1. Gültigkeit der Aufbaurichtlinien

This „Guide to Fitting Bodies for Trucks“ (hereinafter also called the „Guide“) is published by MAN Nutzfahrzeuge.
The Guide is also available via our „MANTED® Technical Data“ software and on the Internet.

The user is responsible for ensuring that he is working with the latest issue. Our TDB Department (see „Publisher“ above) can provide information about the current status of the document.

This Guide serves as instructions and as a technical aid for companies that carry out the design and installation of bodies for truck chassis as well as companies that carry out modifications to truck chassis.

This Guide applies to:

- New vehicles
- Old vehicles

if retrospective work is being carried out on these vehicles.

A Guide to Fitting Bodies for bus chassis can be obtained from NEOMAN.

Responsibilities concerning trucks are as follows:
for

- Sales enquiries
  → the nearest MAN branch
  → Sales Support
- Technical enquiries
  → for sales negotiations
    - the nearest MAN branch
    - the ESC Department (for address see “Publisher” above)
- Customer service matters
  → After Sales

2. Vehicle designations

To identify and differentiate MAN vehicles, components and assemblies, Sections 2.1 to 2.5 of this chapter will describe some of the designations in greater detail. The figures contained in model designations serve only as an indication and are not definite figures for actual maximum load carrying capacity for specific components or assemblies; in addition, they do not always agree with the legally specified limits.

2.1 Model ranges

Within the MAN vehicle programme there are different vehicle classes or model ranges.
When reference is made in this Guide to vehicle families or model ranges, it is referring to the following vehicles:

L2000	7,5t - 10,5t	see Table 12
M2000L	12t - 26t	see Table 13
M2000M	12t - 25t	see Table 14
F2000	19t - 41t	see Table 15
E2000	19t - 50t	see Table 16

Table 15: F2000

Model no.	Tonnage	Designation	Suspension	Engine	Wheel formula
T01	19t	19.xxx F	BB	R5	4x2/2
T02	19t	19.xxx FL	BL	R5	4x2/2
T03	19t	19.xxx FLL	LL	R5	4x2/2
T04	19t	19.xxx FA	BB	R5	4x4/2
T05	23t	23.xxx FNLL	LLL	R5	6x2/2 6x2-4
T06	26t	26.xxx FNL	BLL	R5	6x2/2 6x2-4
T07	26t	26.xxx FNLL	LLL	R5	6x2/2 6x2-4
T08	26t	26.xxx FVL	BLL	R5	6x2/4
T09	26t	26.xxx DF	BBB	R5	6x4/2
T10	26t	26.xxx DFL	BLL	R5	6x4/2
T12	27/33t	27.xxx DFA	BBB	R5	6x6/2
T15	32t	32.xxx VF	BBBB	R5	8x4/4
T16	35/41t	35.xxx VF	BBBB	R5	8x4/4
T17	32t	32.xxx VFLR	BBLL	R5/R6	8x4/4
T18	27/33t	27.xxx DF	BBB	R5	6x4/2
T20	19t	19.xxx FLL	LL	R5	4x2/2
T31	19t	19.xxx F	BB	R6	4x2/2
T32	19t	19.xxx FL	BL	R6	4x2/2
T33	19t	19.xxx FLL	LL	R6	4x2/2
T34	19t	19.xxx FA	BB	R6	4x4/2
T35	23t	23.xxx FNLL	LLL	R6	6x2/2 6x2-4
T36	26t	26.xxx FNL	BLL	R6	6x2/2 6x2-4
T37	26t	26.xxx FNLL	LLL	R6	6x2/2 6x2-4
T38	26t	26.xxx FVL	BLL	R6	6x2/4
T39	26t	26.xxx DF	BBB	R6	6x4/2
T40	26t	26.xxx DFL	BLL	R6	6x4/2
T42	27/33t	27.xxx DFA	BBB	R6	6x6/2
T43	40t	40.xxx DF	BBB	R6	6x4/2
T44	40t	40.xxx DFA	BBB	R6	6x6/2
T45	32t	32.xxx VF	BBBB	R6	8x4/4
T46	35/41t	35.xxx VF	BBBB	R6	6x2/4
T48	27/33t	27.xxx DF	BBB	R6	6x2/2
T50	19t	19.xxx FLL	LL	R6	4x2/2
T62	19t	19.xxx FL	BB	V10	4x2/2
T70	26t	26.xxx DFL	BLL	V10	6x4/2
T72	27/33t	27.xxx DFA	BBB	V10	6x6/2
T78	27/33t	27.xxx DF	BBB	V10	6x4/2

3.2 Responsibility

The responsibility for proper

- design
- production
- installation of bodies
- modification to the chassis

always lies fully with the company that is manufacturing the body, installing it or carrying out modifications (manufacturer's liability). This also applies if MAN has expressly approved the body or the modification. Bodies/conversions that have been approved in writing by MAN do not release the body manufacturer from his responsibility for the product.
Should the company carrying out the work detect a mistake either in the planning stage or in the intentions of

- the customer
- the user
- its own personnel
- the vehicle manufacturer

then that mistake must be brought to the attention of the respective party.
The company is responsible for seeing that the vehicle's

- operational safety
- traffic safety
- maintenance possibilities and
- handling characteristics

do not exhibit any disadvantageous properties.
With regard to traffic safety, the company must operate in accordance with the state of the art and in line with the recognised rules in the field in matters relating to

- the design
- the production of bodies
- the installation of bodies
- the modification of chassis
- instructions and
- operating instructions.

