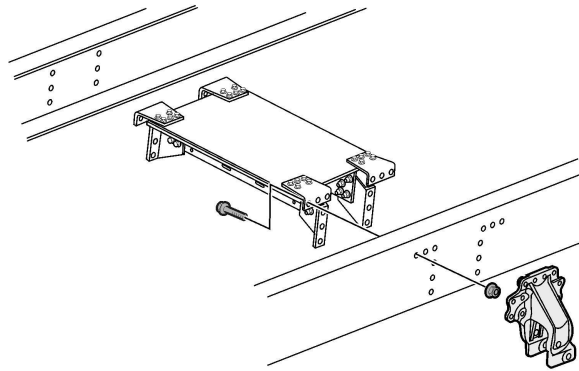
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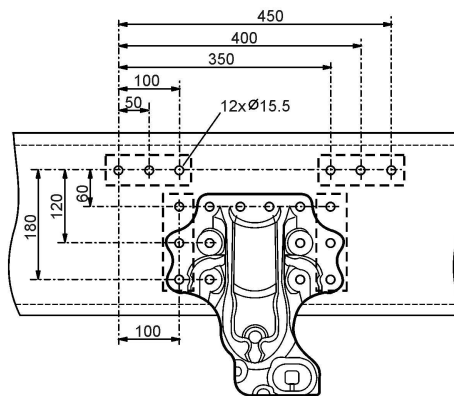
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- Using the illustrations provided as reference, lay out and mark positions for additional holes needed in the right and left frame rails and drill additional holes needed for installation of the Aluminum cross member.

**Note:** If an Aluminum cross member is being replaced by an Aluminum cross member, then no additional holes need to be drilled in the frame for installation.



W7001470



W7001471

- Remove the end plates from the Aluminum cross member so that the cross member can be installed between the frame rails.

## Installation

- Position the cross member between the frame rails and install end caps to cross members. Install fasteners but do not tighten at this time.
- Install bolts through the frame to the cross member.
- Install bolts for all stand off brackets for the electrical and pneumatic harnesses also installing bolts into all unused bolt holes in the frame.

**Note:** Install bolts but do not tighten at this time.

- Tighten all bolts in the frame and torque to 156 Nm (115 ft-lb).
- Tighten all bolts in the cross member and torque to 65 Nm (48 ft-lb).
- Bolt the pneumatic valve to the cross member.
- Install the fifth wheel on the fifth wheel angles.
- Install both right and left side wheels and tires. Torque lug nuts to 780 Nm (575 ft-lb).

# Rear Suspension Cross member (Bogie), Replacement (Steel to Aluminum)

## Removal

- 1 Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.
- 2 Remove the fifth-wheel fasteners from the fifth-wheel angles and slide the fifth wheel forward out of the way.
- 3 Jack up the truck and place jack stands under rear drive axle.
- 4 Remove both the right and left rear drive tires and wheels.
- 5 Remove the pneumatic valve package from the rear suspension cross member.
- 6 Place a jack stand under the nose of the rear drive axle housing to keep the front of the differential from dropping down when all of the Huck fasteners are removed.
- 7 Using the Huck removal tool, remove the Huck fasteners from both sides of the frame rail.  
**Note:** If some of the Huck fasteners are too long you will need to use a right angle grinder to cut off some of the excess from the threaded end of the Huck fastener.
- 8 Remove the end plates from the cross member so that the cross member can installed between the frame rails.
- 9 Position the cross member between the frame rails and install end caps to cross members. Install fasteners but do not tighten at this time.

## Installation

- 1 Install the bolts through the frame rails.
- 2 Install bolts for all stand off brackets for the electrical and pneumatic harnesses, also installing bolts into all unused bolt holes in the frame.  
**Note:** Install bolts but do not tighten at this time.
- 3 Tighten all bolts in the frame at this time and torque to 156 Nm (115 ft-lb).
- 4 Tighten all bolts in the cross member at this time and torque to 85 Nm ( ft-lb).
- 5 Bolt up the pneumatic valve to the cross member.
- 6 Install the fifth wheel on the fifth wheel angles.
- 7 Install both right and left side wheels and tires, torque lug nuts.

