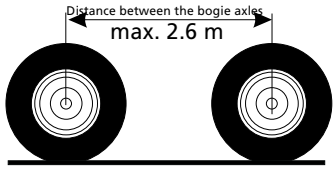
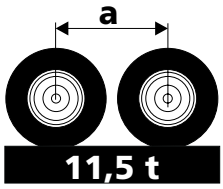
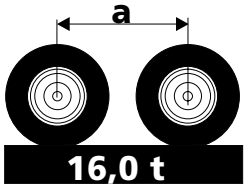
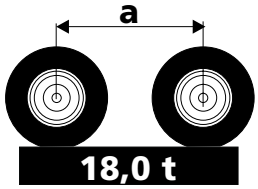
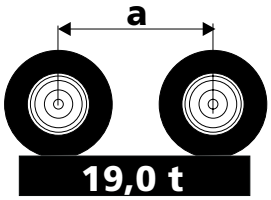
Bodybuilders Instructions

Press Button

3.1 Masses and main dimensions of vehicles and vehicle combinations in international traffic (EC countries)

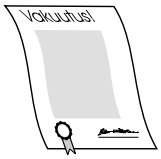
The masses and dimensions of the vehicle referred here must not exceed the values approved in the country where the vehicle is registered or approved for entry into service.

If the registered vehicle is used in other member state of the EEA, the member state may restrict the masses and main dimensions into the following values.

	When a vehicle is driven on the road, the mass on the axle must not exceed the following values: Other than driving axle: 10 tonnes Driving axle: 11.5 tonnes
	When a vehicle or vehicle combination is driven on the road, the mass on the axle or bogie or the maximum laden mass of the vehicle must not exceed the value marked in the vehicle register.
	NOTE! The maximum permissible distance between the bogie axles is 2.6 meters.
	When a motor vehicle is driven on the road, the mass on the bogie must not exceed the following values:
	11.5 tonnes (a < 1.0 m) Two-axle bogie, the distance between the axles is under 1.0 meter.
	16.0 tonnes (a = 1.0–1.299 m) Two-axle bogie, the distance between the axles is over 1.0 meter but under 1.3 meters.
	18.0 tonnes (a = 1.3–1.799 m) Two-axle bogie, the distance between the axles is over 1.3 meters but under 1.8 meters.
	19.0 tonnes (a = 1.3–1.799 m) Two-axle bogie, if the distance between the axles (a) is over 1.3 meters but under 1.8 meters and the driving axle has double wheels and air suspension, or its suspension is recognized to be equivalent to air suspension, or each driving axle has double wheels and the mass on any axle does not exceed 9.5 tonnes.*****
* "A suspension recognized to be equivalent to air suspension" means a suspension system for a vehicle axle or group of axles that complies with the requirements of Annex I, point 7.11 to Directive 97/27/EC. "Air suspension" means a suspension system on which at least 75 percent of the spring effect is caused by the air spring.	

e.g. A tipping gear mounted on a vehicle is a complete machinery and the installer/supplier must issue the above-mentioned EC declaration of conformity referred to in Annex II, point A + attach the CE mark.

e.g. When the vehicle manufacturer or dealer supplies a vehicle equipped with a sander, plow, belly blade, etc. designed for road-maintenance duties, the manufacturer or dealer must issue the declaration of conformity referred to in Annex II, point A and attach the CE mark.



b) The declaration of conformity referred to in Annex II, point B (declaration by the manufacturer, no CE marking), if the machinery is intended to be incorporated into machinery.

e.g. A separate tipping cylinder for a tipping gear is an element and must be accompanied by the declaration of conformity referred to in Annex II, point B, issued by the manufacturer, but no CE marking.

e.g. A tail lift must be must be accompanied by the declaration of conformity referred to in Annex II, point B, issued by the manufacturer (the bodywork company mounting the tail lift on the vehicle will issue the declaration of conformity referred to in Annex II, point A and attaches the CE mark).

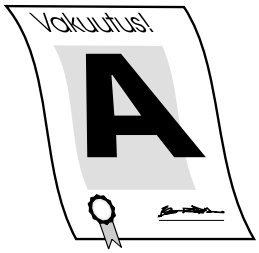
c) The declaration of conformity referred to in Annex II, point C, if the machinery is a safety component supplied separately for the machinery.

(In the Machinery Directive, a safety component means a component to fulfil a safety function when in use and the failure or malfunctioning of which endangers the safety or health of exposed persons. However, a safety component is not interchangeable equipment as defined in Article 1 (2).)

Hence, there are three types of declarations of conformity:
A, B and C.

4.2.3.1 Declaration A.
(declaration of conformity for machinery)

Contents of the EC declaration of conformity for machinery:



(The declaration must be drawn up in the same language as the original instructions and must be either typewritten or handwritten in block capitals. It must be accompanied by a translation in one of the official languages of the country in which the machinery is to be used.)

The EC declaration of conformity must contain the following particulars:
- name and address of the manufacturer or his authorised representative established in the Community;
(Business name and full address; authorised representatives must also give the business name and address of the manufacturer)
- description of the machinery;

(Description of the machinery, e.g. make, type, serial number.)

- all relevant provisions complied with by the machinery;

(e.g. the directives, harmonized standards, etc. that the machinery complies with)

- where appropriate, the name and address of the notified body and number of the EC type-examination certificate;

- where appropriate, the name and address of the notified body to which the file has been forwarded in accordance with the first indent of Article 8(2)(c);

- where appropriate, the name and address of the notified body which has carried out the verification referred to in the second indent of Article 8(2)(c);

- where appropriate, a reference to the harmonised standards;

- where appropriate, the national technical standards and specifications used;

- identification of the person empowered to sign on behalf of the manufacturer or his authorised representatives

9 General safety instructions

Foreword

A bodywork is always constructed for a truck due to its transportation or driving task. Sisu dealers will select the truck's chassis in cooperation with the customer so that it will form, together with the bodywork, an optimal assembly for the vehicle's transportation or driving task.

The bodywork manufacturer/installer must always establish the vehicle's intended purpose and operating conditions carefully with the vehicle owner.

If the bodywork manufacturer/installer for some reason cannot follow this manual's instructions relating to the chassis, or a procedure is not instructed in this manual, he must contact the nearest authorized **SISU** dealer/repair shop.

The bodywork manufacturer/installer should agree with the other parties of the vehicle supply chain (dealer, importer, bodywork manufacturer/installer, etc.) on who will take full responsibility for the bodywork, issue the declaration of conformity, attach the CE mark, and provide and retain the required technical construction files for thirteen years, when the bodywork structure/structures are regarded as machinery.

Mounting bodyworks on heavy trucks will inevitably lead to situations where there is a risk of accident. The risk is eliminated by planning and anticipating different stages of work.

This section presents possible risks that must be anticipated for safe working.

Always follow

- ❑ The safety instructions.
- ❑ Regulations given by the authorities.
- ❑ Instructions and provisions presented in this manual by Sisu Auto Inc.

WHEN WORKING:

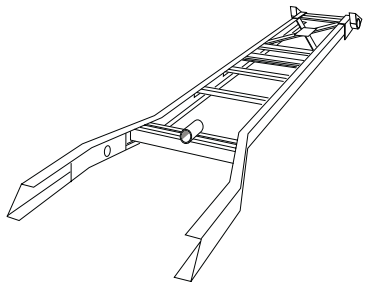
- ❑ Anticipate.
- ❑ Be careful.
- ❑ Follow the instructions.

9.1 Dangers

- ❑ Falling
- ❑ Rolling over
- ❑ Electric shock
- ❑ Pneumatics
- ❑ Hydraulics
- ❑ Coolant
- ❑ Refrigerant
- ❑ Unintentional starting/moving of the vehicle

4 Subframe

4.1 General



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This section gives general guidelines for the subframe structure and mounting on the vehicle's frame. These instructions are universally applicable.

Since the vehicle types, driving tasks and driving conditions are not identical, the structure, dimensioning and mounting of the subframe must be selected separately for each case.

More detailed instructions on the structure, dimensioning and mounting of the subframe on the vehicle's chassis frame are given in the appropriate chapters dealing with different types of subframes.

One of the most important issues in mounting bodyworks is the **tipping stability** of the tipping bodyworks. Almost without exception, all tipping bodyworks require a subframe, which must be dimensioned and constructed correctly.

Furthermore, the mounting of the subframe on the vehicle's chassis must be correct in order to ensure the appropriate tipping stability and durability of the chassis.

4.1.1 Subframe function

The frames of Sisu trucks are dimensioned for an even load. However, the load is not usually distributed evenly over the whole length of the frame, rather than the forces pass into the frame through the bodywork's bearing points. Moreover, e.g. when tipping or in other bodywork operation situations, high point loads are generated on the bodywork mounting point and/or e.g. on the tipping axle; the loads vary between the early and final stages of tipping.

Hence, many bodyworks for different driving tasks require a subframe. **The only exception for this general rule can be made with a SISU high frame.**

The function of the subframe is to distribute the weight of the bodywork and the vehicle's load evenly on the vehicle's chassis, increase the vehicle's frame strength and torsional resistance in different driving tasks and increase e.g. tipping stability on vehicles equipped with tipping gear. In other words, the subframe serves as a flexible and strengthening component on a truck's frame.

4.2 Material

The requirements for subframe material properties depend on the bodywork. In heavy-duty operation, e.g. in tipping vehicles, concrete trucks, etc. the material's strength properties should be close to those of the frame.

If the subframe is subjected to minor stresses only, the strength properties of the subframe material can be clearly lower than the frame's material. In all cases, the material must have good weldability.

Minimum material requirements:

- Yield point: 355 N/mm^2
- Tensile strength: 520 N/mm^2
- Strain: A_5 25%

Material min. S355 (Fe 52)

☛ **Recommended subframe materials for Sisu S- and E-series: RAEX 490 HSF**

4.5 Bolted joints

4.5.1 General

All bodyworks must be attached to the webs of the frame beams with bolted joints. The joint type can be either friction or rigid joint. A rigid joint requires drilling the holes together and broaching in order to insure adequate accuracy.

Bolted joints must always be dimensioned so that the joint is a friction joint only. An operational precondition of a friction joint is the preload of the bolt during tightening.

Since the bolts for bodywork mounting are usually short, the stretch length of the bolts is short. The preload generated in tightening decreases rapidly during driving, since the joint is moving and the paint coatings on the contact surfaces wear out. This is why it is very important to retighten the joint after a certain amount of time from mounting for the proper operation of the joint. For the same reason, the paint coatings on the contact surfaces must be as thin as possible.

The use of lock nuts does not prevent the loosening of the joints, since even if the nut does not move with regard to the bolt, the pretension decreases due to the wearing of the paint coatings. Lock nuts prevent the detaching of nuts.