Difficult conditions of use must also be taken into account.

3.3 Quality assurance (QA)

In order to meet our customers' high quality expectations and in view of international product liability legislation an on-going quality monitoring programme is also required for conversions and body manufacture/installation. This requires a functioning quality assurance system. It is recommended that the body manufacturer sets up and provides evidence of a quality system that complies with the general requirements and recognised rules (e.g. DIN EN ISO 9000 et seq. or VDA 8). Evidence of a qualified system can be provided for example by:

- Self-certification in accordance with the VDA checklist or that of another vehicle manufacturer
- A positive system audit carried out by other vehicle manufacturers (second party audit)
- Auditing of the QA system by an accredited institute (third party audit)
- Possession of a corresponding certificate.

The operating instructions for MAN trucks provide information about the maintenance points on the vehicle. Regardless of what type of body is fitted, good access to the maintenance points must be ensured in all cases. It must be possible to carry out maintenance unhindered and without having to remove any components. Sufficient ventilation and/or cooling of the components is to be guaranteed.

3.9.2 Manuals for MAN trucks

Each MAN truck has:

- Operating instructions
- Inserts that form part of the operating instructions
- Maintenance recommendations
- Maintenance booklet
- Maintenance instructions (available for a fee from the spare parts department).

Operating instructions

provide the driver and vehicle owner with all they need to know about how vehicles are operated and maintained in a ready-to-use condition. Important safety instructions for the driver/vehicle owner are also included.

Inserts

provide technical data on a specific type of vehicle or several similar types of vehicle, thus supplementing the operating instructions. Inserts are also published for new technical features and modifications to specific vehicles if the operating instructions themselves are not being revised.

Maintenance recommendations

are published in the same format as the operating instructions, i.e. DIN A5. They describe the maintenance systems and list specifications for the various operating fluids, fill quantities for various components and list approved operating fluids.
They are a supplement to every operating and maintenance manual. The „Maintenance recommendations“ brochure is published every 6 – 12 months.

Maintenance instructions

indicate the scope of the maintenance to be carried out, provide the technical data that is required for maintenance and describe the individual jobs in detail.
Both operating instructions and maintenance instructions are compiled for „vehicle families“. This means for example, that the „F2000 forward-control heavy-duty range“ operating instructions will include all the heavy-duty forward-control vehicles, regardless of which and how many axles it has or which engine is fitted. In exceptional cases for major customers, model-specific operating and maintenance instructions may be compiled.

Maintenance booklet

provides information about the necessary maintenance services and contains boxes that are filled in as evidence that maintenance work has been carried out properly and on time.

3.17.1 Axle overload, one-sided loading

Fig. 1: Overloading the front axle ESC-052

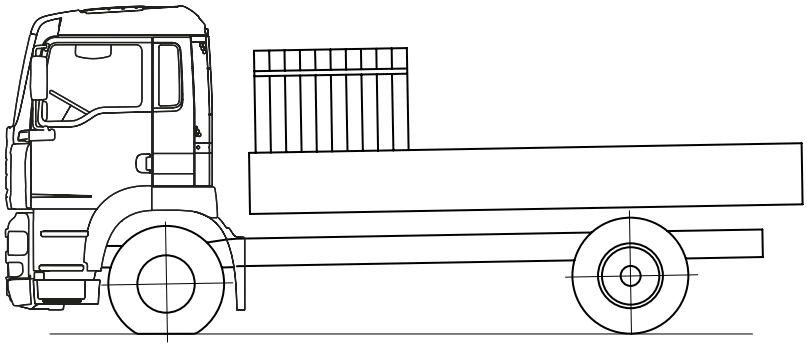


Fig. 2: One-sided loading ESC-054

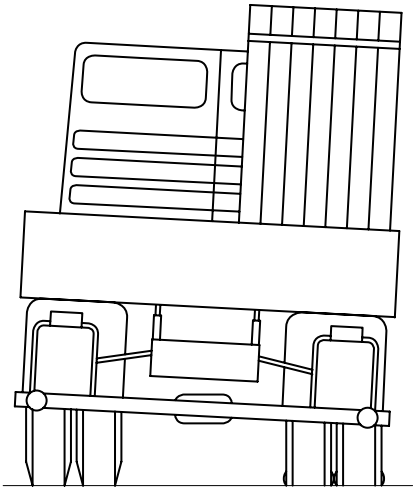
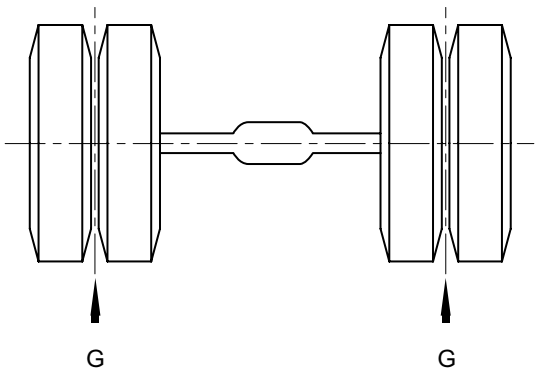


