MAN GUIDELINES TO FITTING BODIES

Series TGL/TGM
Edition 2018 V2.0

$$\frac{\pi \cdot M_{Mot} \cdot \eta \cdot i_G \cdot i_V}{U}$$

$$\frac{\cdot\ 3{,}14 \cdot 1850 \cdot 0{,}85}{3{,}1}$$

526 N ~ 205,5 kN

$$= l \cdot \sqrt{1 + \left(\frac{p}{100}\right)^2}$$

MAN

If not otherwise specified: all dimensions are in mm, all weights and loads are in kg.

3.0 Liability

3.1 Liability for material defects

Claims on liability for defects only exist within the contract of sale between the purchaser and the seller. The liability for defects consequently rests with the seller of the article of sale. Claims may not be made of MAN if the reported defect results from the following:

- Non-adherence to these body guidelines
- Selection of a chassis unsuitable for the intended purpose of the vehicle
- Damage to the chassis caused by:
  - the body,
  - the nature/execution of body installation,
  - modification to the chassis,
  - incorrect operation.

3.2 Product liability

Defects in workmanship detected by MAN are to be corrected. In as much as this is legally admissible, MAN will bear no liability, in particular for consequential damages.

Product liability regulates:

- The liability of the manufacturer for their product or component of a product.
- The claim to compensation from the manufacturer of an integrated component of a product made by the manufacturer claimed upon if the occurring damage results from a defect of this component of a product.

The company that executes the bodywork or modification to the chassis shall indemnify MAN from any claims for liability made by its customers or other third parties, in as much as any damage results from the following:

- The company having failed to comply with the guidelines to fitting bodies valid at the time.
- The bodywork or chassis modification has caused damage through faulty
  - Engineering Design
  - Manufacture
  - Assembly
  - instructions.
- The set principles were not complied with in any other way.

II. Product identification

As a rule, vehicle identification numbers for MAN chassis of the Trucknology Generation begin with the letters “WMA”.

Exceptions are, amongst others, vehicles

- from CKD plants (these have their own manufacturer’s codes)
- of the Steyr brand (VAN)
- of the ÖAF brand (VA0)
- of the ERF brand (SAF).

The vehicle identification number contains the model number in places 4 – 6.
(see Chapter II, Section 2.2 “Model number”).

Note:

Stamped vehicle identification numbers must not be obscured by vehicle bodies or modifications.

Vehicle production number
The vehicle production number consists of seven characters and describes the vehicle’s technical equipment.
It contains the model number in places 1 - 3 followed by a four-character alphanumeric code.

Table 11-II: Example of a vehicle production number

Digit	1	2	3	4	5	6	7
Example	0	6	X	0	0	0	4
	Typ number			Sequential designation			

Table 12-II: Example of vehicle designation, model number, identification number, base vehicle number and vehicle production number

Designation of vehicle	Model number	Vehicle identification number (VIN)	Base vehicle number	Vehicle production number
TGX 18.440 4x2 BLS	**06X**	WMA**06X**ZZ97K001464	L**06X**KG31	**06X**0004
TGS 26.410 6x2-4 LL	**21S**	WMA**21S**ZZ67M479579	L**21S**GF38	**21S**0002
TGM 18.330 4X2 BL	**N18**	WMA**N18**ZZ16Y155852	L**N18**CE08	**N18**0008

More information on model numbers can be found in Chapter II, Section 2.2 “Model number”.

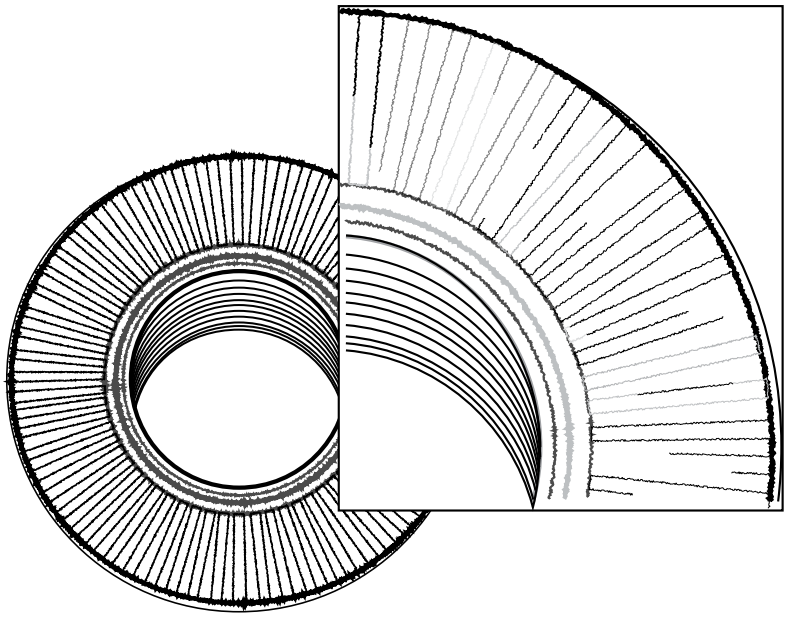
Bolted connections on chassis frame
If ex works bolted connections are changed, a bolted connection of equal quality as per manufacturer's specifications must be restored in accordance with MAN standard M3059 (for obtaining this standard, see www.ptd.man.eu). For this purpose, the following aspects of the bolted connections must be identical:

1. Number and location of bolted connections (e.g. at connections of cross members)
2. Strength class (e.g. ribbed bolts 10.9, hexagonal flange nuts 10)
3. Types of nuts and bolts (ribbed bolts/hexagonal flange nuts)
4. Thread dimensions (e.g. M14 x 1.5)

Tightening torques are to be applied as per MAN standard M3059-1. To the end, the total coefficients of friction of the nuts and bolts must be between μ_{tot} = 0.09 to 0.15.
MAN recommends the use of ribbed bolts/hexagonal flange nuts as per MAN standards M7.012.04/M7.112.40.

If connections are disassembled, use new nuts and bolts on the tightening side when reassembling ribbed bolts. The tightening side can be identified by slight grooves on the ribs in the bolt/nut flange (see Fig. 08-III).

Fig. 08-III: Marks on nips on the tightening side



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Alternatively, in accordance with manufacturer's specifications it is also possible to use high-strength rivets (e.g. Huck-BOM, blind fasteners). A riveted joint must be at least equivalent to a bolted connection in terms of design and strength.

2.2.7 Wheel-load difference

The wheel-load difference describes the difference in load on the left and right wheel or set of wheels of **an axle or group of axles**. The difference in load can cause a tilted position in relation to the road. In conjunction with a laterally shifted center of gravity, this can lead to adverse driving characteristics. Furthermore, it can also result in one-sided wear on the tyres.

Bodybuilders and operators must ensure that the wheel-load difference in all operating states (laden and unladen) is as low as possible. An uneven load distribution as a result of the body can, for example, be countered by relocating parts such as the tank, battery box and spare wheel.

If there are increased wheel-load differences, ESP (Electronic Stability Program) should be selected as alternative equipment in order to improve driving stability.

The maximum wheel-load difference must not exceed 10% of the actual (1) axle load, but 5% of the permissible (2) axle load. The smaller value is the decisive factor (see red line in Fig. 12-III).

In addition, the permissible load of the tyre and rim combination should be checked. Information concerning this can be found in the technical manuals of the tyre and rim manufacturers.

Proceed as follows to determine the maximum permissible wheel-load difference per axle or group of axles.

Step 1: calculate the limit value of the axle load = $\frac{0{,}05}{0{,}1}$ · permissible axle load

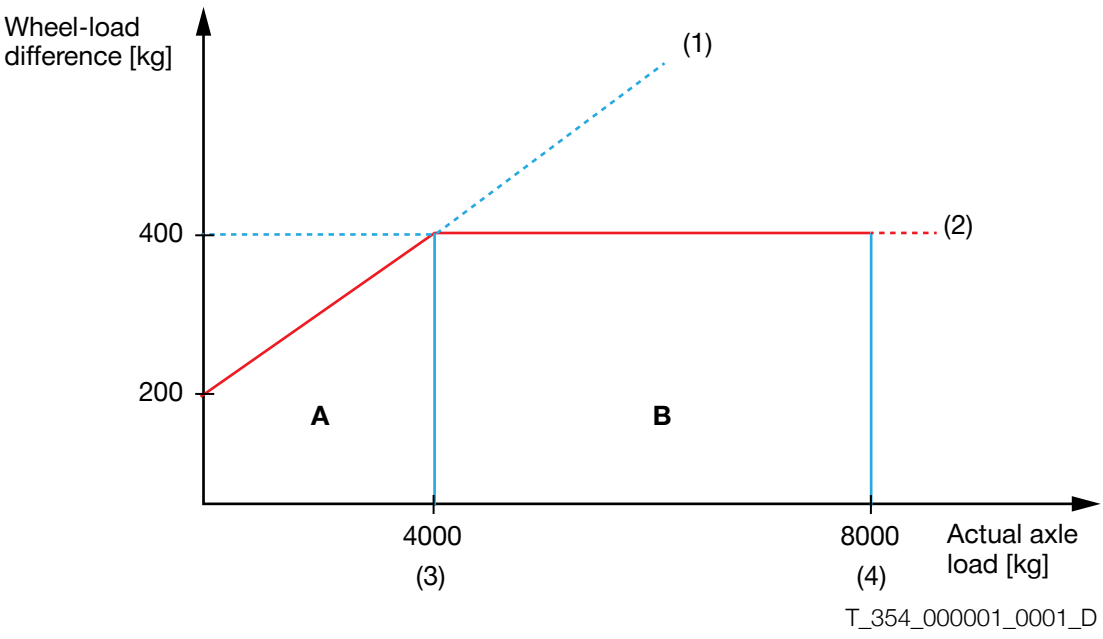
Step 2: determine the applicable range: Range A ≤ limit value
Range B > limit value

Step 3: calculate the permissible wheel-load difference
If the actual axle load is in Range A, the formula
- permissible wheel-load difference = 0.1 x actual axle load applies.

If the actual axle load is in Range B, the formula
- permissible wheel-load difference = 0.05 x permissible axle load applies.