## Notes

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# Frame Length, Adjustment



## CAUTION

It is the sole responsibility of the body builder to verify the axle alignment is corrected after making modifications such as, mounting a body, adding an axle or changing the wheelbase.



## WARNING

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with debris or fluids.

**Note:** Total wheel vehicle alignment may be necessary after completing this procedure. Refer to the appropriate service information.

**Note:** The only approved alteration to the frame is shortening of the vehicle wheelbase by moving the rear axle(s) forward and cutting the excess frame from the end. Frame rails are not to be spliced or extended.



## WARNING

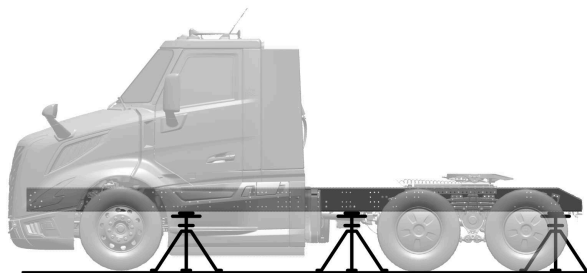
Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate, which can result in serious personal injury.



## WARNING

Use a hoist or get assistance when lifting components that weight 23 kg (50 lb) or more. Make sure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct capacity. Make sure hooks are positioned correctly. Always use a spreader bar when necessary. The lifting hooks **MUST NOT** be side loaded. Failure to follow these warnings may result in personal injury.

- 1 Place the vehicle on jack stands at the normal ride height. Do not jack the vehicle up.



T7205020

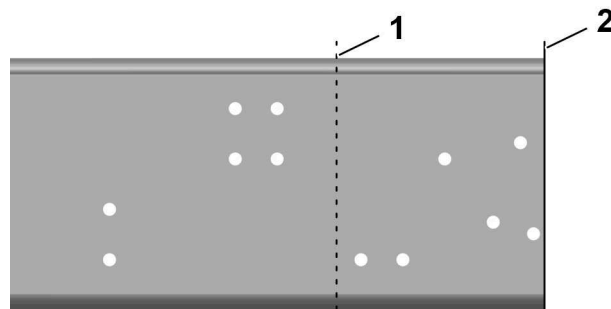
- 2 Remove the drive shaft.
- 3 Unbolt the fifth-wheel angle irons from the frame and remove the fifth wheel and the angle irons as an assembly.
- 4 Mark the frame at the existing wheelbase (center line of the rear axle for single axle and center between axles for a tandem axle).
- 5 Unbolt the existing suspension brackets, hardware and cross members.

- 6 Unbolt and remove any other brackets, hoses, or electrical wiring that obstruct the area of the frame to be altered.
- 7 Remove any intermediate cross member that will no longer be needed.
- 8 Make a template of the hole pattern for the rear suspension using the existing wheelbase and hole pattern as reference points.
- 9 Determine the new wheelbase for the vehicle and mark on the frame rails.
- 10 Mark and drill the new holes necessary to accommodate the rear axle cross member at its new position. Refer to “Bolt Hole Patterns”, page 11 .
- 11 Unbolt the rear axle cross member end plates from the frame and move the cross member to its new position.
- 12 Bolt up the suspension and cross members. Tighten the fasteners as follows:  
M14 200 ± 30 Nm (47.51 ± 22.12 ft-lb)  
M16: 320 ± 50 Nm (236.01 ± 36.87 ft-lb)
- 13 Remove the jack stands from under the frame.
- 14 Determine the appropriate minimum overhang from the table below.

Axle Type	Overhang		
	Straight End	Tapered end*	Tapered end**
<b>4x2</b>	838 mm	813 mm	889 mm
<b>6x4</b>	1371 mm	1346 mm	1422 mm