Fig. 3: Difference in wheel load ESC-126



Formula 8: Theoretical wheelbase and overhang for a four-axle vehicle with two front and two rear axles (any load axle distribution)

$$l_t = l_{23} + \frac{G_{permissible1} \bullet l_{12}}{G_{permissible1} + G_{permissible2}} + \frac{G_{permissible4} \bullet l_{34}}{G_{permissible3} + G_{permissible4}}$$

Formula 9: Zulässige Überhanglänge Vierachser mit zwei Vorder- und zwei Hinterachsen

$$U_t \leq 0{,}70 \bullet l_t$$

3.21 Permissible overhang for a four-axle vehicle with two front and two rear axles

Calculation of the axle load is essential to achieve the correct body design. Optimum matching of the body to the truck is only possible if the vehicle is weighed before any work on the body is commenced. The weights obtained from this can then be used in an axle load calculation. The weights given in the sales documents are only for vehicles with standard equipment. Build tolerances can occur, see point 3.17 in the section “Definitions, dimensions and weights”.

The vehicle must be weighed:

- Without the driver
- With a full fuel tank
- With the handbrake released and the vehicle secured with chocks
- If fitted with air suspension, raise the vehicle to normal driving position
- Lower any liftable axles
- Do not actuate any moving-off aid.

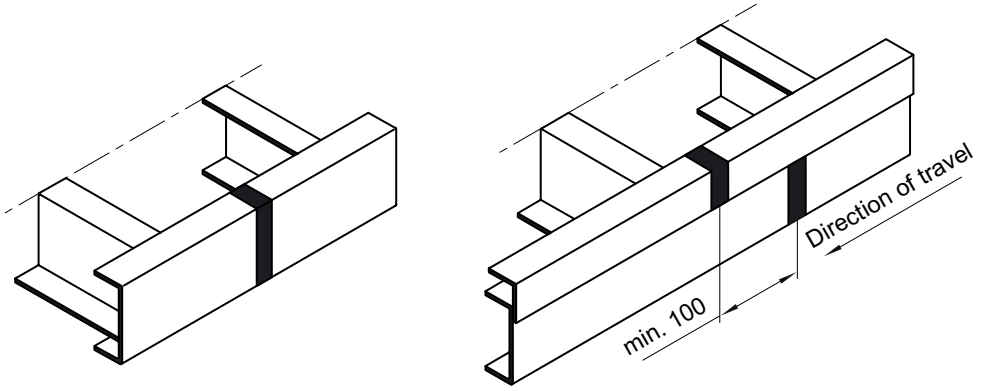
When weighing, observe the following sequences:

- Two-axle vehicles
  - 1st axle
  - 2nd axle
  - the whole vehicle as a check
- Three-axle vehicles with two rear axles
  - 1st axle
  - 2nd and 3rd axles
  - the whole vehicle as a check
- Four-axle vehicles with two front and two rear axles
  - 1st and 2nd axles
  - 3rd and 4th axles
  - the whole vehicle as a check.

3.22 Weighing vehicles with trailing axles

The weights stated in the sales documents and the MANTED® documents for vehicles with trailing axles have been calculated with the trailing axle lowered. The distribution of axle loads to the front and driven axle after the trailing axle is lifted is to be determined either by weighing or by calculation. An example of a calculation is given in the „Calculations“ section.

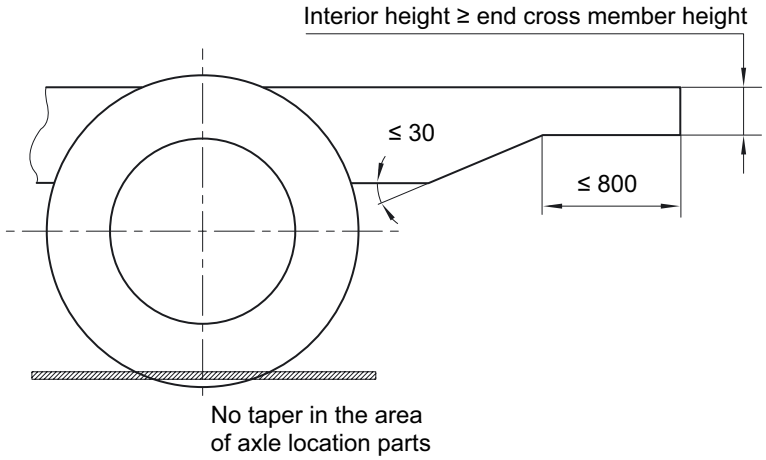
Fig. 24: Extending the frame and the subframe ESC-017



Even if a frame overhang has been extended the standard trailer load remains the same.
When the frame overhang is shortened, the largest possible technical trailer load is possible.