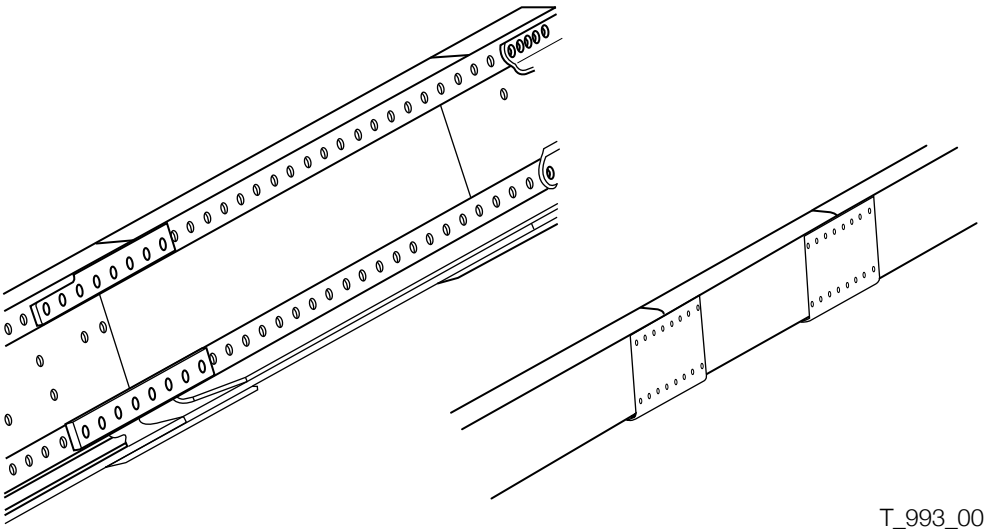
Step 4: check the permissible wheel loads

Fig. 12-III: Representation of the permissible wheel-load difference (the numerical values apply to this example; they are not universally applicable)



1) 10% of the actual axle load
2) 5% of the permissible axle load
3) Limit value between Ranges A and B
4) Permissible axle load

Fig. 20-III: Insert covering, outside and inside



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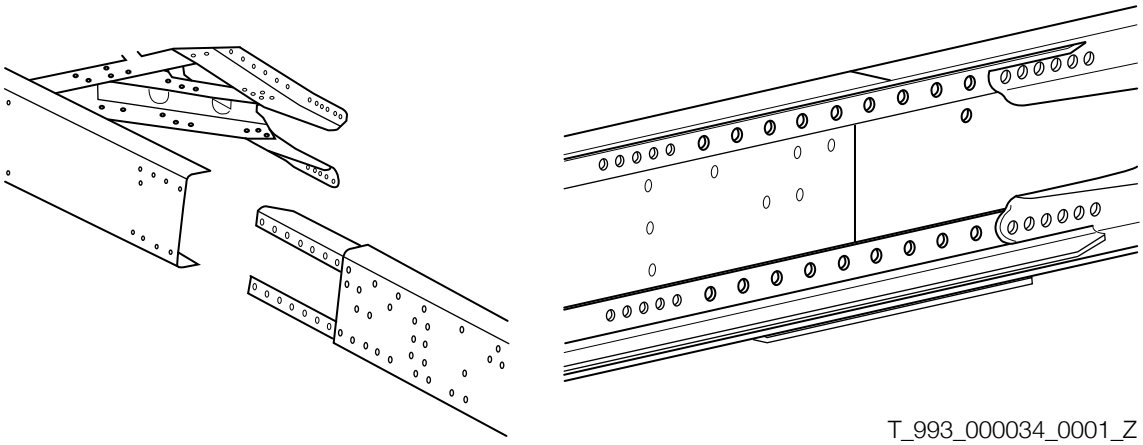
The joint between the frame and the insert seam may not coincide with a weld seam in the frame - a distance of 100 mm between seams must be observed.
This is easy to achieve if during cutting of the frame the location of the frame-insert joint is already taken into account.

Fig. 21-III: Projecting inserts, outside and inside



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3.2 Cabs

This section provides an overview of cabs including technical data for all the model ranges. The tabular overviews provide information on designation, dimensions and a schematic representation for identification purposes.

TGL/TGM chassis are supplied with the following cab variants:

Table 02-III: TGL/TGM cabs

Designation	Dimensions*			
Name	Technical designation	Length	Width	Height (from Cab-0)
C	**With D0836 (6-cyl.):** Left-hand drive vehicle: F99**L10**S Right-hand drive vehicle: F99**R10**S	1.620	2.240	1.664
	With D0834 (4-cyl.): Left-hand drive vehicle: F99**L12**S Right-hand drive vehicle: F99**R12**S			
L	Left-hand drive vehicle: F99**L32**S Right-hand drive vehicle: F99**R32**S	2.280	2.240	1.737
LX	Left-hand drive vehicle: F99**L37**S Right-hand drive vehicle: F99**R37**S	2.280	2.240	2.035
DK	**With D0834 (4-cyl.):** Left-hand drive vehicle: F99**L58**S Right-hand drive vehicle:F99**R58**S	2.786	2.240	1.737
	With D0836 (6-cyl.): Left-hand drive vehicle: F99**L57**S Right-hand drive vehicle: F99**R57**S			

*) Cab dimensions without added on parts such as wings, skirts, mirrors, spoiler, etc.

5.0 Frame attachments

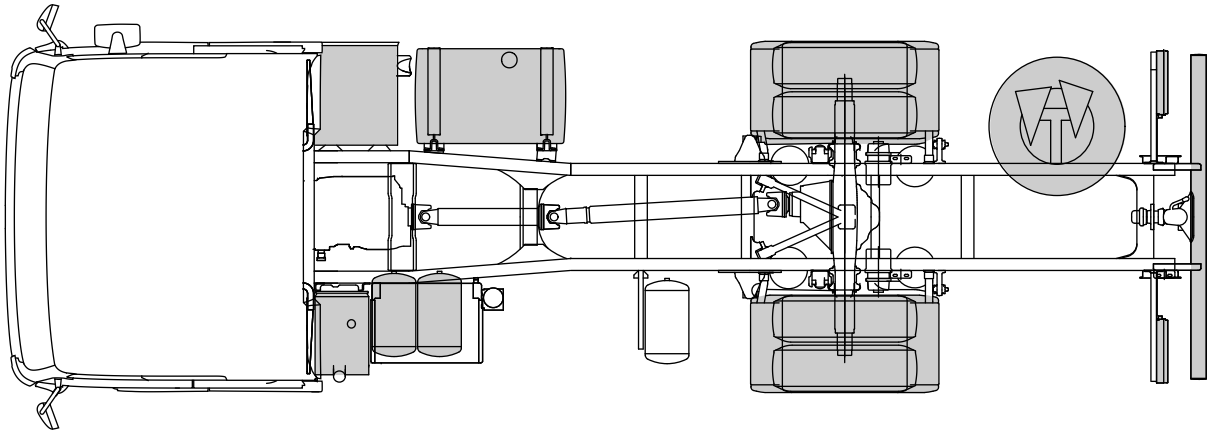
5.1 General

Frame attachments are parts whose attachment points are located on the frame.

These include, for example:

- Fuel and AdBlue tank
- Side underride protection
- Underride protection
- Battery box
- Spare wheel
- Exhaust silencer
- Mudguard

Fig. 35-III: Example for frame attachments



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5.5.1 Mounting fuel tanks

Various fuel tank versions are offered ex works for the different series.

The following points must be observed when fuel tanks are mounted on the frame:

- MAN recommends using original MAN fuel tanks, tank supports and fixing elements. These can be obtained from the MAN Spare Parts Service.
- The weight of the tank should be borne equally by the tank supports.
- If possible, tank supports are to be mounted on the chassis frame close to cross members.
- Ensure that the attachment points for the tank support in the chassis frame have the greatest possible vertical spacing.
- For strength and stability reasons, clamping straps must be placed over the baffles of the fuel tank.
- The distance from the centre of the tank support to the centre of the baffle must not exceed 200 mm for tank volumes of up to 400 l. The distance from the centre of the tank support to the centre of the baffle for greater volumes (> 400 l) must not exceed 150 mm.
- Individual fuel tanks of up to 600 l are fixed to the vehicle frame by two tank supports and clamping straps. Depending on the application, however, three tank supports may already be required.
- For 600 l and larger, fuel tanks are fixed to the vehicle frame by three tank supports and clamping straps.
- The fuel tanks are fixed to the vehicle frame by tank support brackets. Between the tank supports and tank shell and between the clamping straps and tank shell, underlays must be added in accordance with MAN standards M3306-2 and M3306-1 respectively in order to ensure even, slip-free transmission of force from the clamping straps and tank supports to the tank shell. Absolutely no deformation of the fuel tank may be allowed to occur.

Body builders can obtain the mentioned MAN works standards via www.ptd.man.eu (registration required).

6.3 Engine environment

6.3.1 Modifications to the engine

Important notice

MAN does not permit any modifications to the engine or its components. Non-compliance voids type approval and warranty.

6.3.2 Modification to the air intake

Modifications to the intake system must generally be avoided. Various deliverable serial variants are available for TGL/TGM that must be checked with respect to their usability. Information about the delivery options for the respective vehicle is available in the nearest MAN sales branch.

If modification of the air intake is unavoidable, the following standards shall apply. If these cannot be observed, a written request and approval from MAN is required (for address, see “Publisher” above).