The clearances between the bolt and the holes drilled in the mounting plate and frame must be as small as possible. This ensures only minimal movement when the joint is under stress. For the same reason, the bolt shank must reach as far as possible through the frame and mounting plate.

4.5.2 Bolted-joint dimensioning, tightening

- The number of bolts must be selected according to the load.
- Simultaneous drilling with a 13.8 mm drill bit for M14 bolts, concerning the mounting plates and cross beams.
- Simultaneous drilling with a 15.8 mm drill bit for M16 bolts, concerning the mounting plates and cross beams.
- The bolt shank must reach as far as possible through the bracket and frame.

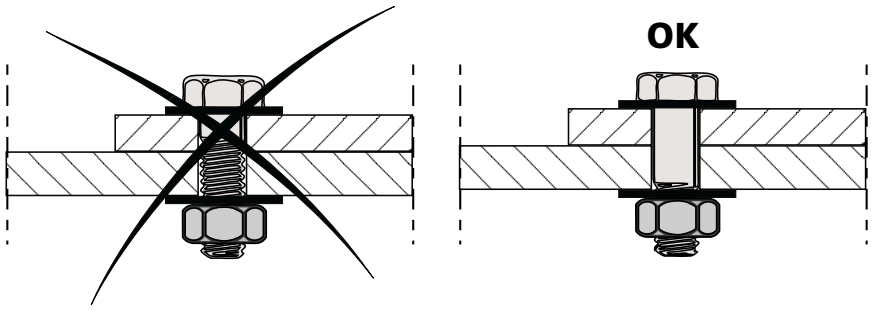


Fig. 907023

- Washers must always be used under the bolt and nut.
- Only lock nuts may be used for locking (spring washers are prohibited).

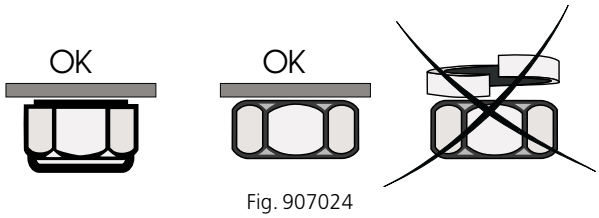


Fig. 907024

- We recommend grade 8.8 fine-threaded M14 bolts, specially designed for Sisu frames. The diameter of the bolt shank is higher than in the standard M14 bolts, which allows a tightening torque of 130 Nm. The length of the bolt must be selected according to the joint thickness using the following table.

1.3.4 Mounting the tipping gear on a vehicle with a high frame

Since vehicles with high frames do not require a subframe, tipping-gear Z-beams must be mounted on the web of the frame beam with mounting plates.

☛ **NOTE! Welding the Z-beams to the frame beams is strictly prohibited!**

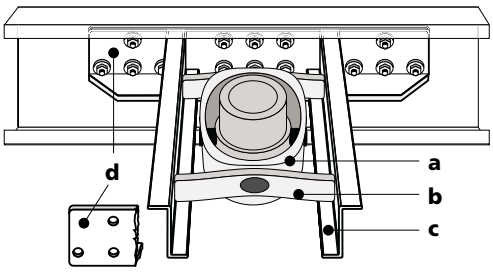


Fig. 908050

Fig. 908050 shows an example of mounting the tipping gear

A = cradle
b = rack beam
c = Z-beam
d = mounting plates

- Construct L-section mounting plates that are sufficiently strong regarding the tipping-gear load.
  Dimension the mounting plates appropriate for the Z-beams and the required number of mounting bolts. (For example, see Fig. 908052.)

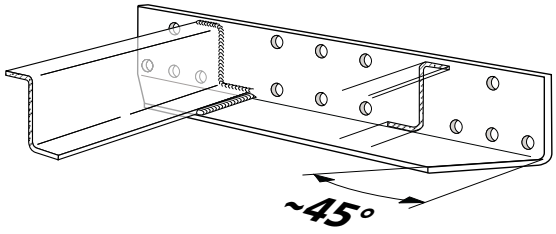


Fig. 908053

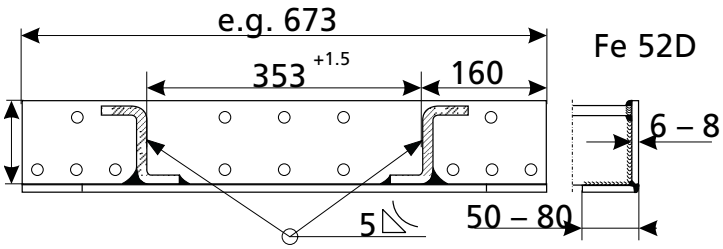


Fig. 908052en

An L-section can be manufactured by bending the plate 90° or welding a 50–80 mm flange to the plate. Chamfer both ends of the flange to 45°.

Mounting plate thickness: 6–8 mm, minimum material requirement: Fe 52D

- The mounting plates must be mounted on the webs of the frame beams at an appropriate height and using sufficient number of bolts with regard to the tipping-gear load. For mounting holes and bolted joints, see section **2** and follow the tipping-gear manufacturer's instructions.
- Cut the Z-beams to an appropriate length (web width – mounting plate thickness). The Z-beams must be cut at both ends so that the tipping gear cradle is located exactly in the middle of the frame. See tipping-gear manufacturer's instructions.
- The Z-beams must be welded to the mounting plates when the beams are in their correct position inside the vehicle's frame. Weld a continuous seam carefully around the object according to the welding instructions.

The mounting plate shown in Fig. 908052en is for a Z-beam distance of 353 mm. If the Z-beam distance is shorter or longer, the total length of the mounting plate is altered accordingly.

The height of the mounting plate should be approximately 10 mm higher than the Z-beams so that the upper and bottom edges of the Z-beams can be properly welded.

When mounting the tipping gear, more space can be obtained by removing the upper square hollow section of the frame cross beam, if required. See Fig. 908051.

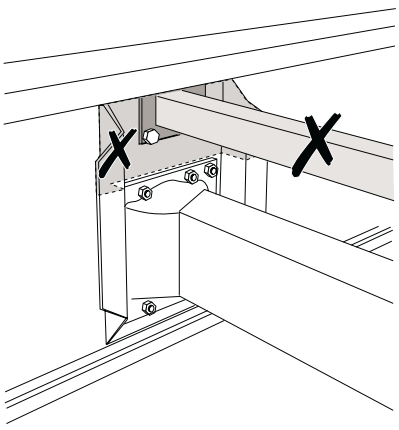


Fig. 908051

1.3.5 Warnings

Relocating the cross beams located at the spring brackets or propeller-shaft bearing is strictly prohibited without the prior consent of the vehicle's manufacturer.

The tipping cylinder/gear must be mounted according to both the tipping gear manufacturer's instructions and the instructions by Oy Sisu Auto Ab presented in this manual regarding the mounting of tipping gear onto the chassis frame.

- The subframe must include the same number of cross beams as the vehicle's frame, and they must be located at the chassis-frame cross beams.
- The frontmost cross beams must be constructed with an open section, e.g. U-section.
- At the rear, the last two cross beams must be constructed with a closed RHS section, and there must be rigid mounting brackets on the chassis frame at their location. The last cross beam of the subframe should be at the rearmost cross beam or trailer-coupling mounting beam of the chassis, unless this is prevented by structural factors.
- The cross beams are mounted on the webs of the longitudinal beams by bolting or welding; welding continuously around the object.
- The frame of a fixed platform or van body can also be integrated into the subframe, i.e. the platform's cross beams at the same level as the subframe, resulting a slightly lower construction (see figures).

Fig. 903
/908022

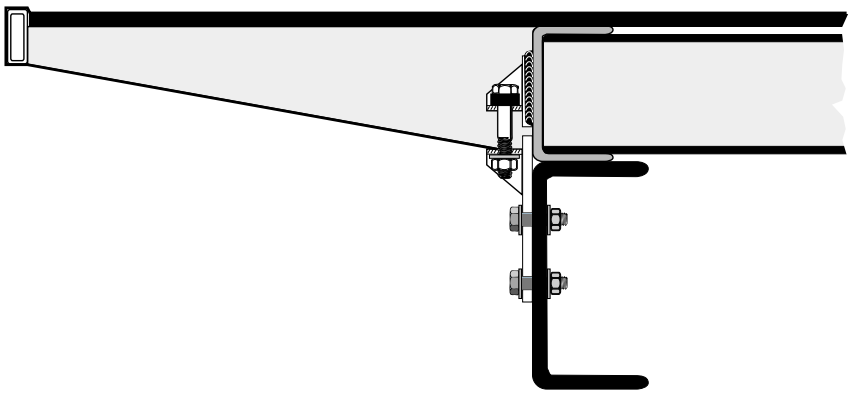
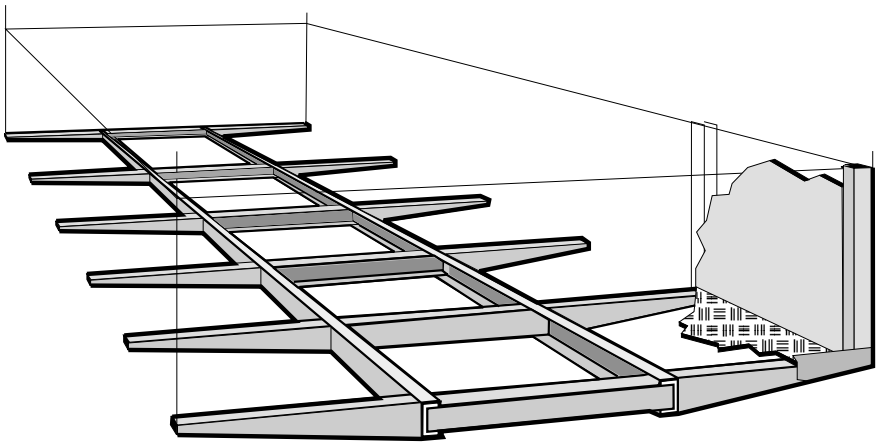


Fig. 886
/908023



2.3 Mounting the bodywork

- The vehicle's frame must be level when mounting the bodywork.

Read the instructions on bodywork mounting in general guidelines 03.

2.3.1 Mounting

The front of the subframe is attached to the longitudinal beams of the chassis

5.6 Timber bunks

Fig. 1209/908033, item C.

- Timber bunks are mounted according to the bunk manufacturer's instructions.
- Mounting the timber bunks directly on the frame upper flange is strictly prohibited.

In high-frame vehicles where the bunks are mounted directly on the frame, strong L-sections must be bolted to the web of the frame at the upper flange level on both sides.