The rear end of the frame may be tapered as in Fig. 25 The resulting reduced cross-section of the longitudinal frame member profile must still be of sufficient strength. No tapers are allowed in the vicinity of the axle locating parts.

Fig. 25: Tapered frame end ESC-108



The rear ends of the chassis and body longitudinal members must be closed up with suitable coverings. Suitable coverings are, for example, metal plates or caps of rubber or suitable plastics (see e.g. §32 StVZO „Guidelines on the quality and fitting of external vehicle components“, note no. 21). This does not apply to body longitudinal members if they are set back or protected by the respective cross member or other suitable constructions.

Formula 10: Three-dimensional working angle

$$\tan^2 ß_R = \tan^2 ß_v + \tan^2 ß_h$$

The required angle of offset γ can be calculated using the joint angles in the horizontal and vertical planes as follows:

Formula 11: Angle of offset γ

$$\tan \gamma_1 = \frac{\tan ß_{h1}}{\tan ß_{\gamma 1}}; \quad \tan \gamma_2 \frac{\tan ß_{h2}}{\tan ß_{\gamma 2}}; \quad \gamma = \gamma_1 + \gamma_2$$

Where:

$ß_R$	=	Three-dimensional working angle
$ß_\gamma$	=	Vertical working angle
$ß_h$	=	Horizontal working angle
γ	=	Angle of offset.

Note:

In the case of three-dimensional offset of a propshaft with two joints only the three-dimensional working angles need to be equal.
In theory therefore, an infinite number of layout options can be achieved from the combination of the vertical and horizontal working angles.
We recommend that the manufacturers' advice be sought for determining the angle of offset of a three-dimensional propshaft layout.

4.9.3.1 Propshaft train

If the design dictates that greater lengths have to be spanned, propshaft systems comprising two or more shafts may be used.
Fig. 32 shows three basic forms of propshaft system in which the position of the joints and the drivers with respect to each other were assumed to be arbitrary. Drive dogs and joints are to be matched to each other for kinematic reasons. Propshaft manufacturers should be consulted when designing the system.

Fig. 32: Propshaft train ESC-078

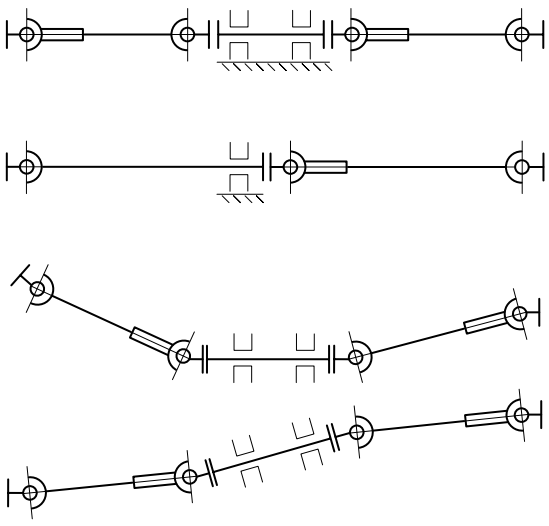


Table 25: Types of tippers and whether they require sideguards

Length of tipper body	≤ 7.500	> 7.500
Rear tipper	yes	yes
Roll-off/set-down skip loader	yes	yes
Two-way tipper	no	yes
Three-way tipper	no	yes

Vehicles intended for combined transport and vehicles suitable for off-road use are not exempt from the fitting of sideguards.

If the body manufacturer is to fit sideguards to the chassis, then profile sections, profile supports and installation parts are available from MAN in a variety of designs. They can be obtained from the spare parts service. To aid the design process, the maximum spans and projections for which the regulations with regards to strength have been met are stipulated in a design report (see Figs. 38 and 39). Dimension combinations for span „l“ and projection „a“ can be obtained from the diagram in Fig. 40. If the permissible dimensions as stated in the report are exceeded, then the body builder must carry out a strength test.

The figures clarify only the dimensions with which the MAN sideguards fulfil strength requirements. Other legal regulations have intentionally not been mentioned because the company that is installing the sideguards is responsible for meeting these. Further information can be obtained from Directive 89/297/EEC and, in Germany from §32c StVZO.