The following regulations generally apply here:

- Air intake must be unobstructed.
- The low pressure in the intake pipe must not change.
- Cross-sections of the piping in the form and/or surface must not be modified under any circumstances.
- Sharp bends in the pipes must be avoided, mitre cuts are not permissible.
- Do not modify air filters.
- Only use approved air filter elements.
- The suspension or support concept and the basic installation position of the components must be retained.
- In the case of modifications to the intake system, it must be guaranteed that all provisions relevant to noise and emissions and other legal provisions continue to be fulfilled.
- The air intake must be protected from taking in heated air (e.g. engine waste heat from the region of the wheel arches or near to the exhaust silencer). A suitable intake point must be selected, which guarantees that the intake air is not heated more than 5°C (ambient temperature at the temperature in front of the turbo charger). If the intake air temperature is too high, there is a risk of exceeding the exhaust limit values. If the exhaust limit values are not observed, the operating licence is invalidated!
- The piping on the clean air side must be selected so that it is externally completely leak-proof. The inside of the clean air pipe must be smooth, it must not be possible for particles or similar to become free. Slipping of the clean air pipe at the sealing points must be avoided at all costs. Suitable retaining devices must be provided for this purpose.
- In order to avoid taking in burning cigarette ends or similar, a cigarette protective grill must be installed directly on the intake point in the same manner as the serially installed grille (non-combustible material, mesh size SW6, area of the open cross-section min. area of the untreated air nozzle on the air filter). Non-observance of this involves the risk of vehicle fires! MAN is unable to make a statement regarding the measure decided upon; the responsibility for this is held by the implementing company.
- The intake point must be in an area with lower dust levels and in the splash-proof area.
- All the provisions must also be fulfilled which are called for by the Employers’ Liability Insurance Association or equivalent establishments relating to the relevant components (e.g. surface temperature in the handle area).
- An adequate drain facility by means of water trapping mechanisms as well as unobstructed dust discharge from the filter housing and the untreated air region must be guaranteed, otherwise damage to the engine may occur.
- The intake system must have water trapping efficiency of at least 80% (in accordance with SAEJ2554 for an air volume flow of 13 - 22m3/min).
- All intake pipes must have low pressure resistance of 100 mbar as well as temperature resistance of min. 80°C (short-term 100°C) Flexible pipes (e.g. hoses) are not permitted.

If subassemblies/components are seated to move in relation to one another, the following basic rules must be followed when routing leads:

- A lead must be able to follow the movement of a subassembly without hindrance; ensure that there is sufficient spacing between moving parts (rebound/compression, steering angle, tilting of cab). Lines must not be stretched.
- Precisely define the respective beginning and end of the movement as a fixed clamping point. The polyamide pipe or corrugated tube is gripped tightly at the clamping point using the widest cable tie possible or a clip suitable for the diameter of the pipe.
- If polyamide pipes and corrugated tubes are laid at the same junction, the stiffer polyamide pipe is laid first. The softer corrugated tube is then attached to the polyamide pipe.
- A line tolerates movement at right angles to the direction in which it is laid, so ensure sufficient spacing between the clamping points (rule of thumb: spacing of clamping points ≥ 5 x amplitude of movement to be sustained).
- Large amplitude of movement is best withstood by laying a pipe U-shaped and allowing movement along the arms of the U.

Rule of thumb for minimum length of slack loop:
Minimum length of slack loop = ½ ● amplitude of movement ● minimum radius ● π

- Observe the following minimum radii for PA pipes (define the respective start and end of the movement precisely as the fixed clamping point).

Table 15-III: Minimum radius for PA pipes

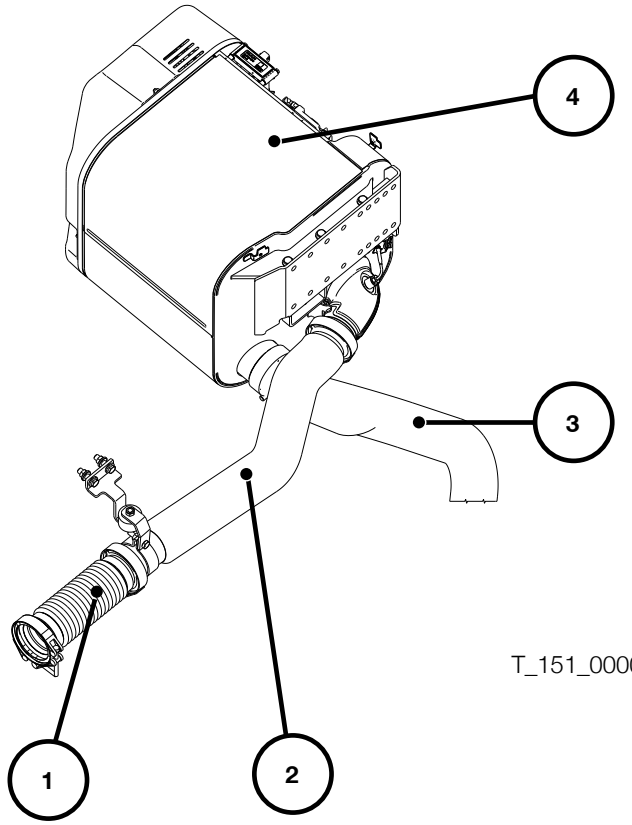
Nominal diameter - Ø [mm]	4	6	9	12	14	16
Radius [mm]	20	30	40	60	80	95

- Use plastic clips to secure the lines and comply with the maximum clip spacing stated in Table 16-III.

Table 16-III: Maximum space between clips used to secure pipes in relation to pipe size

Pipe size	4x1	6x1	8x1	9x1,5	11x1,5	12x1,5	14x2	14x2,5	16x2
Clamp spacing [mm]	500	500	600	600	700	700	800	800	800

Fig. 56-III: Components of the exhaust-gas piping



1) Flexible metal hose
2) Exhaust pipe
3) Exhaust tailpipe
4) Exhaust silencer

The exhaust pipe may be lengthened in the section between the flexible metal hose and the silencer (see Fig. 56-III: Components of the exhaust-gas piping).

In this regard, the exhaust pipe between the flexible metal hose and the silencer may not exceed the following lengths (neutral axis), see Fig. 57-III: Neutral axis).

- TGL (4-cyl. engine): 1720 mm
- TGL (6-cyl. engine) and TGM: 1540 mm

Description of lines in vehicles with Euro 6 emission standard with SCRonly technology:

- The AdBlue suction line from the AdBlue tank to the supply module is bundled, together with a heating water line, to a line set, is covered with corrugated tube and sealed with spring clips at the ends.
- The AdBlue return line from the supply module to the AdBlue tank is bundled, together with a heating water line, to a line set, is covered with corrugated tube and sealed with spring clips at the ends.
- The AdBlue pressure line from the supply module to the metering module is bundled, together with a heating water line, to a line set, is covered with corrugated tube and sealed with spring clips at the ends.
- Modifications to these line sets are not permitted.
- Heating water supply line from engine to water shut-off valve
- Heating water return line from point of separation at the exhaust silencer to engine
  - in vehicles up to 04/2018
  - Dimensions: 8 x 1 mm, polyamide material

  - in vehicles as of 04/2018
  - Dimensions: 12.5 x 1.25 mm, polyamide material

- Other heating water supply lines
  - Dimensions: 8 x 1 mm, polyamide material

Minimum bending radii:

- AdBlue pipe sets : minimum 90 mm
- Polyamide heating water lines 8 x 1 mm : minimum 40 mm
- Polyamide heating water lines 12.5 x 1.5 mm: minimum 60 mm

Maximum lengths of lines in the AdBlue line set:

Line sets that carry AdBlue must not be changed. MAN (for address see „Publisher“ above) offers line sets in varying lengths. Information and overview drawings are available from MAN.

Metering line (between supply module and exhaust silencer):

- in vehicles with the supply module installed at the AdBlue tank (short suction line and return line), the maximum length of the polyamide part is 2.4 m.
- in vehicles with the supply module installed at the AdBlue tank (TGL with L/LX/crew cab), all available polyamide parts can be used.
- Metering line must be directed downwards and away from the supply module. Subsequent ascent after a siphon is permitted.

Lines between supply module and AdBlue tank:

- Avoid modifications to the routing of the line between supply module and AdBlue tank
- Should modifications to the line routing be necessary, the following points should be observed:
  - Do not exceed or drop below the heights specified in the installation overview (see Fig. 65-III)
  - Suction line and return line must be directed downwards and away from the supply module. Subsequent ascent after a siphon is permitted.

Mudguard pipe-brackets available from the MAN Spare-parts Service may be used for this purpose (Fig. 71-III: Mudguard pipe-bracket). Installation space of approximately 40 mm must be provided for the mudguard pipe-bracket.

Fig. 71-III: Mudguard pipe-bracket

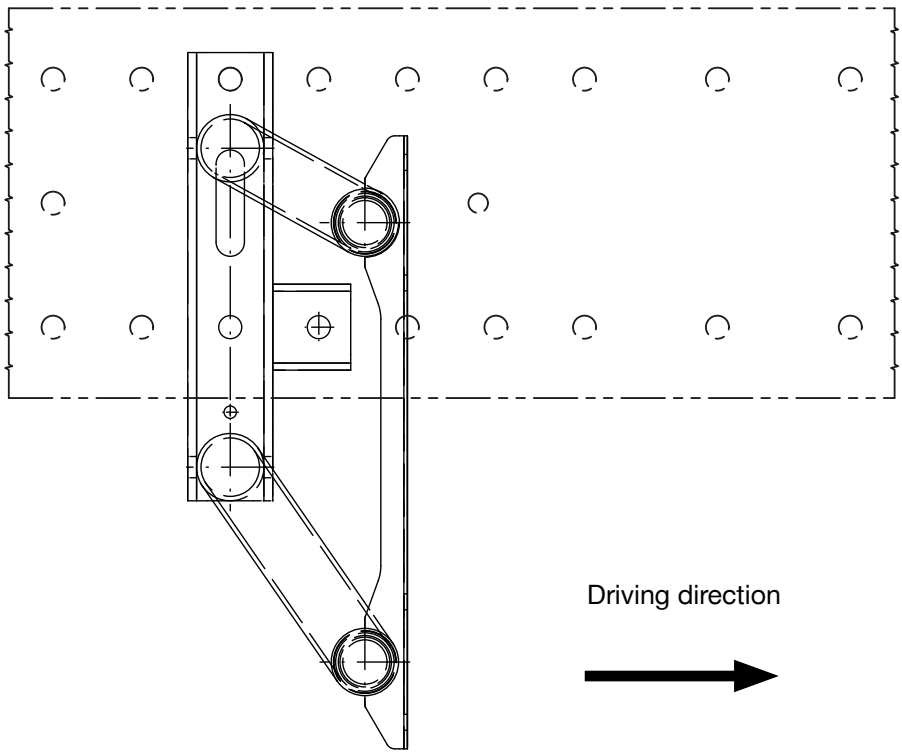
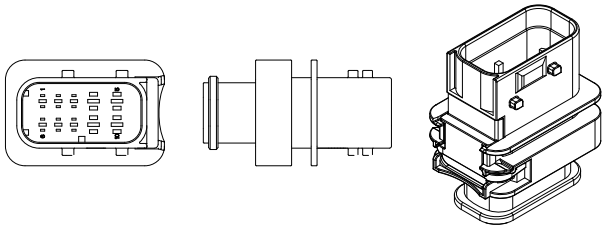


Table 21-III: Plug connector on AdBlue tank and supply module - continued

Material for cable set		
Qty.	MAN part no.	Material / line
1	07.08302-1191	Line FLRYW-2X 0.75-GE-OR-191-192
1	07.08181-0385	Line FLRY-0.75-BROR
3	07.08181-0343	Line FLRY-0.75-GEOR
1	07.08181-0506	Line FLRY-1-GE
1	07.08181-0776	Line FLRY-1.5-BRGE
1	07.08181-0706	Line FLRY-1.5-GE
1	04.37135-9938	Corrugated tube 8.5 dia.