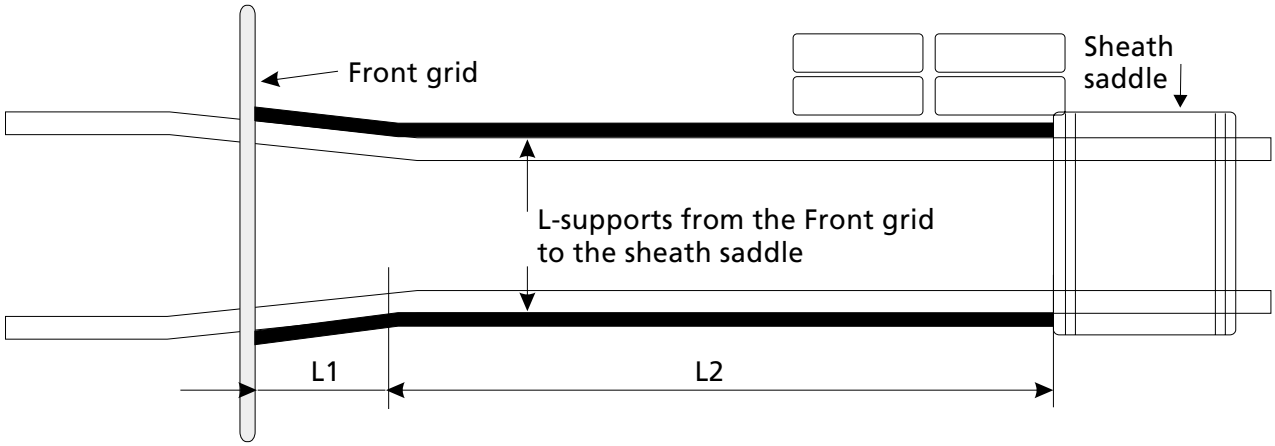


Fig. 1118/908036

The timber bunks are attached to the L-sections in high-frame vehicles.

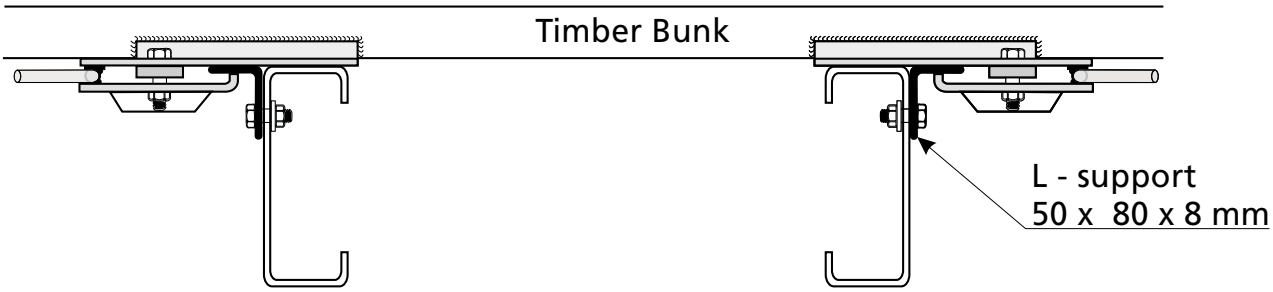


Fig. 1117/908037

- The timber bunk mounting must not prevent the torsional movement of the frame or subframe, i.e. the mounting must be flexible (bolt mounting).
- In vehicles with a subframe, the timber bunks must be mounted according to the bunk manufacturer's instructions.
- Note!
  Ready-made L-sections can be purchased from your nearest RS Hansa Auto Oy dealer.

1. Van body or container

1.1. General structure information

A van body is mounted either on a subframe or a frame resting on the chassis frame along its total length is constructed in the van body. Here a container means the container itself and the subframe designed for transporting the containers and to which the container is positively locked.

When using a subframe, the subframe is constructed according to the general instructions (section 02) and dimensioned according to the requirements set by the bodywork.

If a van body is so called integrated type, i.e. the mounting frame is a part of the van body, the mounting frame must start as far to the front as possible. The best results are achieved if the integrated mounting frame (figure 908023) is constructed to reach under the cab according to the subframe length requirements.

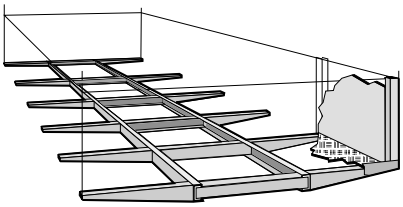


Fig. 908023

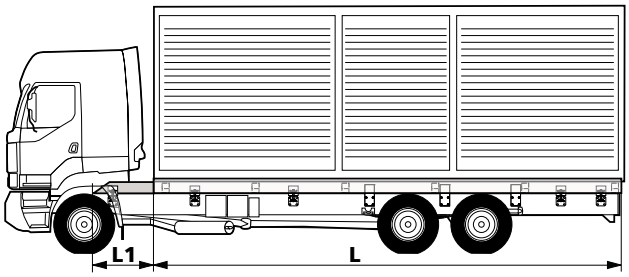


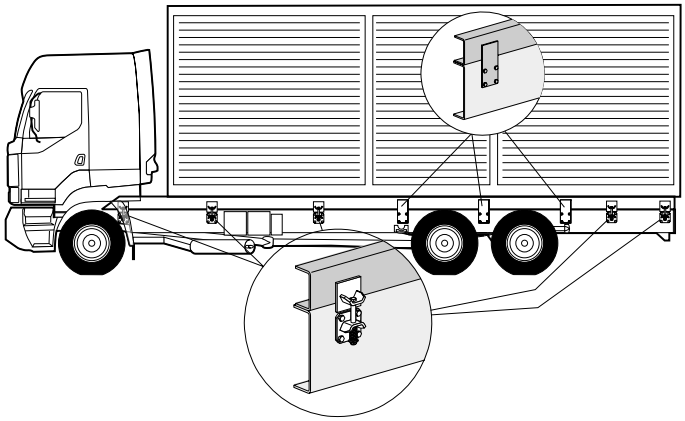
Fig. 936002

This van body mounting frame construction decreases the load acting on the chassis frame and dampens the frame vibration which decreases riding comfort. The frame must also be constructed so that the load is as far forward as possible (if front axle load allows).

The most important issue when installing a rigid bodywork is that the bodywork mounting frame or subframe (if a subframe is used) is mounted on the chassis frame according to the following principles:

- The mounting between the chassis frame and subframe or between the chassis frame and bodywork mounting frame must be flexible
- The bodywork may resist but may not prevent the torsional movements of the chassis frame when driving on uneven surfaces (the dampening of flexible movements prevents the frame vibration when driving on even roads).
  The mounting brackets must allow upward movements of cargo space with regard to the frame. The mounting bracket must guide the cargo space in longitudinal and lateral direction but must also allow minor longitudinal movement due to the frame's torsional, lateral and bending movements.
  The flexibility is acquired by using flexible mounting brackets. The mounting brackets must allow the appropriate flexibility suitable for the bodywork stiffness and driving conditions.

Fig. 936003



The bodywork mountings are usually flexible at the front, then rigid at the rear axle area and again flexible at the **long** rear overhang area.

3.4. Milk transport lorries

The bodywork in milk transport lorries usually consists of a space for dry cargo and a milk tank.

In mounting the milk tank on the chassis frame, the same rules apply as for tank lorries in general.

An allowable exception is mounting the tank on the chassis frame without a subframe (or if the mounting frame of the tank does not extend under the cabin) in 6x2 trucks with a maximum tank volume of 15 m^3, provided that the chassis frame is equipped with a long inner frame (the inner frame reaches from the rear of the truck to the front of the rear spring shackle of the front axle).

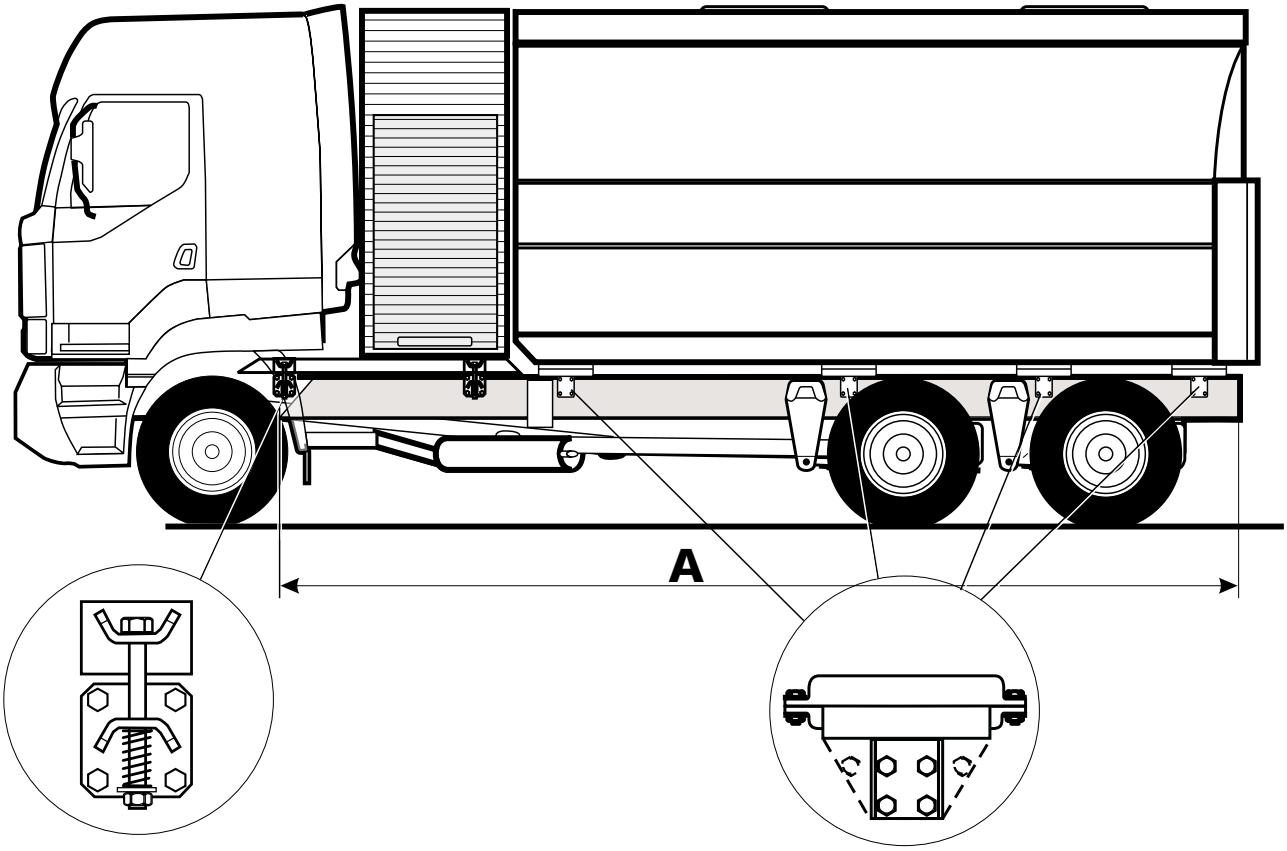


Fig. 936039

A = The long inner frame on the chassis frame. Mounted at the car factory (if ordered).