\* For bar type mud flap brackets\*\* for spring type mud flap brackets

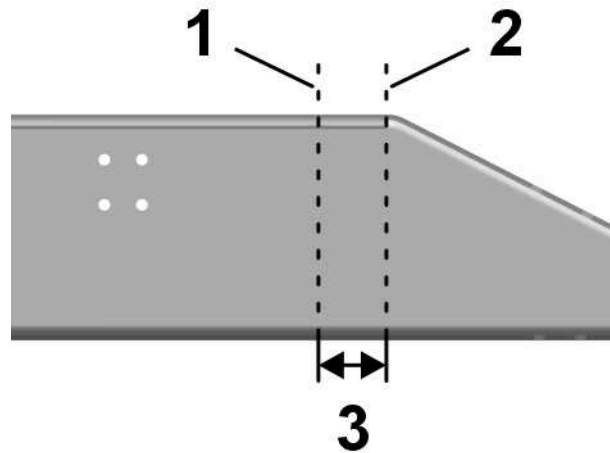
- 15 Measure rearward from the new center line of the rear axle (4x2) or from the new center line of the bogie (6x4) the overhang amount. Mark that point on the frame rails as the **desired end of frame**. **DO NOT CUT THE FRAME**.



T7205021

- 1 Desired End of Frame
- 2 Current End of Frame

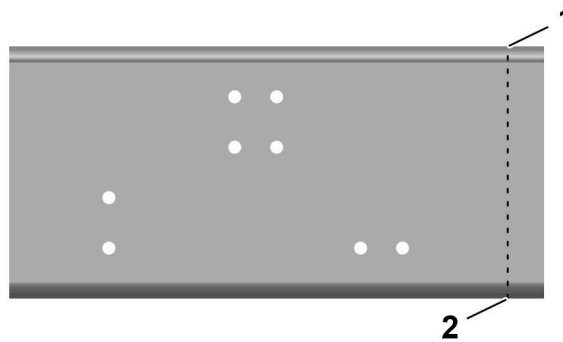
- 16 For tapered rail ends only, mark the frame rail at a point 28.5 mm (266 mm frame height) or 36 mm (300 mm frame height) past the mark for desired end of frame. This is the **rough cut** mark.



T7205022

- 1 Desired End of Frame
- 2 Rough Cut
- 3 28.5 mm (266 mm frame)  
36.0 mm (300 mm frame)

- 17 For straight rails, cut the excess frame off at the mark for **desired end of frame**. For tapered rails, cut the excess frame off at the mark for **rough cut**.



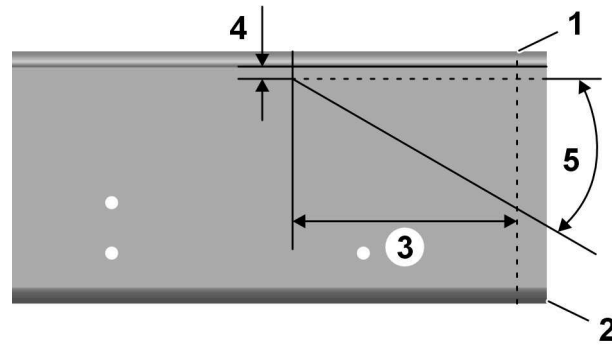
T7205023

- 1 Desired End of Frame
- 2 Rough Cut

- 18 Insert the closing cross member between the frame rails and slide it as far forward as possible.

**Note:** Steps 20 through 29 for cutting, beveling and welding the frame web apply only to vehicles that require a tapered closing cross member.

19 Mark a wedge shape on the frame web for cutting. Refer to the table below for dimensions.

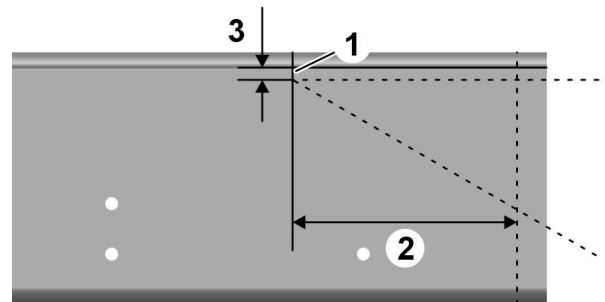


T7205024

- 1 Desired End of Frame
- 2 Rough Cut
- 3 See Table for Dimensions
- 4 12 mm
- 5 27°

Frame Height	Frame Thickness			
	6 mm	7 mm	8 mm	9.5 mm
266 mm	219.8 ± 2 mm	217.6 ± 2 mm	215.9 ± 2 mm	
300 mm	280.7 ± 2 mm	278.7 ± 2 mm	276.7 ± 2 mm	274.8 ± 2 mm

20 Drill a 24 mm diameter hole with center at the upper corner of the wedge (12 mm below the bottom of the upper flange).