Socket housing SF31 MAN item no.: not available / TE Connectivity no.: 1-1564516-1

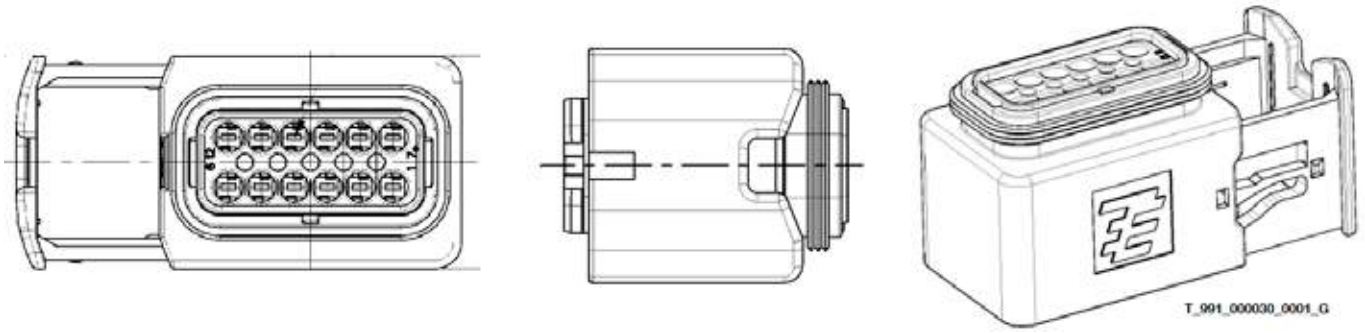


Material for SF31 pin housing			
Qty.	MAN code	MAN part no.	Part designation
1	SF31	81.25475-0335	Pin housing
1	AW94	81.25433-0292	Adapter HDSCS D-180° - NW13
1	AR17	81.25433-0118	Slip-in reducer NW13 - NW10
1	AR47	81.25433-0006	Slip-in reducer NW10 - NW8.5
1	GV59	81.25475-0338	Locking slide size: "D" yellow
6	XG60-1<0	07.91201-0216	Contact (volume goods)
1	XG20-1<0	07.91202-0603	Contact (individual goods)
2	XG20-2<5	07.91202-0604	Contact (individual goods)
6	DL11	07.91163-0069	Sealing element
1	DL25	82.25435-0090	Sealing element
2	DL26	07-91163-0077	Sealing element
1	DL27	07.91163-0065	Blind plug

SF31 pin housing pin-out				
PIN	Manager	Cross-section mm²	Contact	Sealing element
1	191	0,75	XG60-1<0	DL11
2	192	0,75	XG60-1<0	DL11
3	31000	0,75	XG60-1<0	DL11
4	31000	1,5	XG20-2<5	DL26
5	90008	1	XG20-1<0	DL25
6	90311	0,75	XG60-1<0	DL11
7	90321	0,75	XG60-1<0	DL11
8	15038	0,75	XG60-1<0	DL11
9	90004	1,5	XG20-2<5	DL26
10	not used	-	-	DL27 (blind plug)

Table 27-III: Plug connector on AdBlue supply module

BF16 socket housing MAN item number: 81.25475-0284



Supply module			
Qty.	MAN code	MAN item number	Part designation
1	BF16	81.25475-0284	Plug housing
1	AWA1	81.25433-0298	Angle adapter, 90°
1	AR17	81.25433-0118	Slip-in reducer 13-10
1	AR47	88.25433-0006	Slip-in reducer 10-8.5
4	DL10	07.91163-0068	Single-lead seal
4	DL11	07.91163-0069	Single-lead seal
4	DL40	07.91163-0086	Single-lead seal
4	XU61-1<5	07.91201-6030	Socket (individual goods)
4	XU61-1<0	07.91201-6025	Socket

BF14 socket housing pin-out supply module				
PIN	Cable	Cross section mm²	Contact	Sealing element
1	Free			DL10 (blind plug)
2	90521	0,75	XU61-1<0	DL11
3	90523	0,75	XU61-1<0	DL11
4	90522	0,75	XU61-1<0	DL11
5	Free			DL10 (blind plug)
6	Free			DL10 (blind plug)
7	Free			DL10 (blind plug)
8	90525	1,5	XU61-1<5	DL40
9	90524	1,5	XU61-1<5	DL40
10	90520	0,75	XU61-1<0	DL11
11	90531	1,5	XU61-1<5	DL40
12	90532	1,5	XU61-1<5	DL40

Propeller shaft train

If a design dictates the need for more length, it is possible to implement a propeller shaft train comprising two or more shafts. Fig. 90-III illustrates basic forms of a propeller shaft train in which the position of the joints and drivers relative to one another was randomly chosen.

Drivers and joints have to be harmonized for kinematic reasons. In matters concerning propshaft train design, the propshaft manufacturers should be consulted.

Fig. 90-III: Propshaft train

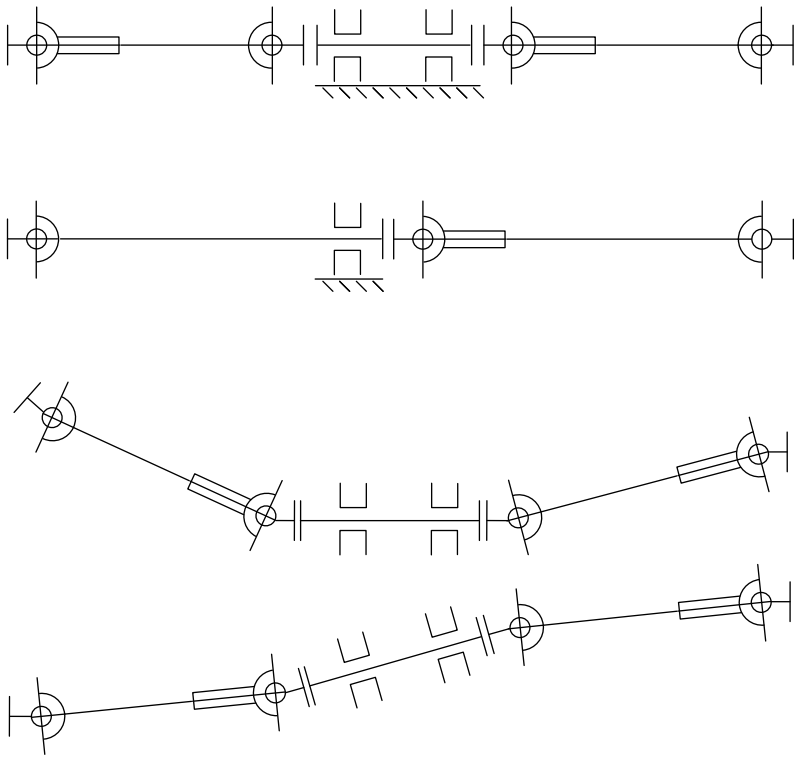


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Table 32-III: Overview of aerial equipment

Designation	Item no.	Position	Aerial, see electrical parts list
Aerial installation	81.28200.8365	Pos. 1	Radio aerial
Aerial installation	81.28200.8367	Pos. 1	Radio aerial + D and E networks
Aerial installation	81.28200.8369	Pos. 1	Radio aerial + D and E networks + GPS
Radio aerial installation, LHD	81.28200.8370	Pos. 2	CB radio aerial
Radio aerial installation, RHD	81.28200.8371	Pos. 3	
Radio aerial installation, LHD	81.28200.8372	Pos. 2	Trunked radio aerial
Radio aerial installation, RHD	81.28200.8373	Pos. 3	
Radio aerial installation, LHD	81.28200.8374	Pos. 2	Radio aerial (2-m band)
Radio aerial installation, RHD	81.28200.8375	Pos. 3	
Aerial installation, LHD	81.28200.8377	Pos. 3	GSM and GPS aerial for toll system
Aerial installation, RHD	81.28200.8378	Pos. 2	
Radio aerial installation, LHD	82.28200.8004	Pos. 2	CB-radio and radio aerial
Combined aerial installation, RHD	81.28205.8005	Pos. 3	GSM + D and E networks + GPS + CB-radio aerial
Combined aerial installation, LHD	81.28205.8004	Pos. 2	

8.1.4 Diagnostics concept and parameterisation using MAN-cats

MAN-cats is the MAN tool for diagnosis and parameterisation of electronic systems in vehicles. MAN-cats is used in all MAN Service outlets.