The dry cargo space is mounted on its own short subframe which must begin under the cab, in accordance with the general instructions. The front and the rear of the subframe must be bevelled by 45°. The subframe is mounted on the chassis frame with two or three flexible mounting plates on each side.

The dry cargo space must be securely mounted in the subframe. There must be enough room to allow the movement of the cab and the milk tank.

1. Additional devices, mounting in front of the cab

1.1. General

Front-mounted additional devices are usually used for road maintenance, e.g. snow plow, brush. Almost without exception, the devices are attached to the headgear and connected to the hydraulic system with quick connectors. These devices must be CE marked and include the declaration of conformity issued by the manufacturer.

Devices mounted on top of the cab are usually lights or horns. For mounting these devices, instructions are given on drilling the holes in the roof and packing nuts, either already provided or to be installed later.

1.2. Headgear

Headgear is optional equipment that enables the mounting of a front plow, brush or equivalent device on front of the vehicle.

Fig. 963005

Headgear can also be retrofitted to Sisu S- and E-series trucks. A section is cut off from the plastic bumper and replaced by the headgear.

The parts required for each vehicle model can be purchased from your nearest authorized dealer.

1.2.1. Mounting

Grade 12.9 bolts must be used for headgear mounting.

The maximum static moment generated by a device attached to the headgear is 17.3 kNm at the level of the headgear's front surface.

If this moment load is exceeded, the frame's front extension must be strengthened. Your nearest authorized dealer must be consulted for detailed instructions for each case.

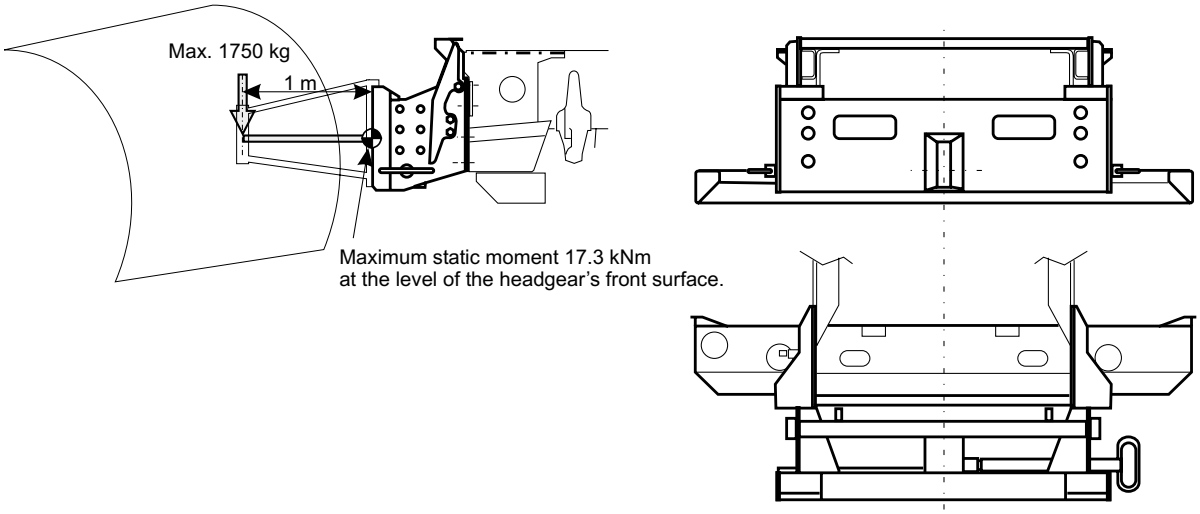


Fig. 963006

3.3.3. Stability factor

Note!
All mass on the vehicle's side increases stability.
All mass outside the roll axis decreases stability.

The stability factor **n** is calculated by dividing the total sum of moments increasing stability by the total sum of moments decreasing stability.

$$\frac{\textit{Moments increaSing stability}}{\textit{Moments decreaSing stability}} \quad n$$

To acquire sufficient stability, the minimum theoretical stability factor used should be **1.4**.

3.3.3.1 Calculating the stability factor

Stability factor is calculated for each roll axis, the crane at a 90-degree angle in relation to the axis, using the crane's maximum reach and maximum load equivalent to the reach.

Moments increasing the stability are calculated by multiplying the masses on the vehicle's side by their distance from the roll axis.

Moments decreasing the stability are calculated by multiplying the masses outside the roll axis by their distance from the roll axis.

The masses and centers of gravity are presented on the vehicle's and crane's technical specifications.

Note!
When calculating the stability factor for lifting from the front area, i.e. for outrigger/front-axle center point roll axis, or for lifting directly in front of the vehicle, i.e. the roll axis at the centerline of the front axle (see Fig. 963015), the crane's center of gravity may be outside the roll axis. In this case, G2 x E2 is placed under the line in the equation, i.e. it decreases the stability.

Note!
In various outrigger and/or mounting versions, the masses and distances inside the roll axis (on the vehicle's side) are stabilizing moments and are placed on top of the line in the equation.
The masses and distances outside the roll axis are moments decreasing stability and are placed under the line in the equation.

Note!
The crane manufacturer provides the required crane dimensions and masses.
The vehicle dealer provides the required vehicle dimensions and masses.

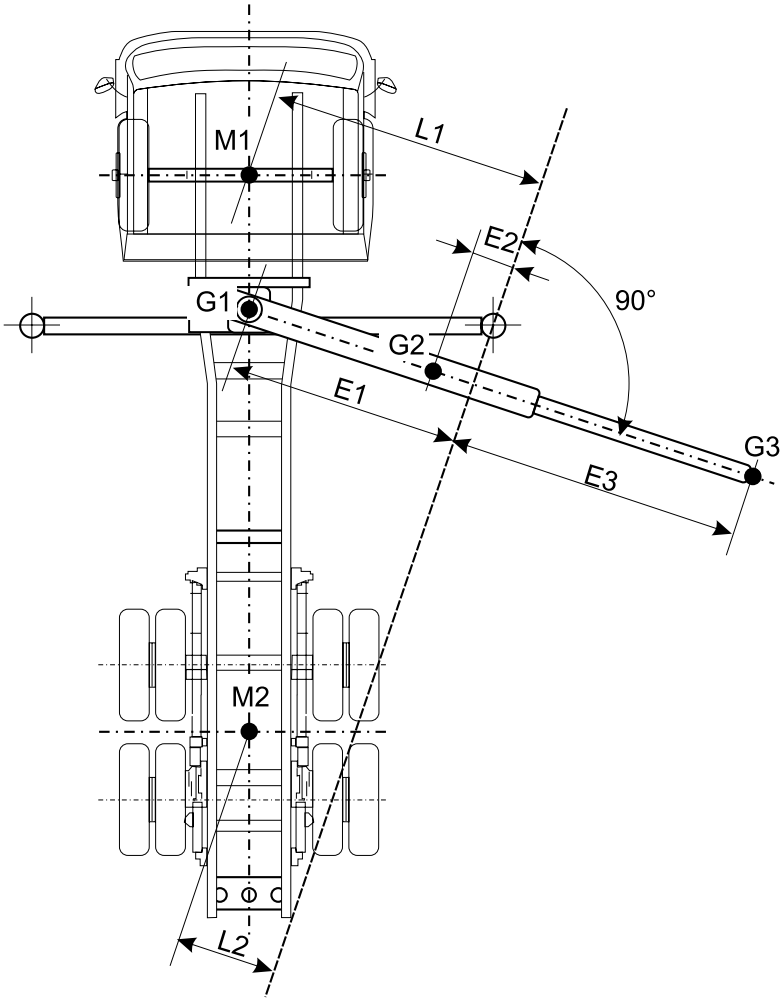


Fig. 963016

M1 = Front axle load (dead weight)
M2 = Rear axle load (dead weight)
G1 = Frame assy and hydr. oil mass
G2 = Boom assembly mass
G3 = Max. load mass
n = Stability factor

L1 = Distance from the roll axis
L2 = Distance from the roll axis
E1 = Distance from the roll axis
E2 = Distance from the roll axis
E3 = Max. reach from the roll axis

Examples of crane-mounting dimensions for calculation

Total lift moment (Ma) provided by the manufacturer; includes the moment of the load and boom assembly multiplied by the dynamic factor.
Do not mix up dimensions e and f .

Note!
Crane manufacturers may give dimension e as e^x, depending on whether the longitudinal distance between the bearing points is at the center point of the mounting bolts or e.g. bearing points Fh/Fi are in the middle of two mounting bolts (as in Fig. 963032). However, dimension e used in the calculations is always the longitudinal distance between the bearing points.