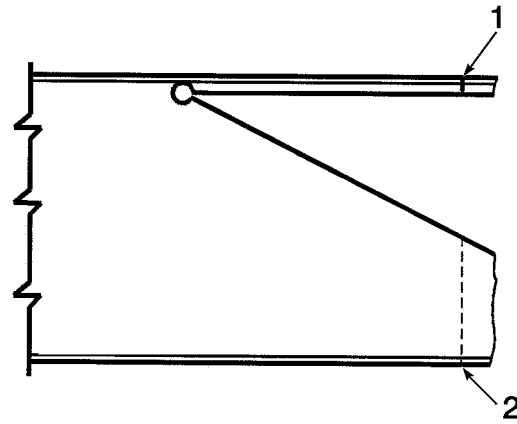


T7205025

- 1 Drill Hole Here
- 2 See Table for Dimensions
- 3 12 mm

21 Verify the angle of the wedge is  $27 \pm 0.25^\circ$ .

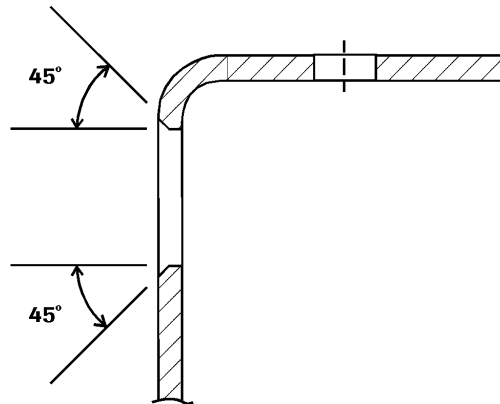
22 Cut out the wedge.



W7001172

- 1 Desired End of Frame
- 2 Rough Cut

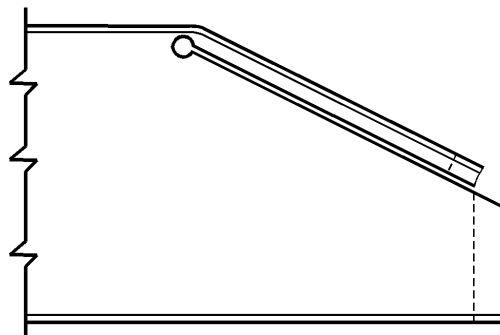
23 Bevel the outer edges of the cuts to 45°.



W7000390

24 Bend the upper flange down until it makes contact with the web.

**Note:** It may be necessary to heat the flange in order to bend it.



W7000408

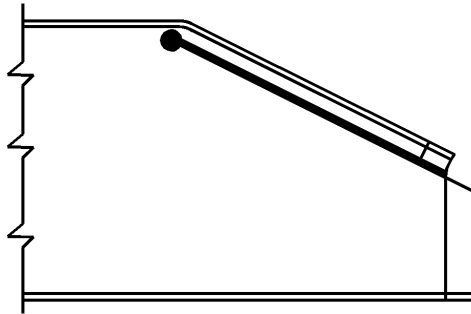
25 Verify the proper fit up of the tapered cross member before welding.



## WARNING

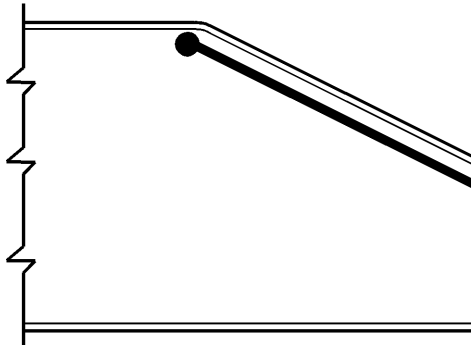
Eye injury hazard. Wear eye protection during welding. Failure to wear eye protection could result in severe eye injury and blindness.

- 26 Weld the cut edges of the web together.