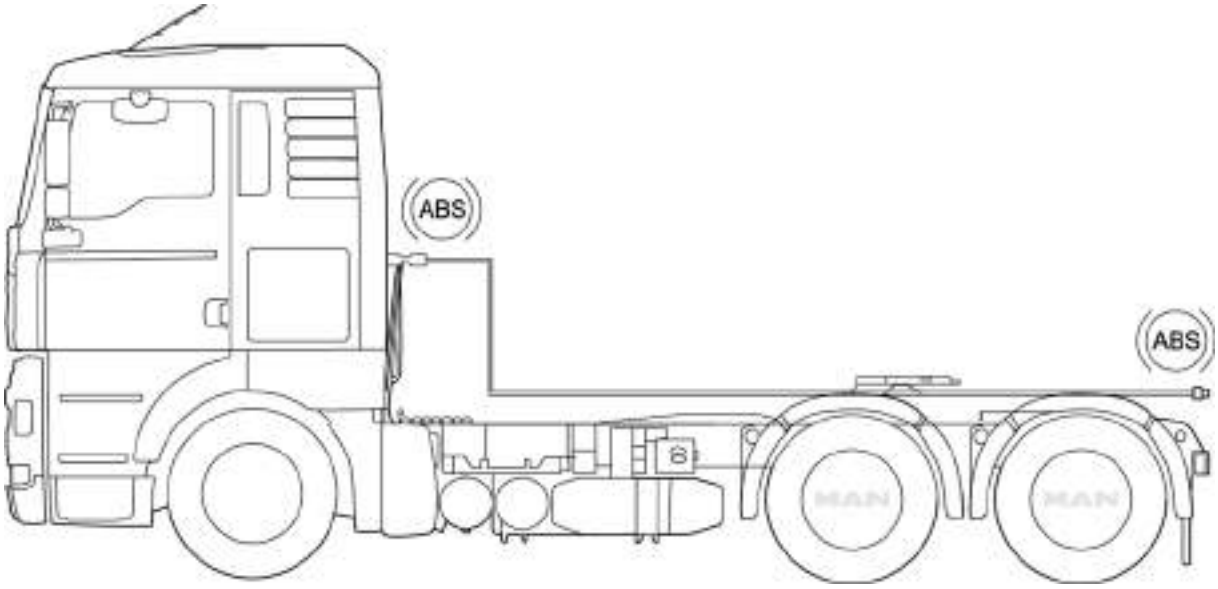
If the bodybuilder or the customer informs MAN of the intended use or the body type (e.g. for the intermediate speed control interface) when the vehicle is ordered, these can be incorporated into the vehicle at the factory using EOL (end-of-line) programming. If this variant is possible, under certain circumstances it may not be necessary to carry out parameterisation with MAN-cats.

MAN-cats must be then used if the parameters set in the vehicle are to be changed. For certain types of intervention in the vehicle systems the electronics specialists at MAN Service outlets are able to contact systems specialists at the MAN plant to obtain the appropriate releases, approvals and system solutions.

Important notice

For vehicle modifications that require approval or are relevant to safety, necessary adaptation of a chassis to the bodywork, conversion measures or retrofits, clarify with a MAN-cats specialist from the nearest MAN Service outlet before beginning whether the vehicle will require new parameterisation.

Fig. 101-III: Use of ABS extension cable



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Important:
Connect the ABS socket in accordance with use.

In this way the ABS socket may be mounted either behind the cab (tractor unit) or at the frame end (truck).
The cable lengths available conform with the wheelbases of the respective MAN tractor units (see Table 44-III).

Table 44-III: ABS extension cables

Item no.	81.25453.6288	81.25453.6290	81.25453.6291	81.25453.6292
Cable length (total)	4.700mm	5.400 mm	6.100 mm	6.800 mm
Use Wheelbase R	Semitrailer tractor 4x2, 4x4 R <= 3.900	Semitrailer tractor 6x2 R <= 3.200+1.350	Semitrailer tractor 6x4, 6x6 R <= 3.600+1.350	Semitrailer tractor 6x4, 6x6 R <= 3.600+1.350

8.3.7 Interface for reversing-camera preparation

The electrical interface for the rear-view camera preparation makes it possible to connect either one or two rear-view cameras and show the image on the screen of the MAN Radio MMT advanced. The system automatically switches to the camera image when reverse gear is engaged, or the rear view can be manually selected using a separate button.

The rear-view camera preparation interface is a system independent of the MAN radio MMT advanced, and must be ordered separately using the sales code for the rear-view camera preparation.

If the interface is not available ex works, it is possible to retrofit it. Because a retrofit is costly and requires access to the vehicle electrical circuit, we recommend having it done at a MAN Service centre.

Some camera manufacturers offer an adapter lead suitable for our interface (rear-view camera preparation), which can also be sourced from a MAN specialist workshop.

From September 2016 there will be a new generation of radios, which two cameras can be connected to. Switching between the two images takes place using the CAM button on the radio.

This section also describes the distinctive features of the different radios and the different interfaces.

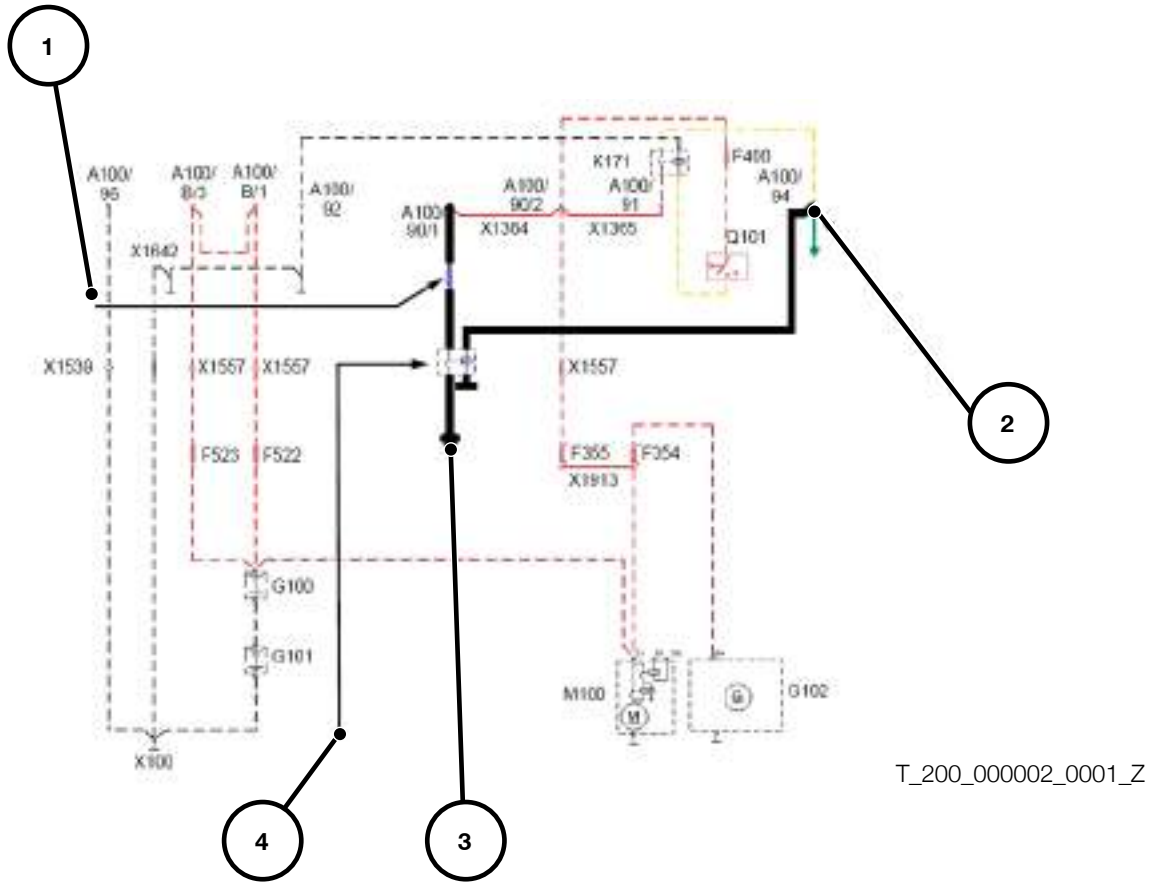
MAN Radio MMT advanced (from 2012)

This radio has a 5-inch display and a CD slot. The system automatically switches to the camera image when reverse gear is engaged, or the rear view can be manually selected using a separate button in the switch block of the instrument panel.

MAN Radio MMT advanced (from 2016)

This radio has a 7-inch display and the system automatically switches to the camera image when reverse gear is engaged, or it can be manually selected using a button on the radio (CAM button). As a further variant, it is possible to activate the camera image using a contact to the radio; you can find the description for doing so under “MAN Radio MMT advanced (2016)” – Activating the camera image via a contact.

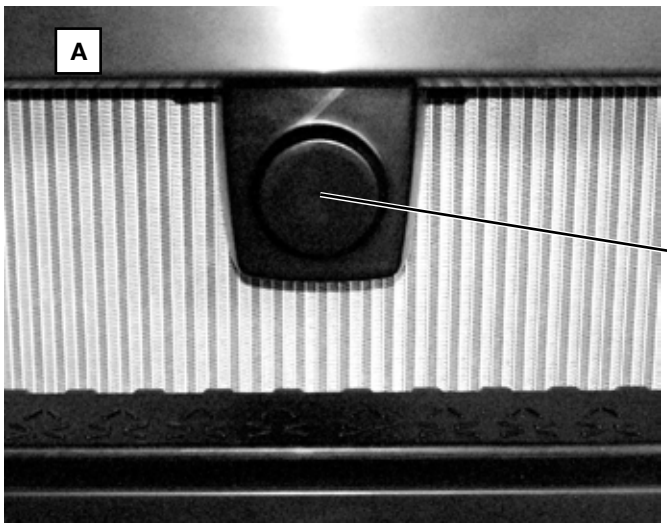
Fig. 115-III: Wiring diagram, additional consumers



1) Fuse as per rated current of permitted consumer
2) Only connect the supply voltage of Terminal 15 of consumers that can also be installed as standard on this connection (exception: relay control for additional consumers).
3) Additional consumer (maximum 10 A rated current)
4) Relay for voltage supply Terminal 15 for the additional consumers (e.g. 81.25902-0473).