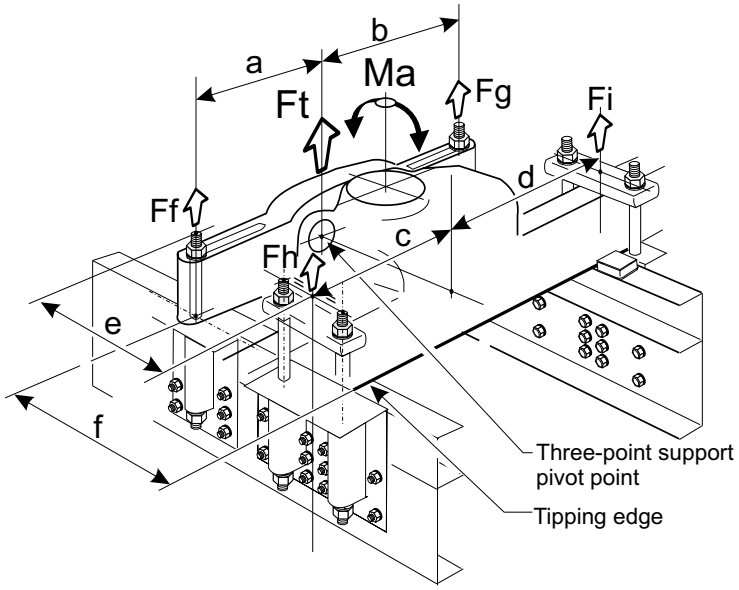


Fig. 963031

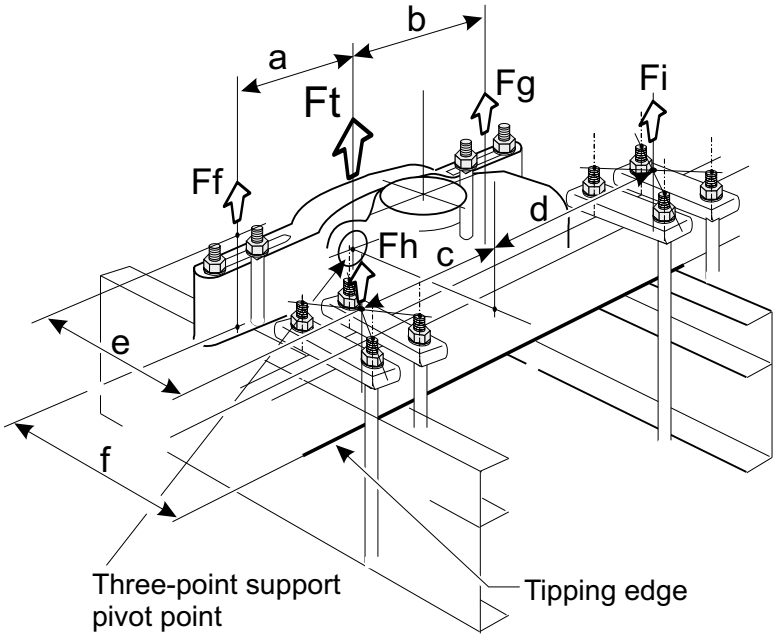


Fig. 963032

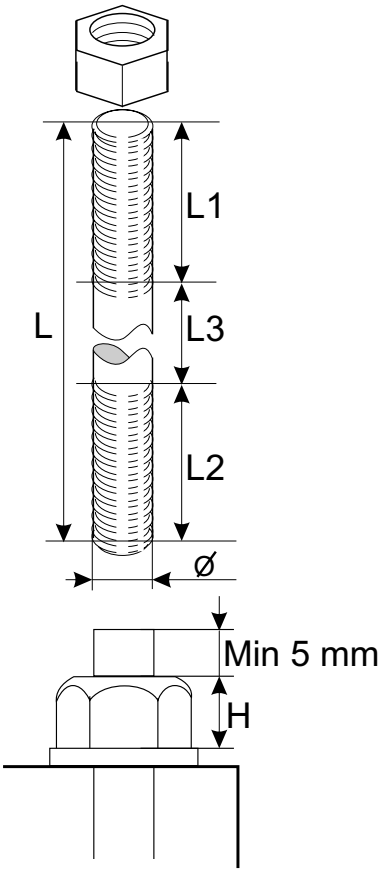


Fig. 963033

After calculating the forces acting on the bearing points, choose the appropriate mounting bolts/bearing point according to their number

Diameter and thread	Grade	Max. load/1 bolt	Tightening torque
7/8-9	10.9	138 kN = 13.8 t	930 Nm
1-8	10.9	181 kN = 18.1 t	1115 Nm
M 27	10.9	210 kN = 21.0 t	1370 Nm
M 30	10.9	259 kN = 25.9 t	1860 Nm
M36	10.9	378 kN = 37.8 t	3250 Nm

3.3.9.3 400 mm special frame for crane trucks with a driving front axle

If a truck equipped with a heavy (40 Tm or higher) or especially heavy crane is required, we recommend that a vehicle with a Sisu 400 mm frame, front bogie and driving front axle be selected for this purpose.

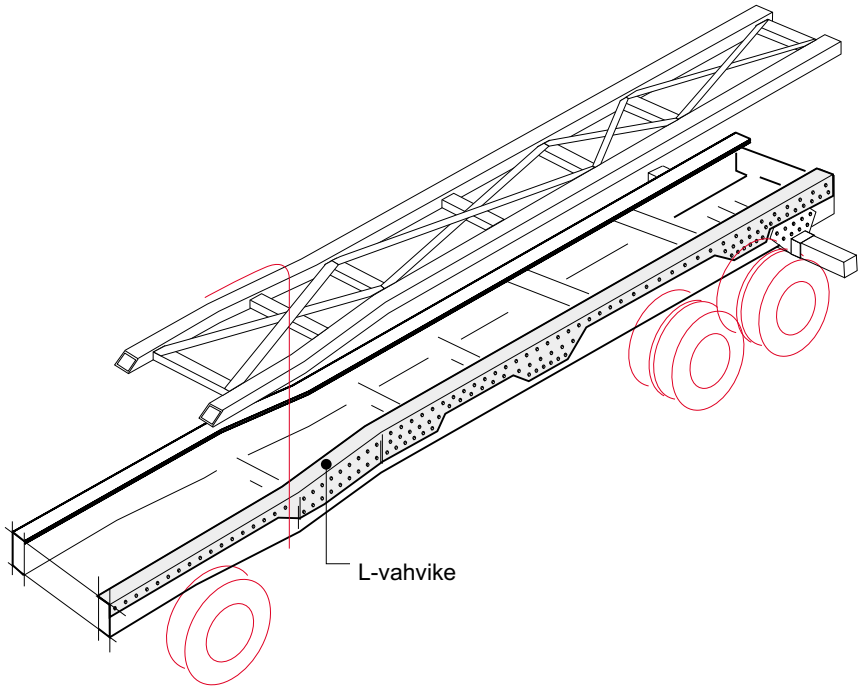


Fig. 963055

The 400 mm frame is especially designed for heavy cranes and is available with one or two inner frames. The vehicles with this frame are always equipped with a driving front axle and usually with a front bogie.

In addition, the chassis frame is delivered with an L-reinforcement designed and dimensioned for the crane in question and e.g. for the outrigger pair installed in front of the cab. If a subframe is still required, the dimensioning data for the subframe are provided.

Especially heavy above 55 tm crane, need always subframe.

By using this frame, bodywork construction costs are notably reduced, correctly calculated and constructed chassis frame/reinforcements are achieved and the time spent on bodywork construction is notably shortened.

3.3.10. Crane commissioning inspection

In order to evaluate the stability, a loading test is carried out during the crane commissioning inspection according to the machinery directive.

Loading test coefficients:

Static: 1.25 x load

Dynamic: 1.1 x load

6.2.2.2 Subframe

The subframe must be dimensioned according to the stresses generated by the bodywork and crane. The subframe must be constructed according to the principles presented in section 02.

Dimensioning examples for the longitudinal subframe beams according to the crane size are presented in the diagram below.

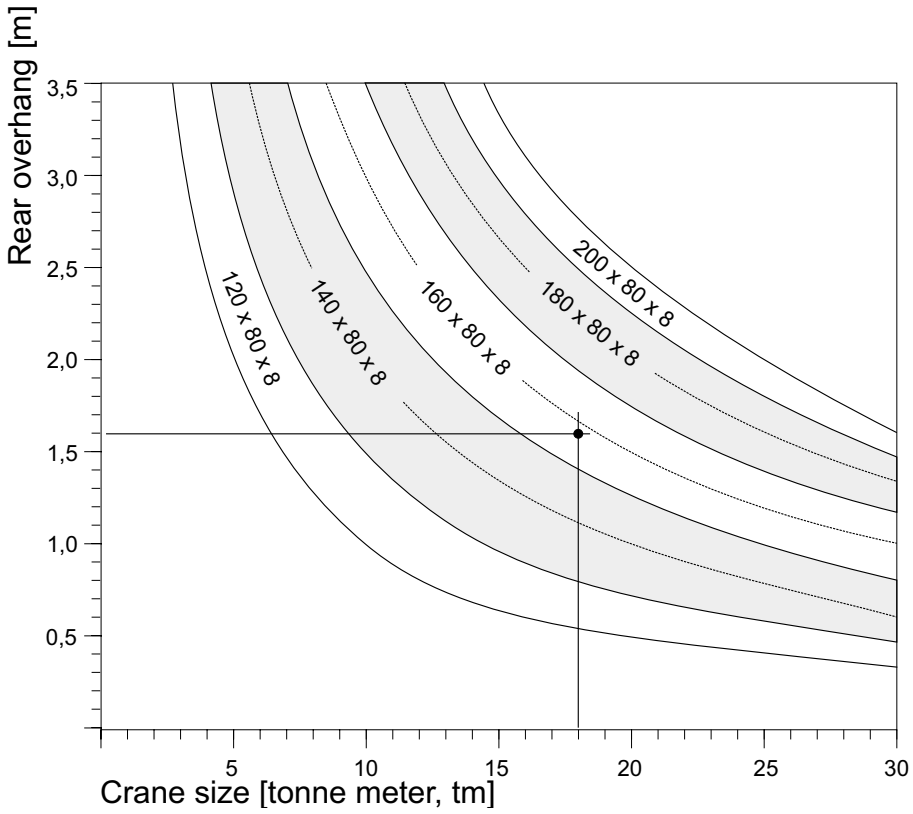
Since dimensioning a subframe includes several factors, the diagram is merely directive. Exact dimensioning details are not possible within this manual.

Subframe beam

U-section

Material RAEX HSF 490 or min. S355 (Fe52)

Fig. 963084



Example

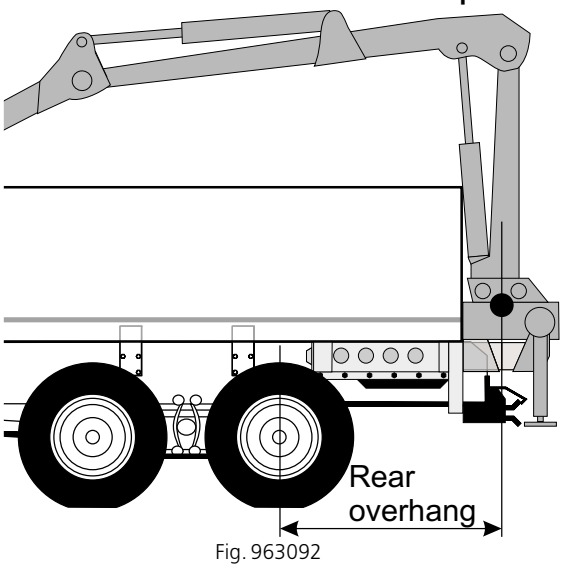


Fig. 963092

Crane size: 18 Tm. Rear overhang: 1.6 m. Draw a vertical line from 1.8 m and a horizontal line from 18 Tm. Intersection indicates a directive subframe beam size.

Note!

If the rear overhang is 2500 mm or longer and the weight of the crane 2000 kg or heavier, the dynamic forces generated by the crane during driving may be crucial when dimensioning the subframe beam size.

Subframe construction

The two rearmost cross beams of the subframe must be constructed with a sufficiently strong and rigid rectangular hollow section. If required, the rear overhang area of the subframe must be stiffened with one or two consecutive truss bracings, constructed with a U- or Z-section.