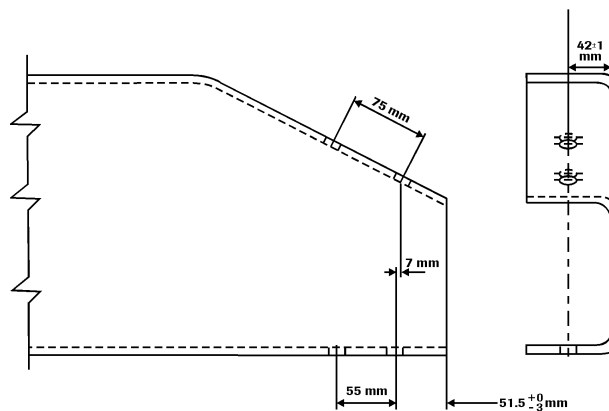
W7000413

- 27 Cut off the end of the frame rail at the desired end frame mark.



W7000414

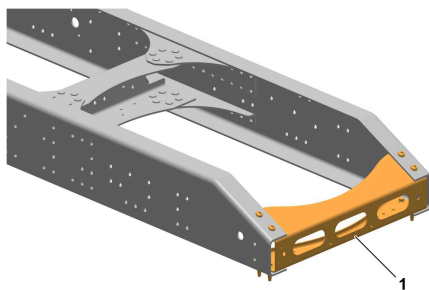
- 28 Repeat the cutting and welding process for the other frame rail.  
29 Measure, mark and drill holes in the frame to accommodate the closing cross member.



W7000391

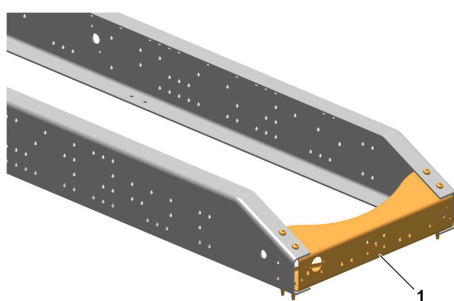
- 30 Grind the end of the frame and the welded areas smooth and paint all bare metal frame surfaces.

- 31 Slide the closing cross member into place. Tighten tapered cross member bolts to:  
275 ± 45 Nm (203 ± 33 ft-lb)



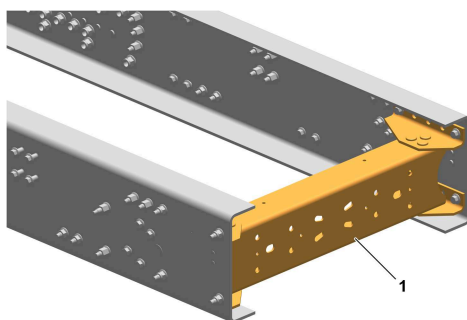
T7202744

1. Closing cross member (Rear) (VNL, VNR – Tractor)



T7202829

1. Closing cross member (Rear) (VNL, VNR – Tractor)



T7218136

1. Straight cut closing cross member (Rear) (VNR – Rigid)

- 32 Mark and drill holes for the fifth-wheel angle irons. Bolt the fifth-wheel assembly to the frame and tighten bolts to:  
275 ± 45 Nm (203 ± 33 ft-lb)
- 33 Install and tighten an appropriate size metric flange bolt into each frame rail web hole that is not used.
- 34 Measure distance from transmission pinion to axle pinion, and record the distance. Have a certified drive-line shop alter the drive shaft for this distance.
- 35 Install the drive shaft.
- 36 Check the pinion angles and ride height, if necessary make corrections.

## Notes

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# Body Bound Bolt, Installation



## WARNING

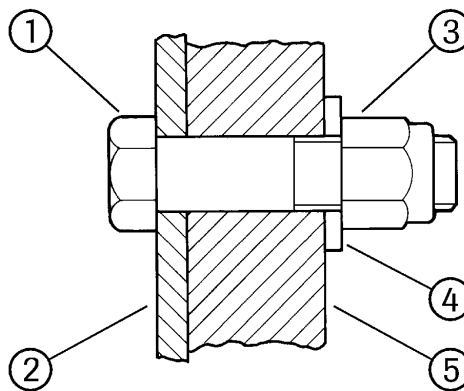
Always wear appropriate eye protection to prevent the risk of any eye injury due to the contact with debris or fluids.