A100		Central electrics box
F354		Main fuse, Terminal 30
F355		Main fuse, Terminal 30
F400		Steering-column lock fuse
F522		Line 30000 fuse
F523		Line 30000 fuse
G100		Battery 1
G101		Battery 2
G102		Alternator
K171		Relay, Terminal 15
M100		Starter motor
Q101		Ignition lock
X1	00	Ground connection engine
X1	364	Bridge between connector pins 90-1 and 90-2 of the central electrics box
X1	365	Bridge between connector pins 90-2 and 91 of the central electrics box
X1	539	X1 557 plug connector, cab interface
X1	642	Ground point in cab behind combined instrument
X1	644	Ground point in cab next to central electrics box
X1	913	Bridge for cable 30076 in the cable conduit on the engine

Fig. 119-III: Cab front Detail A (radar sensor with cover)



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The radar sensor is a component relevant to safety and is located behind a cover (see Fig. 119-III, Position 1) in the vicinity of the step surface on the front of the vehicle. To ensure trouble-free operation of the EBA it is essential that the following points are observed.

During operation, it must be ensured that the radar sensor cannot be either temporarily or permanently obscured. The sensor detection zone will be limited if the area scanned by the radar is partially or fully masked by any (front-end) attachments.

Clearance

General:
The freedom of movement of moving parts must not be adversely affected by the body. Amongst others, the following points must be observed when determining the requisite freedom of movement.

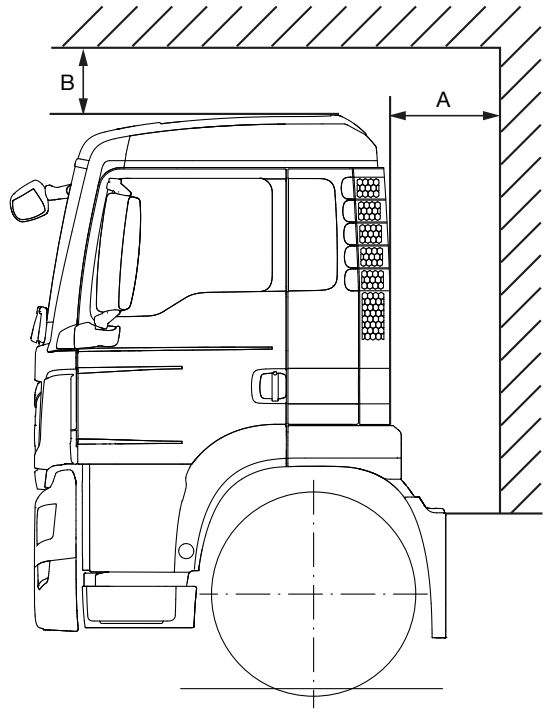
- Maximum spring compression
- Dynamic spring compression during travel
- jounce when pulling away or braking,
- sideways tilt when cornering,
- Operation with snow chains
- Limp-home mode characteristics of the air spring (e.g. damage to an air-spring bellows during a trip)

Cab:
Acceleration occurring during driving operation leads to rolling and pitching movements of the cab. These movements must not be hampered by the body. The body builder must ensure that the following distances between cab and body are maintained (see Table 01-IV and Fig. 01-IV).

Table 01-IV: Minimum distance between cab and body

Model range	Cab	Dimension A [mm]	Dimension B [mm]
TGL/TGM	C, DK	50	50
	L, LX	60	50

Fig. 01-IV: Clearance between cab and body



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A – Distance between cab rear wall and body
B – Distance between cab roof and body

Scope and purpose

The RED defines a regulatory framework for the market launch and commissioning of radio equipment on the EU market.

Explanation of terms:

'Radio equipment' means electrical or electronic products, which intentionally emit and/or receive radio waves for the purpose of radio communication and/or radiodetermination, or electrical or electronic products which must be completed with an accessory, such as antenna, so as to intentionally emit and/or receive radio waves for the purpose of radio communication and/or radiodetermination.

'Radio waves' are electromagnetic waves of frequencies lower than 3,000 GHz, propagated in space without an artificial guide.

Use cases

With the aid of the decision-making aids described below, it is necessary to verify whether retrofitted components are affected by the Radio Equipment Directive. The description is only intended as an aid, and the relevance must be established in principle in accordance with the Radio Equipment Directive.

RED relevance decision-making aid

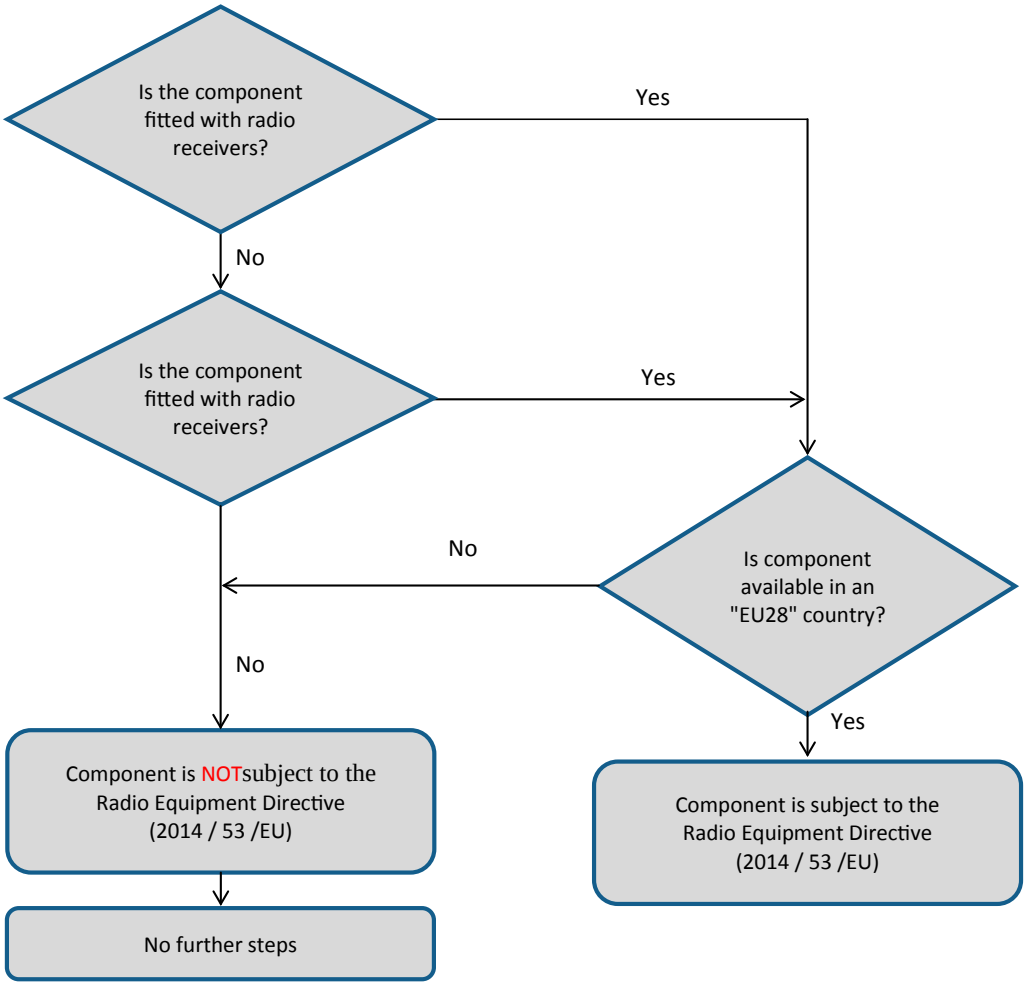
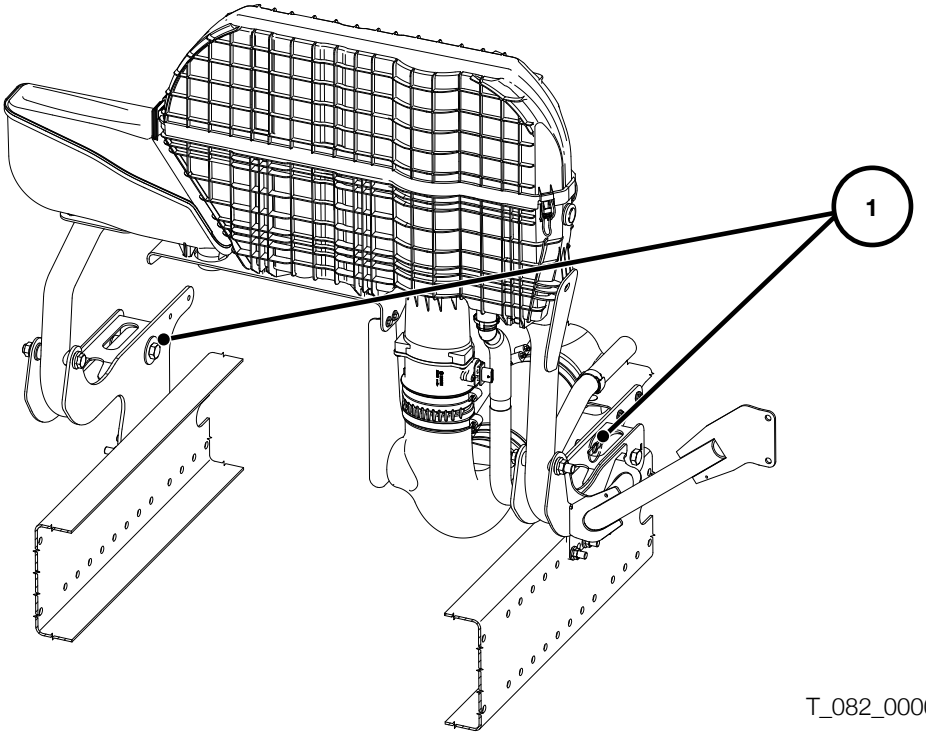