Fig. 38: Sideguards on L2000 and M2000 vehicles ESC 201

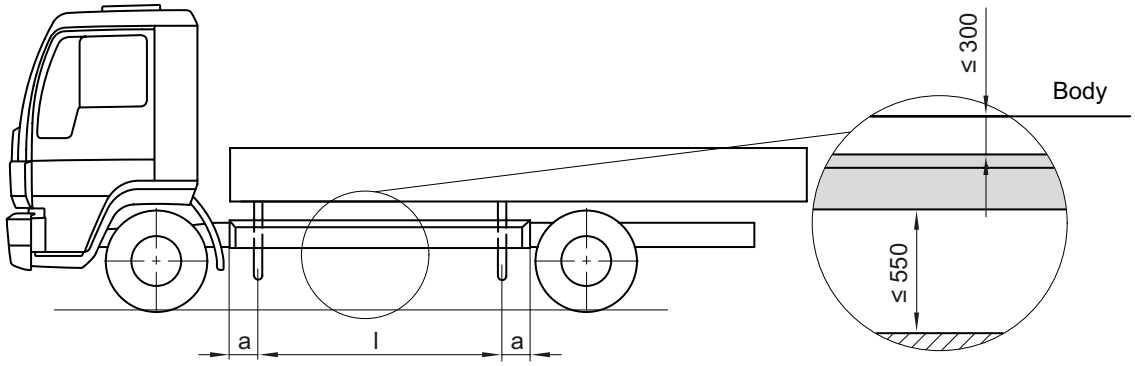


Fig. 39: Sideguards on M2000 and F2000 vehicles ESC 200

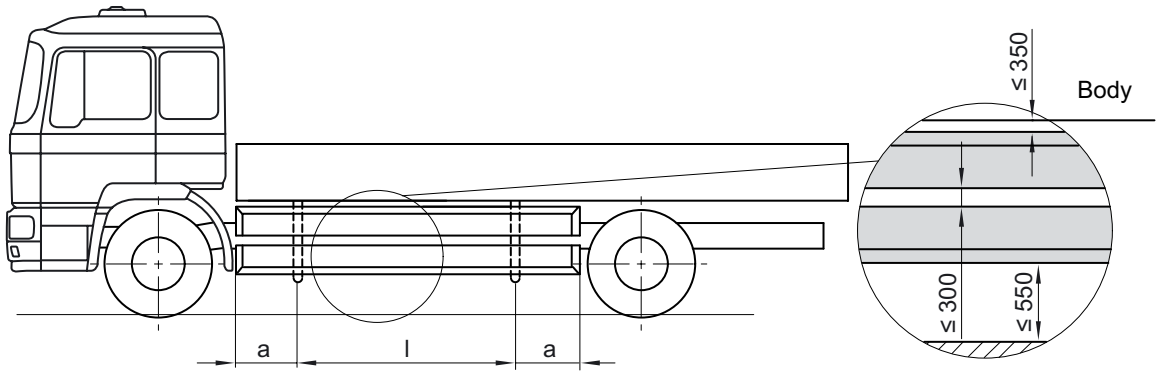


Table 27: Assignment to vehicle by vehicle range, model number and end cross member

M2000L

Model no.	MAN item no.	Hole pattern [mm]	Notes
L89	81.41250.0127	None	Not for trailer couplings
	81.41250.5158	160 x 100	18/25t, frame thickness 7-8mm
L90	81.41250.5158	160 x 100	18/25t, frame thickness 7-8mm
L95	81.41250.5122	None	26t, L95, for frame thickness 7mm and frame height 268mm, not for trailer couplings
	81.41250.5145	160 x 100	26t, L95, end cross member reinforced, for frame thickness 7mm and frame height268mm

M2000M

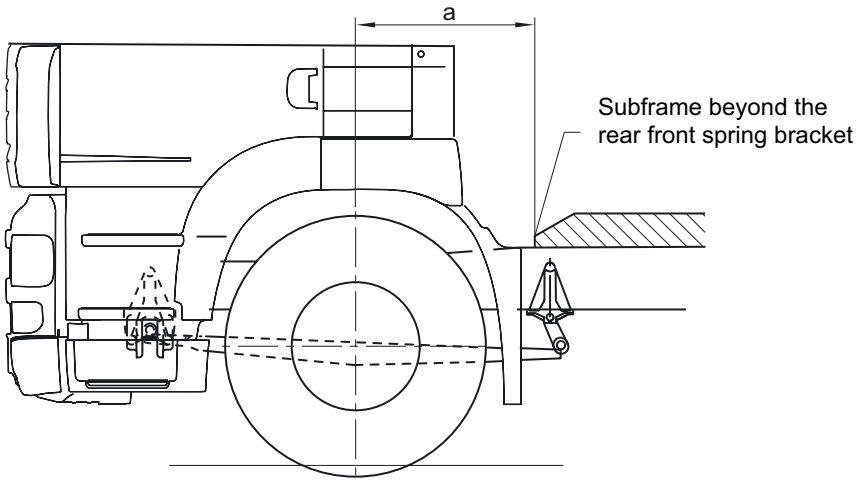
Model no.	MAN item no.	Hole pattern [mm]	Notes
M31	81.41250.0127	None	Not for trailer couplings
	81.41250.5158	160 x 100	13/14/15t, frame thickness 6-7mm
M32	81.41250.0127	None	Not for trailer couplings
	81.41250.5158	160 x 100	13/14/15t, frame thickness 6-7mm
M33	81.41250.0127	None	Not for trailer couplings
	81.41250.5158	160 x 100	13/14/15t, frame thickness 6-7mm
M34	81.41250.5158	160 x 100	13/14/15t, frame thickness 6-7mm
	81.41250.5163	160 x 100	13/14/15t, frame thickness 6-7mm, Fire service, additional hole pattern 83x56
	81.41250.5163	83 x 56	13/14/15t, frame thickness 6-7mm, fire service, additional hole pattern 83x56
M38	81.41250.0127	None	Not for trailer couplings
	81.41250.5158	160 x 100	18/25t, frame thickness 7-8mm
M39	81.41250.0127	None	Not for trailer couplings
	81.41250.5158	160 x 100	18/25t, frame thickness 7-8mm
M40	81.41250.0127	None	Not for trailer couplings
	81.41250.5158	160 x 100	18/25t, frame thickness 7-8mm
M41	81.41250.5158	160 x 100	18/25t, frame thickness 7-8mm
M42	81.41250.0127	None	Not for trailer couplings
	81.41250.5158	160 x 100	18/25t, frame thickness 7-8mm
M43	81.41250.5158	160 x 100	18/25t, frame thickness 7-8mm
M44	81.41250.0127	None	Not for trailer couplings
	81.41250.5158	160 x 100	18/25t, frame thickness 7-8mm