Note!

In this case, the rear overhang length is measured from the rearmost bogie axle centerline to the crane's center of gravity.

Belt tensioning

The belt is tensioned with tensioning guide tool 173-000-0006 (see attached drawing for manufacturing the tool) and a belt tension gauge (available from belt dealers).

1. Check with a ruler that the alignment is correct.

2. Place the tensioning guide tool 173-000-0006 on top of the belt so that the flange edge touches the belt edge.

3. Check the belt tension with the belt tension gauge:

A. Set the lower O-ring of the gauge so that the distance equals **specified belt deflection + tensioning guide tool (173-000-0006) material thickness**.
For example, if the material thickness is 5 mm and the specified deflection 9 mm, the lower O-ring is set to 14 mm.
The higher O-ring is set to the top collar.

B. Insert the tension gauge into the hole in the tensioning guide tool and position the gauge at a 90-degree angle to the belts. The gauge must be in the middle of the belt both longitudinally and laterally.

C. Hold the top of the tension gauge and press the gauge down to the belt until the lower O-ring meets the top level of the tensioning guide tool. Read the force equaling the belt deflection indicated at the higher O-ring. If the force is according to the specification, check the tightness of the mounting bolts.

4. If the belt tension is not correct, loosen bolts 2, 3 and 4. Adjust the tension with nuts 5 on the adjusting rod and tighten the bolts.

5. Re-check the tension.

6. If a new belt is installed, let the engine run for approximately 30 minutes and check the tension again, i.e. after the belt has adapted to the pulleys.

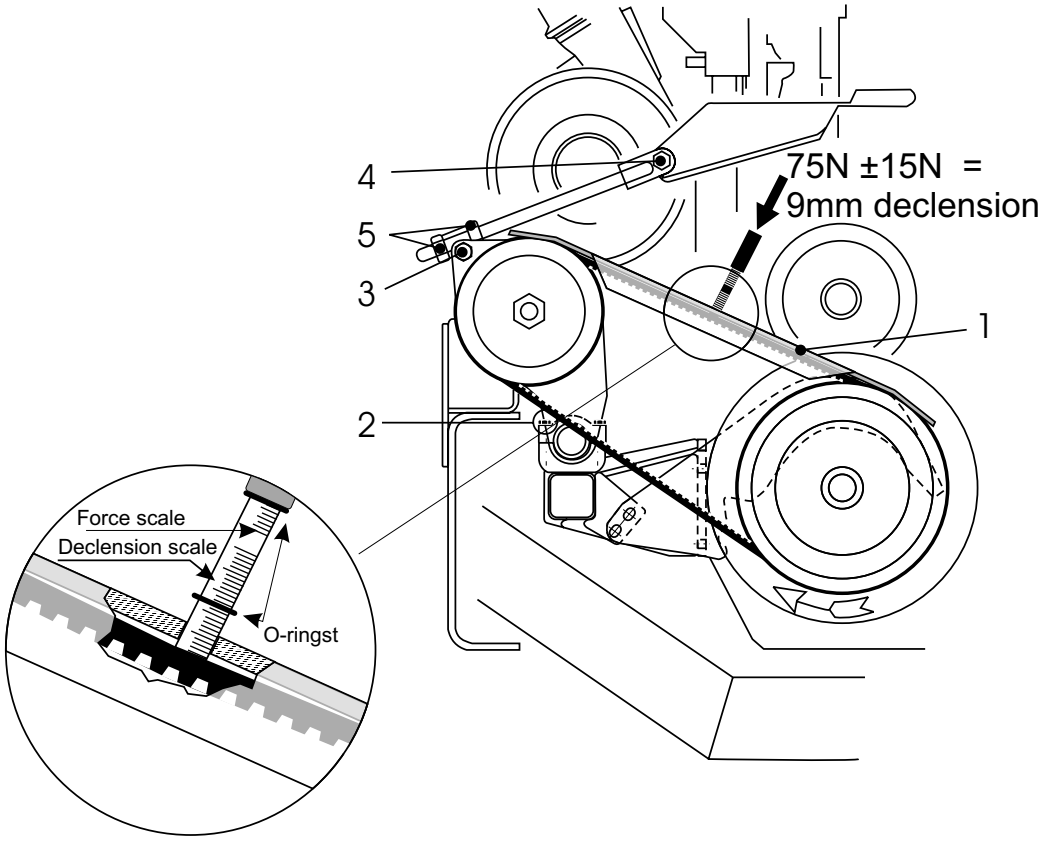
Note!

Too tight a belt will damage the pump and may damage crankshaft bearings.

If the pump shaft is not aligned with the crankshaft, the service life of the belt is significantly shortened.

Remember to loosen all the required bolts when adjusting the belt tension and tighten the bolts after adjustment!

Fig. 09-02



The figure illustrates a type E14 vehicle. The procedure is similar for E11 vehicles.

137-011-4541
Pump drive: Universal shaft flange 90 mm
Direction of rotation: Opposite to engine
Gear ratio: 1.00
Total gear ratios with different gears:
Crawler: 0.262
1. 0.396
2. 0.533
3. 0.725
4. 0.976

Torque:
Intermittent: 590 Nm
Periodic (1.5 h / 12 h): 510 Nm
Continuous: 440 Nm
Output:
Intermittent: 93 kW
Periodic (1.5 h / 12 h): 80 kW
Continuous: 70 kW

2.5. PTOs for Allison HD 4060P and 4560P transmissions

Two PTOs can be mounted on Allison HD transmissions. The locations are on top of the transmission (1 o'clock, as shown) and on the left-hand side (9 o'clock).

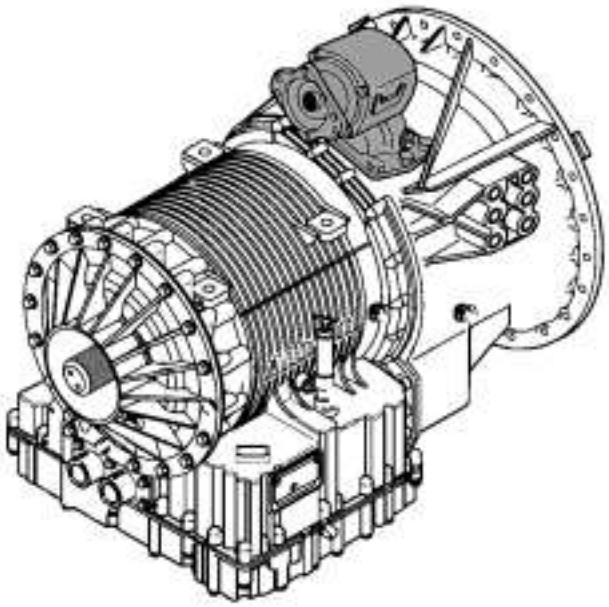


Fig. 838010a

137-000-1351

Pump drive: Direct pump mount SAE-B, 2- or 4-bolt

Direction of rotation: Same as engine

Gear ratio: 1.03

Engaging: Wet multi-plate clutch controlled by the transmission control unit

Torque:

Intermittent: 454 Nm

Continuous: 317 Nm

Output:

Intermittent: 49 kW/1000 rpm

Continuous: 34 kW/1000 rpm

Weight: 20 kg

The PTO delivery includes a mounting kit, comprising the required mounting and guide bolts and connectors. In addition, a PTO hose kit is required. The part number for the hose kit depends on the PTO location.
Left-hand side mount: 179-760-6231
Top mount: 179-760-6241

5.2. PTO with geared adapter

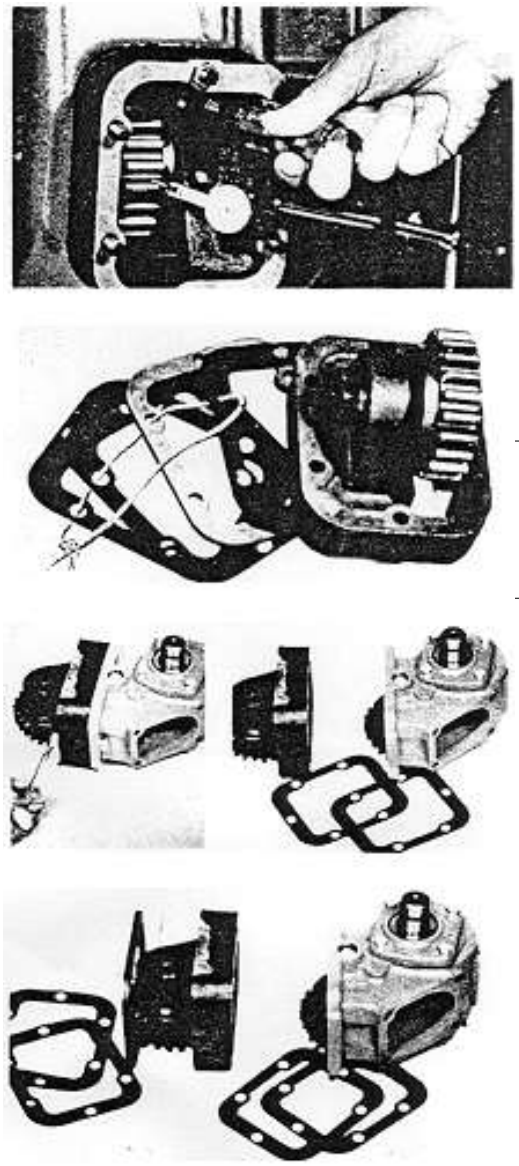


Fig.CHPKLSH3

A geared adapter is used if the PTO cannot otherwise be mounted on the transmission. The adapter changes PTO's direction of rotation, which can be an advantage for certain applications.

1. Install the adapter onto the transmission and check the adapter backslash using the procedure above.

2. After the backslash is adjusted, remove the adapter, gaskets and possible spacer from the transmission. Keep the gaskets and spacer in one stack.

3. Attach the adapter to the PTO in a bench vise.

4. Adjust the backslash of the adapter and PTO gears by changing the gasket thickness between the adapter and PTO.

5. Install the gaskets, adapter and PTO onto the transmission in the correct order.

6. Tighten the mounting bolts according to the torque specification.

Run the PTO for a short period and observe the sound.

WARNING: At this point, the transmission and PTO do not have lubricating oil, so the running period must be as short as possible.

- If the PTO makes howling noise, the backslash may be too small. Increase the gasket thickness.
- If the PTO makes a clattering noise, the backlash may be too high. Decrease the gasket thickness.

As a general rule, a 0.010" (0.25 mm) gasket changes the backslash about 0.006" (0.15 mm) and a 0.020" (0.50 mm) gasket about 0.012" (0.30 mm).