Fig. 12-IV: Exchanging washers for air intake brackets



1) Washers to be exchanged

Power take-offs

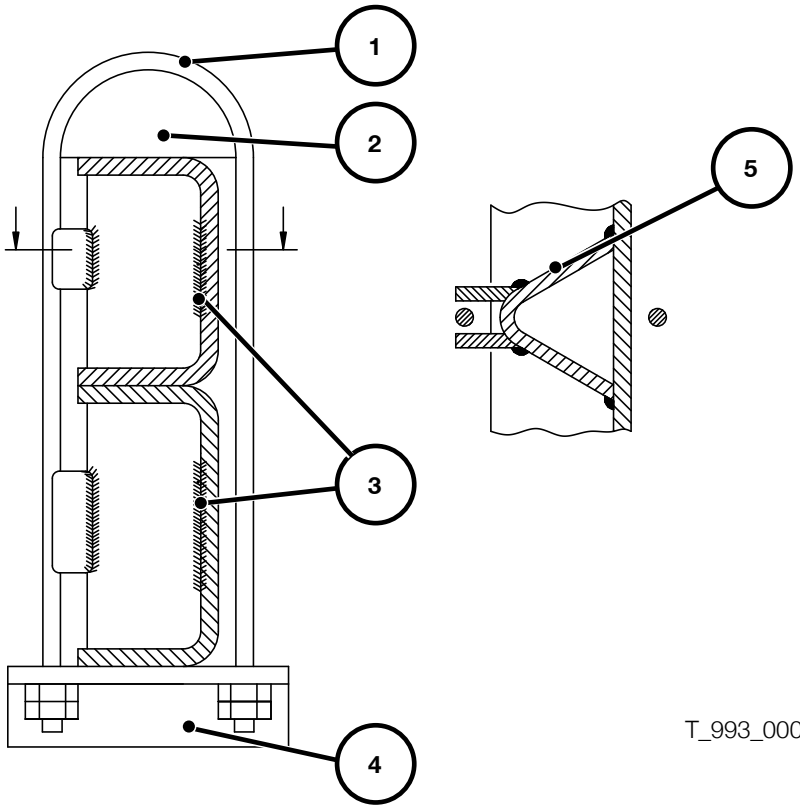
If one or more power take-offs are assembled to the gearbox ex works, the first frame cross-member is fitted behind the gearbox mainly in a height-adjustable design. In this standard position, the cross member, including the bolt head, extends up to 100 mm above the top edge of the frame; see the separate booklet entitled „Power take-offs“, Chapter 1.2 „Propshaft connection to power take-off“.

Upswept exhaust

If the vehicle is equipped ex works with a upswept exhaust pipe, it must be determined whether installation-space problems will arise during assembly of the auxiliary frame due to the fastening of the exhaust pipe (incl. support) for an illustration showing an example, please see Fig. 13-IV. If this is the case, the auxiliary frame has to be adapted as necessary.

For another example of a flexible connection, see Fig. 21-IV.

Fig. 21-IV: Shackle fastening



1) Shackle, strength 8.8
2) Spacer non-elastic
3) Attached on frame web only
4) Angular bracket or U-shaped bridging piece
5) Angle plate, approx. 5 mm thick, fitted

Vertically flexible implementations

The implementation of vertically flexible body fasteners depends in the first instance on the respective body. The torsional stiffness of the body plays a decisive role here. The following context applies.

A) Torsionally flexible body --> the requisite flexibility of the connection in the vertical direction is low (e.g. open platform body)
B) Torsionally stiff body --> the requisite flexibility of the connection in the vertical direction is high (e.g. closed box body)

The flexibility of the connection in the vertical direction can be increased by using long bolts, springs or elastomers. This applies especially to the bolt connections of the first retaining brackets behind the cab because these are subject to high vertical loads.

3.3 Swap body fittings

3.3.1 Chassis and equipment

Chassis in the TGL and TGM model ranges are not designed for operation as swap-body vehicles.
The TGS and TGX model ranges are designed for swap-body applications. For this purpose, specially prepared chassis with swap body fittings are available ex works.

3.3.2 Requirements to be met by the body

The general requirements to be met by body design as set down in Chapter IV, Section 2.0 are to be observed.

The installation of swap body fittings on chassis of the TGL and TGM model range without an auxiliary frame or with a multi-part auxiliary frame is not permitted.

As a basic principle, the installation of swap body fittings on TGL or TGM chassis requires a continuous auxiliary frame. In this case, written approval from MAN (for address see “Publisher“ above) is mandatory.

The usual mountings for swap containers are provided specifically for swap-body mountings. If these mountings are to be used to fasten different types of bodies (e.g. transport concrete mixers, tippers, semitrailer bodies and so on), their suitability must be confirmed by the manufacturer or by the bodybuilder.

Table 06-IV: Liftgate table for three-axle TGM (dimensions are in mm, loads in kg)
Applies to: N26, N44, N46, N48

Wheel base 1. and 2. axle	Wheel base 2. and 3. axle	Liftgate payload	Cabin	Permissible frame overhang	Min. auxiliary frame profile W x H x t
3875	1350	≤ 1000	C	1300	100 x 50 x 5
		≤ 1500	C	1300	100 x 50 x 5
		≤ 2000	C	1300	100 x 50 x 5
4125	1355	≤ 1000	C	1850	100 x 50 x 5
		≤ 1500	C	1800	100 x 50 x 5
		≤ 2000	C	1800	100 x 50 x 5
4425	1350	≤ 1000	C	1700	100 x 50 x 5
		≤ 1000	L / LX	1350	100 x 50 x 5
		≤ 1500	C	1650	100 x 50 x 5
		≤ 1500	L / LX	1350	100 x 50 x 5
		≤ 2000	C	1650	100 x 50 x 5
		≤ 2000	L / LX	1300	100 x 50 x 5
	1355	≤ 1000	C	2050	100 x 50 x 5
		≤ 1500	C	2000	100 x 50 x 5
		≤ 2000	C	2000	100 x 50 x 5
4725	1350	≤ 1000	C	1850	100 x 50 x 5
		≤ 1000	L / LX	1550	100 x 50 x 5
		≤ 1500	C	1850	100 x 50 x 5
		≤ 1500	L / LX	1500	100 x 50 x 5
		≤ 2000	C	1800	100 x 50 x 5
		≤ 2000	L / LX	1500	100 x 50 x 5
	1355	≤ 1000	C	2250	100 x 50 x 5
		≤ 1500	C	2200	100 x 50 x 5
		≤ 2000	C	2200	100 x 50 x 5
5075	1350	≤ 1000	C	2100	100 x 50 x 5
		≤ 1000	L / LX	1750	100 x 50 x 5
		≤ 1500	C	2050	100 x 50 x 5
		≤ 1500	L / LX	1750	100 x 50 x 5
		≤ 2000	C	2050	100 x 50 x 5
		≤ 2000	L / LX	1700	100 x 50 x 5

3.9 Loading crane

Loading cranes on truck chassis are usually fitted behind the cab or at the rear end of the vehicle. In addition, truck chassis are also employed as carrier vehicles for jib cranes.
Crane bodies place great demands on truck chassis and thus necessitate meticulous coordination of body and chassis.

Information

Approval of body
Approval for a crane body will be required if the framework set by these body guidelines is exceeded.

This applies to:
- Body specifications do not permit compliance with the requirements of body and auxiliary-frame design (see Chapter IV, Sections 2.0 and 3.9.3).
- The given maximum total crane moment as per Fig. 42-IV resp. Fig. 43-IV is exceeded (see Chapter IV, Sections 3.9.3).
- Four outriggers
- Special outriggers are fitted.

Acceptance of cranes
A crane body and its working are to be examined before the crane first goes into use in line with national specifications by a crane specialist or another person authorized to examine crane structures.

Warning notice

Responsibility for ensuring stability lies with the bodybuilder.

3.9.1 Chassis and equipment

If the vehicle is deployed with higher body or load centres of gravity, it is possible to select the vehicle equipment accordingly. The equipment options for bodies/loads with high centres of gravity are listed and outlined in Chapter III Section 7.3.

As a basic principle, chassis with model numbers N01 and N11 (see Chapter II, Section 2.2 for explanation) may not be fitted with loading cranes.

For fitting a loading crane behind the cab on chassis in the TGM model range with model no. N16, the “Shock absorber reinforced for front axle” equipment (Sales Code 366CA) is required.

Reinforced axle equipment

Depending on the size of the crane (weight and centre of gravity) and its position (behind the cab or at the rear), vehicles must be fitted with reinforced springs where available. These measures will prevent the chassis from adopting a lopsided position (such as due to reduced compression of the reinforced springs
Nevertheless, it is not always possible to avoid some lopsidedness on a crane body because of the shift in a vehicle’s centre of gravity.