Table 28: End cross members and technical data

MAN item no.	Hole pattern [mm]	D [kN]	S [kg]	C [kg]	R_C = C+S [kg]	D_C [kN]	V [kN]	Max. trailer load [kg]	t [mm]	Vehicle range	Notes
81.41250.5161	160 x 100	55	700	6500	7200	40	18	10500	8	M2000	Fire service, additional hole pattern 83x56,replaced by 81.41250.5163
81.41250.5161	83 x 56	18	80	2000	2080	18	10	2080	8	M2000	Fire service, additional hole pattern 160x100,replaced by 81.41250.5163
81.41250.5162	160 x 100	0	0	0	0	0	0	0	8	F2000	Hole pattern for assembly line installation only,not for trailer couplings
81.41250.5163	160 x 100	55	700	6500	7200	40	18	10500	8	M2000	13/14/15t, frame thickness 6-7mm,fire service, additional hole pattern 83x56
81.41250.5163	83 x 56	18	80	2000	2080	18	10	2080	8	M2000	13/14/15t, frame thickness 6-7mm,fire service, additional hole pattern 160x100
81.41250.5167	160 x 100	200	1000	18000	19000	130	70	D value	11	F2000	T46, T48, overhang = 700mm (900mm) (centre part like 81.41250.5145)
81.41250.5168	160 x 100	53	1000	9500	10500	53	25	10500	8	L2000	Tool and gear truck model L26, fittings for hydraulic PTO shaft, with reinforcement plates 81.42022.0013and 81.42022.0014
81.41250.5170	140 x 80	60	1000	13000	14000	58	35	14000	10	L2000	Allrad 4x4/2, 100mmlower, End cross member reinforced

Abbreviations: t: thickness of end cross member material R_c: Gross vehicle weight rating of rigid drawbar / central axle trailer

Fig. 51: Distance of subframe from centre of first axle ESC-097



So that the required dimensions can be adhered to, the subframe must follow the contour of the frame; it can be chamfered or cut out at the front (for examples, see Figs 52 to 55).

Fig. 52: Chamfering the subframe at the front ESC-030

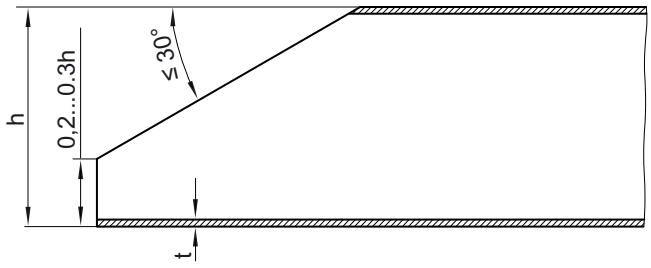


Fig. 53: Cutting out the subframe at the front ESC-031

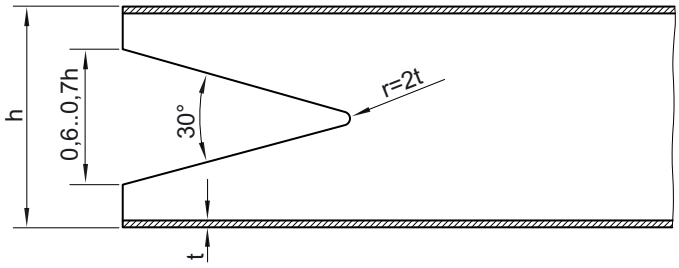


Fig. 54: Subframe – adapting it by expanding it ESC-098

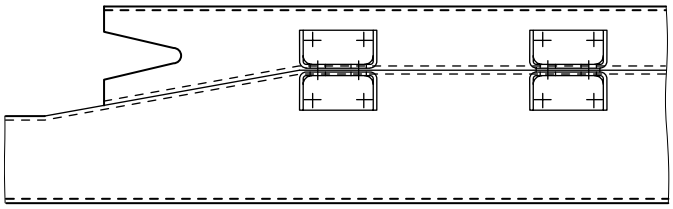
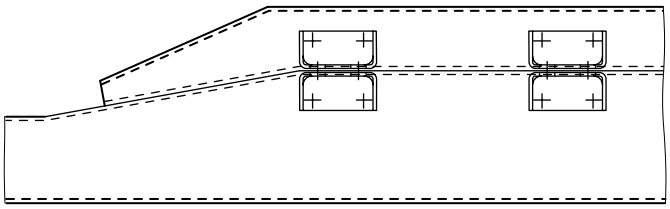


Fig. 55: Subframe – adapting it by chamfering it ESC-099



5.3.3 Tank and container bodies

5.3.3.1 General

Depending on the type of goods transported, vehicles must be equipped by the companies responsible in accordance with national requirements, guidelines and regulations. In Germany, the hazardous goods officers of the technical monitoring organisations (DEKRA, TÜV) can provide information regarding the transportation of hazardous goods.