## CAUTION

Only use a reamer with clockwise rotation. Do not reverse rotation to remove the reamer. Use a drill with a maximum 350 rpm no-load speed. Always use cutting oil. Failure to follow these precautions will result in damage to the reamer.

- 1 Ream the holes in the cross member and end plates or bracket to 16.56 mm (0.652 in.).
- 2 Clean out any metal chips that remain in the holes.
- 3 Measure the thickness of the end plate or spring bracket.



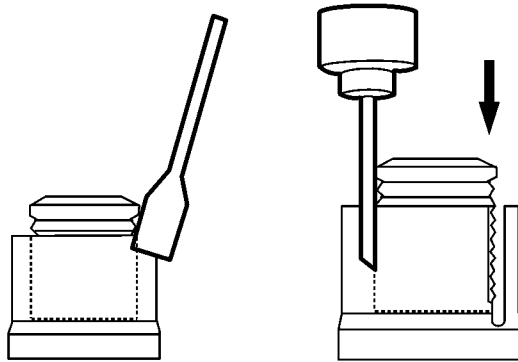
W7000383

- 1 Body bound bolt
- 2 cross member
- 3 Elastic stop nut
- 4 Hardened flat washer
- 5 End plate or spring bracket

- 4 Multiply the thickness from Step 3 by 66%.
- 5 Measure the thickness of the cross member.
- 6 Add the thickness values from Steps 3 and 5. This is maximum bolt shank length.
- 7 Add the thickness values from Steps 4 and 5. This is minimum bolt shank length.
- 8 Select a body bound bolt with a shank length between the minimum and maximum shank length.
- 9 Install the body bound bolts in each hole that was reamed. Place a hardened steel washer and a stop nut on each bolt.
- 10 Tighten the nuts to:  
225 ± 37.5 Nm (166 ± 28 ft-lb)  
Hit the bolt with a brass hammer several times during torquing to insure proper seating.

# HUCKBOLT® Permanent Fastener, Removal

The HUCKBOLT Permanent fasteners have a “swagged” over the grooved pin. No amount of twisting or hammering will dislodge or remove the pin from the collar. The collar must be cut parallel to the HUCKBOLT pin end of the swagged section. This is best accomplished with a small wheel grinder. Other options may be to use a drill or chisel to create openings on the collar wall.



W7001282

Fig. 8 Optional Collar Removal Procedures



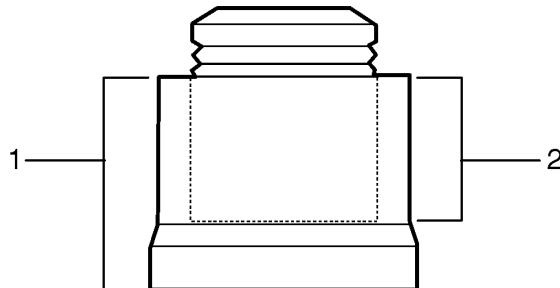
## CAUTION

HUCKBOLT® Permanent Fasteners are clamped at a very high torque and they may release suddenly. Wear proper eye protection and keep your face at least two feet away from the collar. **Do not use a cutting torch for removal.**

**Note:** For further information on Huck Fasteners and Tooling, download the catalog.

<https://huckfastening.com/huck-bolts/>.

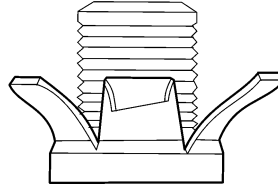
- 1 Using a wheel grinder (preferred method) cut a vertical groove into the “swagged” section of the HUCKBOLT® collar on two or more sides (see arrow in Fig. 17).



W7001283

- 1 Collar Section
- 2 Swagged Section

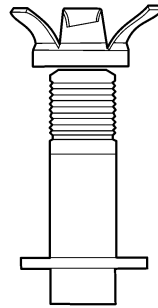
- 2 After the collar is opened over the length of the swagged portion on two or more opposing sides, the pin may become free. If not, additional collar material should be pulled away from the swagged section of the collar using vice grips or a chisel.



W7001274

- 3 Remove the pin after sufficient material is pulled away from the swagged section of the collar.

**Note:** Any fastener that is removed should be replaced with a fastener of equal or greater strength.



W7001276

### Notes

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