1. Coupling devices

Values D, Dc, V and S are given for a coupling device according to EC directive 94/20/EC. The right coupling device for intended purpose can be selected using the given values in various equations.

1.1. Equations for coupling devices

1.1.1. D value

Rated load in kilonewtons [kN] for drawbar trailer coupling devices not designed to support vertical loads.

$$D \quad g\frac{T\,x\,R}{T \quad R} \qquad \text{For example } 9{,}81\frac{26x36}{26 \quad 36} \quad 148\,kN$$

where:

T = Technically permissible maximum mass of the towing vehicle [t]

R = Technically permissible maximum mass of a drawbar trailer (with a drawbar free to move on a vertical plane) [t]

g = Acceleration due to gravity [m/s^2] (9.81 m/s^2)

1.1.2. D value

Rated load [kN] for semi-trailer coupling devices.

$$D \quad g\frac{0{,}6TR}{T \quad R \quad U} \qquad \text{For example } 9{,}81\frac{0{,}6x32x39}{32 \quad 39 \quad 15} \quad 131kN$$

where:

T = Technically permissible maximum mass of the towing vehicle [t]

R = Technically permissible maximum mass of a semi-trailer (fifth wheel load + bogie mass) [t]

U = Vertical mass on the fifth wheel [t]

1.1.3. Dc value

Rated load [kN] for **center-axle trailer** (single-axle) coupling device.

$$Dc \quad g\frac{TxC}{T \quad C} \qquad \text{For example } 9{,}81\frac{26x18}{26 \quad 18} \quad 104\,kN$$

T = Technically permissible maximum mass of the towing vehicle [t], including vertical load imposed by a single-axle center-axle trailer [t]

C = Total axle mass of the center axle trailer loaded to the technically permissible maximum mass [t]

1.1.4. V value

Rated load [kN] for center-axle trailer coupling device.

$$V \quad a\frac{x^2}{l^2}C \qquad \text{For example } 1{,}8\frac{7{,}82^2}{6{,}5^2}18 \quad 47\,kN$$

where:

a = Factor depending on the type of suspension system of the rear axle of the towing vehicle

a = 1,8 m/s^2 (air suspension or equivalent)

or

a = 2,4 m/s^2 (other types of suspension)

x = Length of the cargo space of the trailer [m]

l = Distance from the center of the drawbar eye to the center of the axle assembly [m]

4.2.5. Fifth wheel characteristics

Minimum requirements for fifth wheel's turning about its longitudinal and lateral axis are shown in the figure:

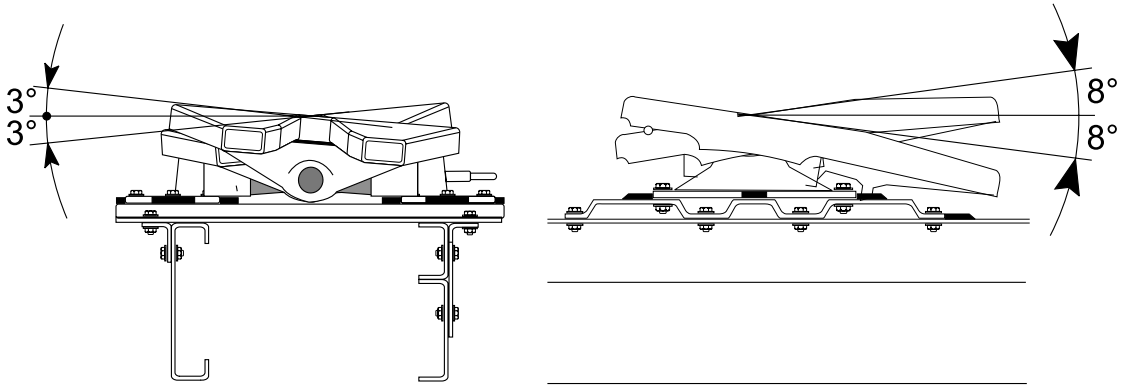


Fig. 965023

4.2.6. Trailer's inclination angles

Figure shows the minimum requirements for the trailer's inclination angles that the coupling's structure must allow. This insures adequate space for trailers in common driving situations.

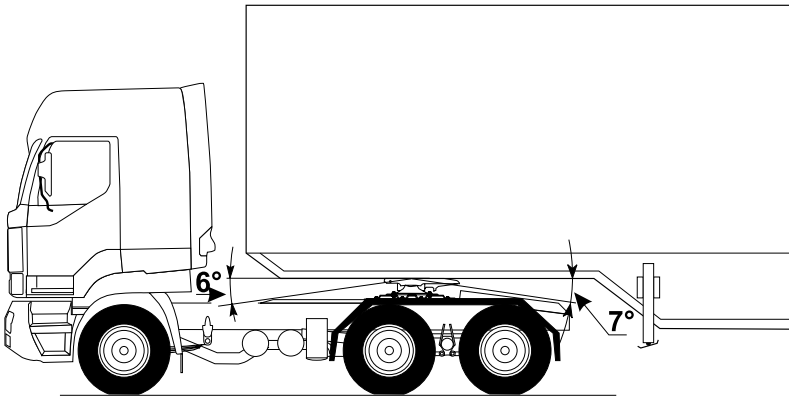


Fig. 965024

Class H fifth wheel height h [mm] for a laden tractor can be determined by using the following equation:

$h \quad 0.137\, l_1 + 0.095 \times b + r + r_1 - 143.5$

where:

l_1 = distance between the fifth wheel coupling point and tractor's rearmost axle centerline

b = total width from top of the tires

r = unladen tire radius

r_1 = laden tire radius

Note! Equation provides the clearance in relation to the tires.

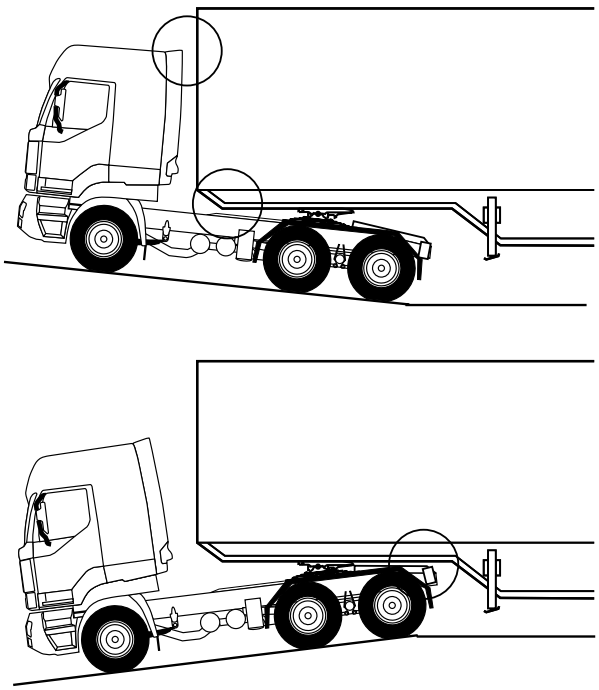


Fig. 965025

Note! Trailer must not be able to come into contact with the tractor's cab or chassis structures under any circumstances.

2.3.1. Disconnecting the electric system

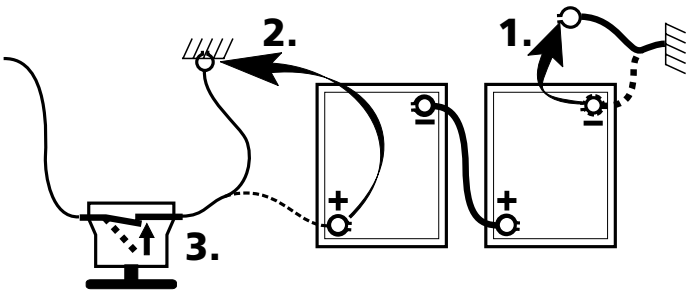


Fig. 931003

Open the main switch

1. Disconnect the – cable from the battery.

2. Disconnect the + cable (power supply cable) from the battery and connect the cable to the ground.

3. Close the main switch.

The circuit is now dead and protected from any possible voltage spikes generated by the welding machine.

2.3.2. Grounding the welding machine

Connect the welding machine ground cable as close to the welding point as possible. **The maximum distance between the ground cable connection and welding point is 50 cm.**

In order to create an appropriate connection, the ground cable connection point must be cleaned thoroughly by grinding away any paint, rust, etc.

In addition, the welding current circuit may not pass through bearings, since the bearing surfaces may be damaged.

2.3.3. Electronic control units and devices, Celect ECM, Mac ECU, ECAS air suspension, ABS braking system, HD transmission

All electric control-unit components, wires and connectors must be protected from welding spatters/sparks and the heat caused by welding. Welding or connecting the welding machine ground cable to any electric control unit, heat sink or other part of the electronic system is strictly prohibited.

According to the instructions of the component manufacturers, all the wires must be disconnected from the control unit in order to be 100% certain that the control unit is not damaged during welding.

However, disconnecting and connecting some connector types cause a greater technical risk of damage to the connector and the unit than electric welding, provided that the above instructions are followed.

Disconnecting the control unit connectors is unnecessary if the instructions on disconnecting the battery cables, closing the main switch and connecting the ground cable close to the welding point are followed!

2.4. Preliminary work

2.4.1. Cleaning

Remove paint, oil, grease, rust and moisture from the area to be welded.

2.4.2. Drying/heating

The welded surfaces must be absolutely dry and their temperature over +15°C, preferably over +20°C.

During winter, bring the vehicle inside well before welding (min. 2–3 hours).

When cold metal is brought inside, moisture condenses on the metal as long as the temperature difference between the metal and the surrounding indoor air is sufficient. Moisture (water, frost, ice) acts as a source of hydrogen, which increases cold cracking and gas-pore formation. A delayed crack caused by hydrogen can, in practice, initiate even several days after welding.

Welding in subzero conditions

If the welding must be carried out outdoors during winter, sections approximately 300 mm wide on each side of the joint must be cleaned and preheated to +50 – +100°C. Possible backing must also be dried.

In subzero conditions, use low-hydrogen, alkaline welding consumables and arrange the welding conditions as optimally as possible.

3.9. Modification plate

Attach a modification plate in close proximity to the original type plate of the modified vehicle. The modification plate must include chassis number and type, old wheelbase, new wheelbase, etc.

The modification plate can be made of aluminum; the changed data are punched into the plate and attached next to the type plate.

Adding or modifying the data on the original type plate is strictly prohibited!

3.10. Straightness of the frame

The straightness of the chassis frame must always be checked after extending or shortening the frame.

Detailed instructions on checking the straightness and possible corrective measures are presented in section **08** / Frame deformations and straightening.