5.3.3.2 Body fixtures, mountings

Tank and container bodies require a continuous subframe, yield point $\sigma_{0,2} \geq 350$ N/mm² (e.g. S355J2G3 = St52-3, see also Table 31: Yield points of subframe materials). The conditions for approving exceptions to this are described in the following section on „Tank and container bodies without subframes“.

The connection between the body and chassis in the front area must be designed so that it does not excessively hinder the frame's ability to twist.

This can be achieved by having front mountings that are as torsionally compliant as possible, e.g. by having

- Pendulum-type mounting (Fig. 73)
- Flexible mounting (Fig. 74)

Fig. 73: Front mounting as a pendulum mounting ESC-103

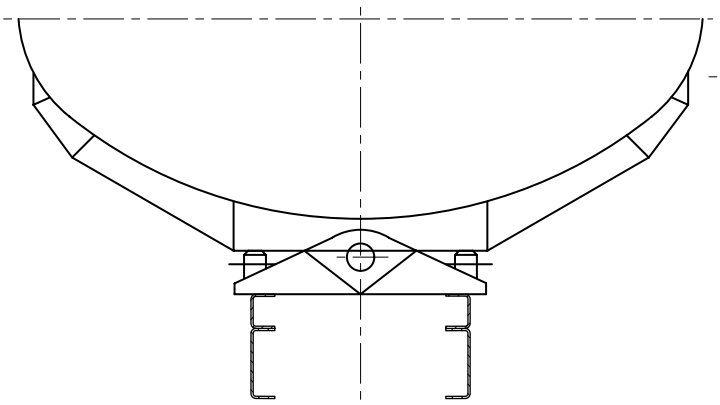
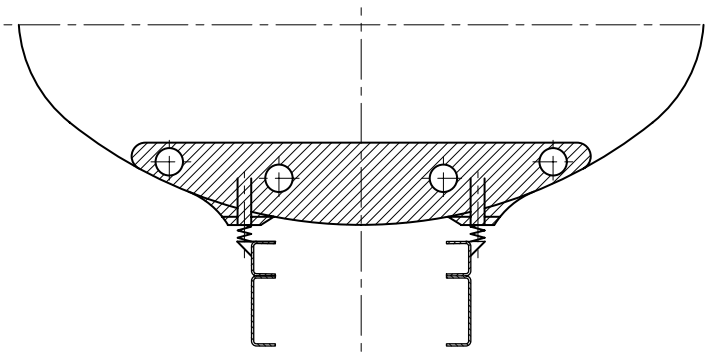


Fig. 74: Front mounting as an elastic mounting ESC-104



The front mounting point should be as close as possible to the front axle centreline. (see fig. 75).
The rear, laterally stiff body support must be fitted in the vicinity of the theoretical rear axle centreline.
At this point the connection to the frame should also be of sufficient size.
The distance between the theoretical rear axle centreline and the centre of the support must be < 1,000 mm (see fig. 75).
See the “General” Chapter for ‘Theoretical axle centreline’.

The centre of gravity of the payload will change depending on whether the crane is detached or not. To achieve the largest possible payload without exceeding the permissible axle loads, we recommend that the centre of gravity of the payload with and without the crane be marked clearly on the body.

The larger overhang resulting from the installation of the coupling device must be taken into consideration. Exceeding the overhang specified in the section on „Permissible overhangs“ in the „General“ Chapter is permitted if no other technical or legal specifications specify anything to the contrary.

5.3.8.3 Subframe for loading crane

All loading crane bodies require a subframe whose minimum geometrical moment of inertia is obtained from Figs. 86 to 88.
Even with crane total moments that theoretically produce a required geometrical moment of inertia of below 175cm^4 a subframe with a minimum geometrical moment of inertia of at least 175cm^4 must be fitted.

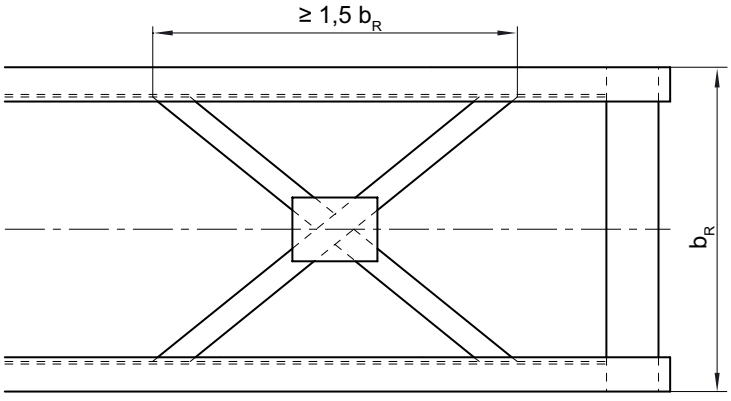
To protect the subframe we recommend fitting an additional upper flange (anti-wear plate) in the area of the crane to prevent the base of the crane from wearing into the subframe. The thickness of the additional upper flange should be between 8 and 10mm, depending on the size of the crane.