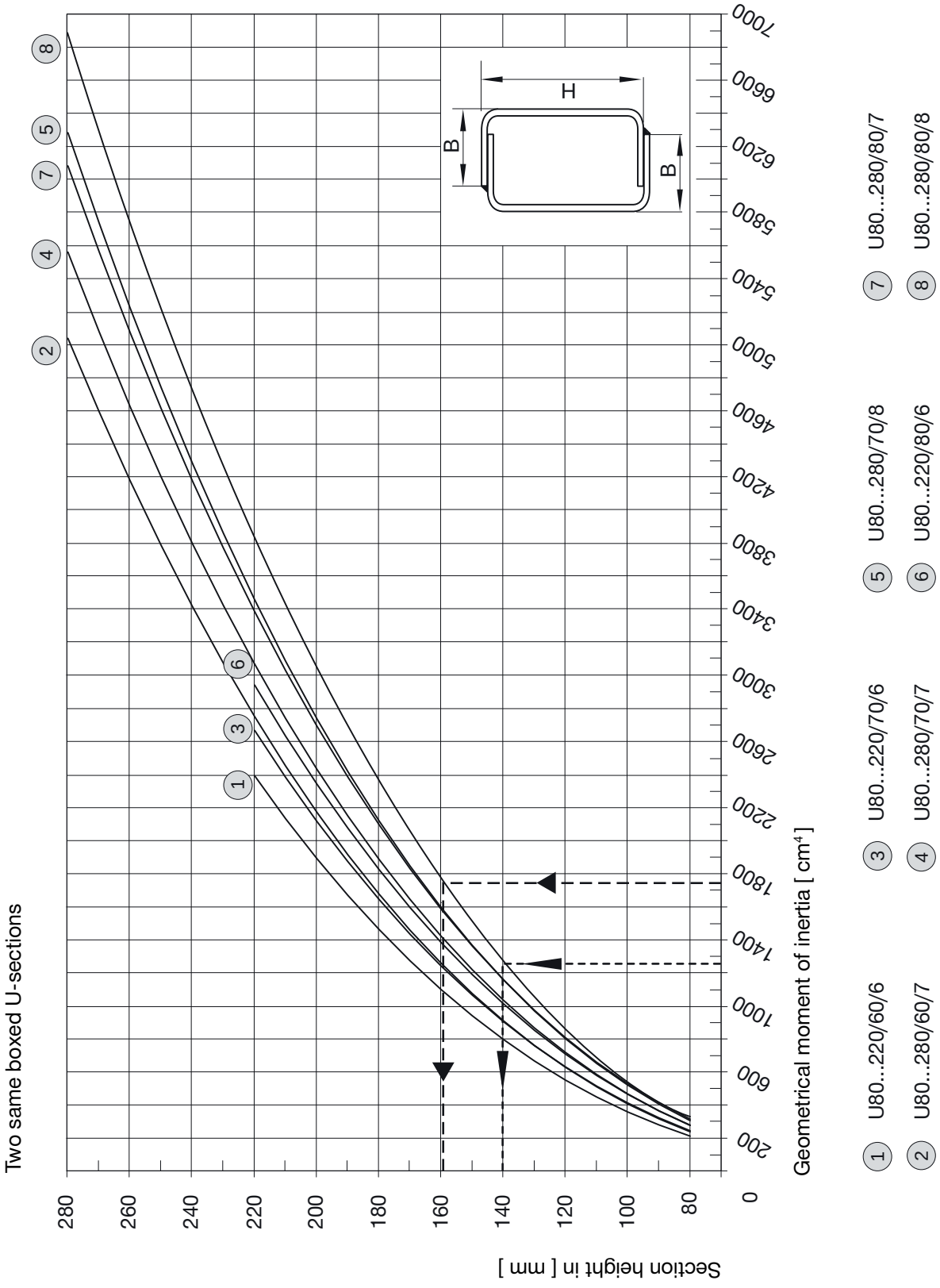
Important notice

The body retaining brackets delivered ex works are not suitable for crane bodies.

If no final cross member is fitted to the chassis (as is the case on the TGL/TGM when no trailer coupling is ordered) one must be retrofitted before a rear loading crane is installed.

Supporting vehicles
Chapter IV, Section 1.6 must in addition be observed with regard to vehicles with outriggers.

Fig. 46-IV: Geometrical moments of inertia of nested U-profiles



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Example: Several efficiencies

Given:
A pump drives a hydraulic motor via a jointed shaft system with two joints.
Output power P_{ab} is 20 kW.

Single efficiencies

Hydraulic pump:	η_1	=	0,7
Jointed shaft joint a:	η_2	=	0,95
Jointed shaft joint b:	η_3	=	0,95
Hydraulic motor:	η_4	=	0,8

Wanted:
How high is the input power P_{zu}?

Solution:

Total efficiency:

$$\eta_{ges} = \eta_1 \bullet \eta_2 \bullet \eta_3 \bullet \eta_4$$
$$\eta_{ges} = 0{,}7 \bullet 0{,}95 \bullet 0{,}95 \bullet 0{,}8$$
$$\eta_{ges} = 0{,}51$$

Input power:

$$P_{zu} = \frac{20}{0{,}51}$$
$$P_{zu} = 39{,}2 \text{ kW}$$

1.6 Power output

Power can be calculated using various different formulae, depending on the givens.

For planar motion:

Formula 12-V: Power for planar motion

$$P = \frac{F \bullet v}{1000} = \frac{9{,}81 \bullet m \bullet v}{1000}$$

For rotating motion:

Formula 13-V: Power for rotating motion

$$P = \frac{M \bullet n}{9550\ \eta}$$

In hydraulics:

Formula 14-V: Power in hydraulics

$$P = \frac{Q \bullet p}{600 \bullet \eta}$$

Where:

P	Power [kW]
m	Mass [kg]
v	Velocity [m/s]
η	Efficiency
F	Force [N]
M	Torque [Nm]
n	Rotational speed [rpm]
Q	Delivery rate (volumetric flow rate) [l/minute]
p	Pressure [bar]
1000	Constant conversion factor of [W] to [kW]
9550	Constant conversion factor of [Nm] and [rpm] to [kW]
600	Constant conversion factor of [rpm] and [bar] to [kW]

Example: Lifting motion

Given:
Liftgate payload including own weight is m = 2,600 kg
Lifting velocity v = 0.2 m/s

Wanted:
How high is the power without considering efficiency?

Example:

Given:
Instead of a tank weighing 140 kg, a tank weighing 400 kg is installed. The vehicle has a theoretical wheelbase of l_t = 4,500 mm. The distance between the tank and the theoretical front-axle centerline is 1,600 mm (see Fig. 03-V).

Wanted:
A calculation of the weight distribution to the front and rear axle is required.

Solution:
Weight difference

$$\Delta G = 400 - 140 = 260 \text{ kg}$$

Rear-axle weight difference

$$\Delta G_H = \frac{260 \bullet 1600}{4500}$$

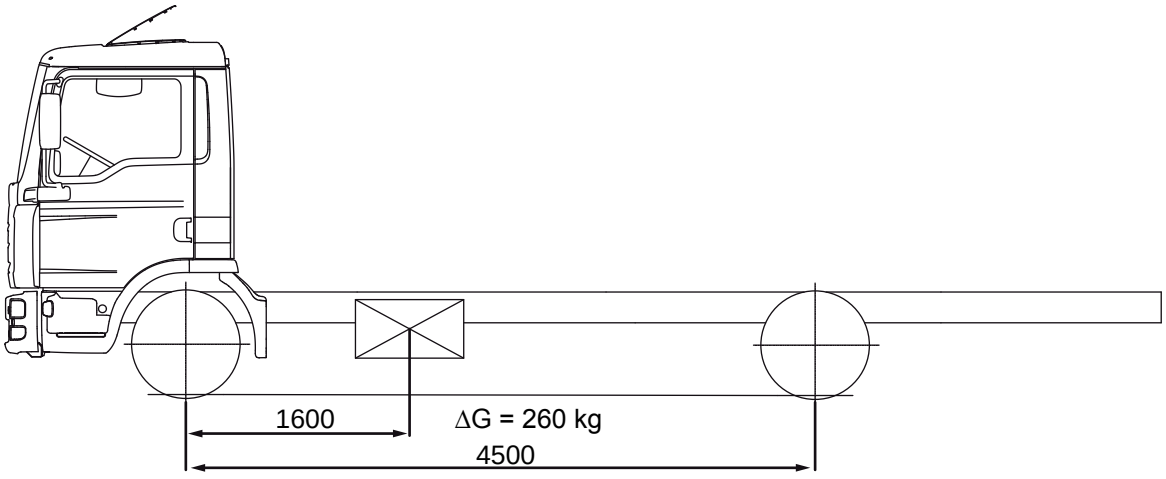
$$\Delta G_H = 92 \text{ kg}$$

Front-axle weight difference

$$\Delta G_V = 260 - 92$$

$$\Delta G_V = 168 \text{ kg}$$

Fig. 03-V: Axle-load calculation: Tank layout



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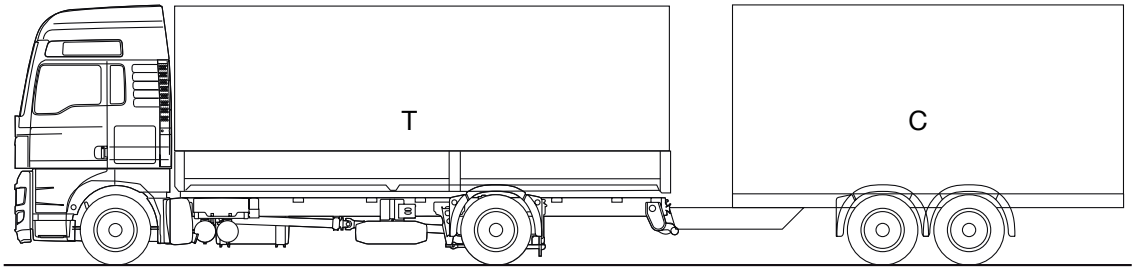
1.12.2 Trailer coupling for rigid drawbar trailer/ center-axle trailer (D_c value, V value)

Other conditions apply for the rigid drawbar and center-axle trailers in addition to the D value. Trailer couplings and final cross members have lower trailer loads because in this case the nose weight acting on the trailer coupling and the final cross member has to be taken into account.

In order to harmonise the regulations within the European Union, the terms Dc value and V value were introduced with Directive 94/20/EC.

The V value is a characteristic value for operation of these trailers. It restricts their operation in dependence on tractor-vehicle and trailer data and specifies the maximum vertical force permitted to act on the coupling.

Fig. 05-V: Articulated train with center-axle trailer



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The following formulae apply:

Formula 31-V: D_C value formula for rigid drawbar and center-axle trailer

$$D_C = \frac{9{,}81 \bullet T \bullet C}{T + C}$$

Formula 32-V: V value formula for center-axle and rigid drawbar trailers with a permissible nose weight of < 10% of the trailer mass and not more than 1,000 kg

$$V = a \bullet \frac{X^2}{l_2} \bullet C$$

If the values for x^2/l^2 <have been calculated as < 1, a value of 1.0 is to be used.

Where:

D_C	Reduced D value when operating with center-axle trailer [kN]
T	Permissible gross weight of the tractor vehicle [t]
C	Sum of the permissible axle loads of center-axle trailer without nose weight S [t]
V	V value [kN]
a	Reference acceleration in coupling point [m/s^2] 1.8 m/s^2 for air suspension on tractor vehicle or 2.4 m/s^2 for all other suspensions
x	Length of trailer body, see Fig. 06-V
l	Theoretical drawbar length, see Fig. 06-V
S	Nose weight of drawbar on coupling point [kg]