4. Installing an additional axle or removing an axle

4.1. General

When installing an additional axle or removing an axle, the instructions given in this manual and appropriate regulations by the authorities must be followed so that the altered vehicle meets the demands and regulations set for operational safety, road safety and overall quality.

An axle may be installed or removed only in repair shops authorized by Sisu Auto Inc. If the vehicle is modified in another repair shop, the modification must be carried out under the supervision of the manufacturer's representative.

Adding or removing an axle is allowed only if the modified chassis is included in the vehicle's model series of the type in question. Otherwise, a modification permit must be obtained from the appropriate authorities.

The modifier is responsible for following the regulations and insuring that the work is carried out properly, following the instructions given in this manual.

Typically, an additional axle is installed if used three-axle timber truck is altered to a four-axle gravel truck. The same principles apply to both adding and removing an axle.

Electric and pneumatic equipment

Foreword

This bodywork manual section (09) gives instructions on connecting bodywork operation systems to the electric and pneumatic systems of the vehicle.

For more information, see the electric and pneumatic device sections in the maintenance manual series.

Read and follow the warnings regarding the electric and pneumatic systems.

Mistakes in installing electric or pneumatic system components may destroy expensive components or result in serious injury.

1 Electric devices

This chapter (**1**) explains the Sisu E series electric system for installing bodywork.

1.1 Safety instructions

Although the truck's nominal voltage of 24 V is not dangerous to a human being as such, electric work must be carried out with extreme care due to the notable electric energy capacity charged to the batteries.

Remove all rings and conductive watchbands before conducting electrical work. If short circuited, they will heat rapidly and cause severe burns.

Follow the instructions carefully when connecting electric connections to the bodywork, and make sure that the connections are working and safe.

A short circuit in the connections will cause an immediate fire hazard!

A faulty connection may cause truck devices to operate unexpectedly, resulting in dangerous situations!

Trucks with Cummins engines: the operating voltage of the injector nozzles is high. Due to the risk of electric shock, never touch the injector nozzles or their wires when the engine is running.

Drilling a hole/holes to the electrical center is strictly prohibited.

Never drill a hole to the electrical center for e.g. inserting a wire (drilling a hole will necessitate the replacement of the electrical center). For information about lead-through routing, see this section, chapter 1.5, page 261.

The bodywork manufacturer is solely responsible for the installation of the electric devices he has conducted.

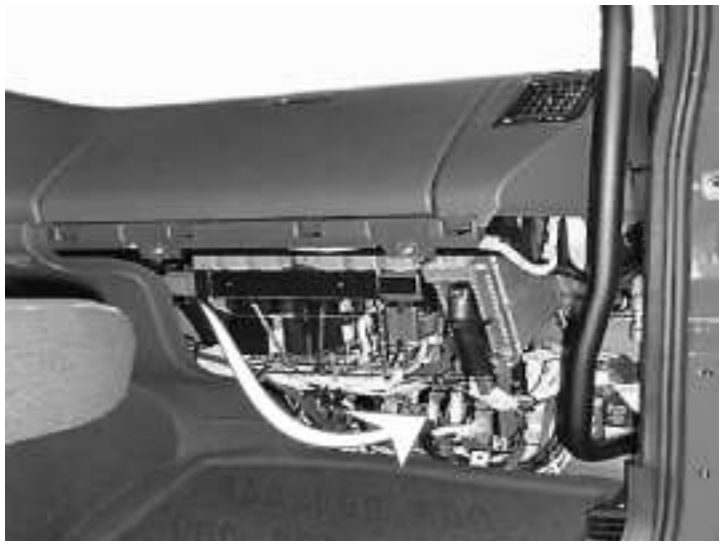
1.5 Lead-through routing, connectors

1.5.1 Wire lead-through routing from the cab to the chassis

Wiring-harness lead-through connectors are provided in the electrical center, on the right-hand side of the cab.

The cab's interior wiring harness connector is connected to the electrical center connector from the cab interior.

Fig. 931007



The connector of the wiring harness routed to the chassis is connected to the corresponding connector from the cab exterior.

Fig. 931008

Fig. 931009

The connectors are color-coded and the electrical center's connector parts have corresponding color codes.

These connectors have spare terminals to enable the bodywork manufacturers to route the harnesses inside the cab easily and safely.

The next figures present the lead-through panel connector diagrams viewed from the cab interior and exterior.

1.7 Electric connections in ADR-equipped vehicles

1.7.1 General

ADR = Vehicle intended for the transport of dangerous goods.

An ADR-equipped vehicle is a vehicle in which the chassis' electric devices are installed according to EEC ADR directive (annex B, appendix B.2), i.e. the chassis of the vehicle has an ADR facility.

- The electric cables, devices and connectors in the chassis are ADR-approved

1.7.2 Regulations

If modifications or additional installations are made to the electric systems of ADR-equipped vehicles, the bodywork manufacturer must follow all appropriate regulations.

1.3 Installing and connecting of lamps

- The color, type, number, position, visibility, alignment, connection, operational tell-tales of the lamps and retro reflectors described in this manual must comply with the requirements of Council Directive 76/756/EEC on the approximation of the laws of the Member States relating to the installation of lighting and light-signaling devices on motor vehicles and their trailers, as amended with directive 84/8/EEC, or with requirements of E regulation 48, and/or with possible national derogations and regulations.
- On vehicles first used on or after 1 October 1994, the color, type, number, position, visibility, alignment, connection and operational tell-tales of the lamps and retro reflectors stated above must comply with the requirements of the directive stated above, as amended with directives 91/663/EEC and 97/28/EC, or with national regulations. The directives and regulations stated above are also applied to the color, position, visibility and alignment of other lamps and retro reflectors.
- If no lamps and retro reflectors complying with the EC directive or E regulation are available for the vehicle model, the mandatory lamps and retro reflectors, except main-beam and dipped-beam headlamps, that comply with standard FMVSS 108 are regarded as equivalent to the lamps and retro reflectors stated above. DOT approved main-beam and dipped-beam headlamps with code 9004, type HB1; code 9005, type HB3 or code 9006, type HB4 bulbs are regarded as equivalent to the mentioned lamps also when lamps and retro reflectors complying with the EC directive or E regulation are available for the vehicle model. This applies only to vehicles first used before 1998. After 1998 exceptions to the European legislation are accepted only for vehicles that are, for example, imported along with immigration.
- The installation height of additional dipped-beam headlamps, main-beam headlamps, direction indicator lamps and front position lamps on snow plowing vehicles may be as required by the conditions. Additional dipped-beam headlamps must be below the lower edge of the windscreen. Additional dipped-beam headlamps must be aligned so that the light does not cause undue glare to oncoming drivers and other road-users.
  Additional dipped-beam headlamp circuit must be equipped with a switch located in such a position that switching between original and additional dipped-beam headlamps is not possible during driving.

1.4 Connections

- The electrical connections must be such that the front and rear position lamps, the end-outline marker lamps, where fitted, the side-marker lamps, where fitted, and the rear registration plate lamp can only be switched on and off simultaneously. This requirement shall not apply when using front and rear position lamps, as well as side-marker lamps combined or reciprocally incorporated with said lamps, as parking lamps.
- In addition, the electrical connections must be such that the main-beam and dipped-beam headlamps and the fog lamps cannot be switched on unless the lamps referred to in the previous paragraph are also switched on. This requirement shall not apply, however, to connections for enabling luminous warning signals with main-beam or dipped-beam headlamps.
- With the exception of the main-beam headlamp, the dipped-beam headlamp and the front fog lamp, the concealment of lamps when not in use is prohibited. It must be possible to move the concealable lamps into the position of use and to switch them on by means of a single control.

☛ **Before making any electric connections to Sisu trucks, read section 09 Electric and pneumatic equipment in the Bodywork manual!**

- Distance from the extreme outer edge of the vehicle must not be more than 400 mm. The distance between two reflectors must not be less than 600 mm.

Rear retro reflector must be aligned towards the rear of the vehicle and it must be horizontally visible at a 30° angle inwards and outwards, and vertically visible at a 15° angle above and below the horizontal level. The vertical angle below the horizontal may be reduced to 5° in the case of a retro reflector less than 750 mm above the ground.

5.9 Third stop lamp (9), optional

In addition to actual stop lamps, a third stop lamp emitting red light may be fitted.

- Third stop lamp must be lit simultaneously with stop lamps.
- Third stop lamp must be fitted at the vehicle's centerline, above the stop lamps and the height must be more than 850 mm above the ground or more than 150 mm below rear window. Third stop lamp must be horizontally visible at a 10° angle inwards and outwards, and vertically at a 10° angle above and at a 5° angle below the horizontal level.
- Doubling of third stop lamp is prohibited and it may not be positioned outside the centerline, unless required by the structure of the vehicle (center-split access doors at rear). Each lighting unit of the doubled third stop lamp shall be approved as a type D lamp. Even in this case, third stop lamp must not be more than 150 mm off the centerline, measured from the lamp's point of reference.

5.10 Work and additional lamps (10), optional

According to national regulations, necessary work and additional lamps for loading, unloading and other operations may be fitted.

Work and additional lamps must be switched off when driving on public roads. This does not apply to work carried out on road.

5.11 Retro-reflecting outline signals and commercial signals, optional

Retro-reflecting outline and commercial signals must meet the following requirements:

- No reflector shall reflect red light in a forward direction.
- No reflector shall reflect white light in a rearward direction.
- Signals must be constructed with E approved materials according to regulation no. 104.
- No retro-reflecting outline or commercial signals are allowed on the towing vehicle unless the trailer is fitted with retro-reflecting signals.
- Band-shaped outline retro-reflector must be 50–60 mm in width and indicate not less than 80% of the length and width of the vehicle. If the reflector is not continuous, spaces between the band sections must not be more than half of the length of the shortest band section.
- Lower edge 250–1500 mm (–2100mm) above the ground.
- Retro-reflecting commercial signal must be positioned on the side of the vehicle inside a retro-reflecting outline signal. Commercial signal may not impair the effectiveness of the outline signals, lamps or retro-reflecting devices.
- Max. length 15 letters, height 300–1000 mm.
- The total area of commercial signal constructed with category D retro-reflecting material as specified in E regulations must not be more than 2.0 m^2

Special dimensions in parentheses apply only to vehicles on which standard lamp/retro reflector position requirements cannot be applied due to structural reasons (e.g. vehicle's external shape).

5.12 Additional rear lamp set for tow trucks

- Tow trucks must be equipped with separate device including rear position, stop and direction indicator lamps that can be attached to the rear of the towed vehicle. This device must be used if conditions during towing duties require the use of lamps and the vehicle's lighting devices cannot be used according to regulations. Alternatively, tow trucks may be fitted with doubled rear position, stop and direction indicator lights, mounted up behind the cab. These lamps may be used during towing only.