Loading cranes are frequently installed along with other bodies, for which a subframe is also required (e.g. tippers, semitrailer tractors, single pivot body). In this case, depending on the body and its requirements, a larger subframe suitable for the entire body structure must be used.

The subframe for a detachable loading crane must be designed to ensure that the coupling device and the loading crane can be supported safely. The body manufacturer is responsible for the design of the console support (bolt fixings, etc.).

During installation of the loading crane behind the cab, the subframe must be enclosed to form a box, at least in the area around the crane (see also Fig. 49, Transition from box section to U-section ESC-043). If the loading crane is installed at the rear, a closed section must be used from the end of the frame to a point forward of the front-most rear axle location element at least. In addition, to increase the torsional stiffness in the subframe, a cross-shaped connecting piece (X-shaped connecting piece), or an equivalent construction must be provided (see Fig. 84). To be recognised by MAN as an equivalent structure, the ESC department must issue an approval (for address see „Publisher“ above).

Fig. 84: Cross-strut in the subframe ESC-024



As a rule a flexible subframe connection is not sufficient for crane use. A rigid connection with a sufficient number of adequately sized shear plates is required. Individual side plates on the frame, as shown in Fig. 85, are regarded as a rigid connection only if verification in the form of mathematical calculations can be provided.
For flexible or rigid connections, see the relevant sections in this Chapter.

Vehicles fitted with loading ramps ex-works (manufactured by Walther) are fitted with a U 120/60/6 sub-frame made of QStE 380 ($\sigma_{0,2} \geq 380$ N/mm^2) , where the connection to the chassis is flexible using MAN angle brackets. If required according to the tables, a partially rigid connection is to be made retrospectively when fitting a tail-lift.
The tables are sorted in ascending order according to model range, suspension type and wheelbase, where the vehicle designation (e.g. LE 8.xxx LC 4x2 BB) is to be regarded as an aid to orientation. The 3-digit type numbers, also known as type code numbers, which appear at the 2nd and 4th positions of the basic vehicle number and at the 4th and 6th positions of the vehicle identification number are binding (for explanation, see the 'General' Chapter). All other technical documents, e.g. chassis drawings, assembly directives relate to the type number.
The overhang – always related to the wheel centre of the last axle – includes both the frame overhang of the standard production chassis and the overall maximum vehicle overhang (including body and tail-lift, see Fig. 93 below), which must not be exceeded when the tail-lift has been fitted. If the specified maximum vehicle overhang is insufficient, the sub-frame data in the following lines for which the ≤-condition is satisfied applies (apart from the start of the rigid connection, which relates only to the wheelbase).
The sub-frames in the tables are examples. For instance U120/60/6 is a U section open to the inside with an outer height of 120mm, top and bottom 60mm wide and 6mm thick over the entire cross section. Other steel sections are acceptable if they have at least equivalent values in respect of moments of inertia I_x, moments of resistance W_{x1} W_{x2} and yield points $\sigma_{0,2}$.

Table 35: Technical data for sub-frame profile

Profile	Height	Width o/u	Thickness	I_x	W_{x1}, W_{x2}	$\sigma_{0,2}$	σ_B	Mass
U100/50/5	100mm	50mm	5mm	136cm^4	27cm^3	355 N/mm^2	520 N/mm^2	7,2kg/m
U100/60/6	100mm	60mm	6mm	182cm^4	36cm^3	355 N/mm^2	520 N/mm^2	9,4kg/m
U120/60/6	120mm	60mm	6mm	281cm^4	47cm^3	355 N/mm^2	520 N/mm^2	10,4kg/m
U140/60/6	140mm	60mm	6mm	406cm^4	58cm^3	355 N/mm^2	520 N/mm^2	11,3kg/m
U160/60/6	160mm	60mm	6mm	561cm^4	70cm^3	355 N/mm^2	520 N/mm^2	12,3kg/m
U160/70/7	160mm	70mm	7mm	716cm^4	90cm^3	355 N/mm^2	520 N/mm^2	15,3kg/m
U180/70/7	180mm	70mm	7mm	951cm^4	106cm^3	355 N/mm^2	520 N/mm^2	16,3kg/m

If adequate, the flexible structure of the sub-frame is designated by a **w**. For the partially rigid structure (designated **s**), the number of screw connections, the weld seam length – in each case per frame side – and the start of the rigid connection from the centre of axle 1 are indicated (see Fig. 93). For the rigid and/or partially rigid connection, the conditions set out in Chapter 5 'Body' apply.

Fig. 93: Tail-lift overhang dimension, dimensions with partially rigid connection ESC-633