Mercedes-Benz

UNIMOG

Implement and Body Mounting Directives

Edition 2002

DaimlerChrysler AG
UNIMOG Division
D - 76568 Gaggenau

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All technical data, illustrations, dimensional data and other information comply with the status at the date of going to press specified.

We reserve the right to make amendments
Dimensions or data should be confirmed by PBU/TES on a case-by-case basis.

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1. General

1.1 Basic notes

This directive shall form the basis for the development, modification and review of **implements and mounted implements** of all types which are occasionally or permanently connected to and operated with the UNIMOG, and for **special bodies** on UNIMOG chassis. The development and review of implements or bodies for the UNIMOG does not, in principle, entitle claims for costs or damages to be made against DaimlerChrysler. The cooperation of DaimlerChrysler in the solution of technical problems is of an advisory character only; in the case of implements to be used in the Federal Republic of Germany, this also applies with regard to compliance with road traffic law and accident prevention as specified in the German Law on Technical Equipment.
Particular reference is made to the responsibility of the implement manufacturer for his scope of delivery and for the rules of safety to be complied with in respect of the vehicle/implement interface.
In order to maintain the operating and road traffic safety of the chassis and in order to maintain warranty rights, the instructions which are listed must be observed exactly.
If instructions are not adhered to, DaimlerChrysler accepts no liability.

Illustrations and drawings are examples and serve to explain the texts and tables.

References to regulations, standards, directives etc. are partly given in key words and serve only as information.

Instructions regarding vehicle safety
We recommend the following:
- That only Mercedes-Benz original parts and conversion parts and accessories which have been expressly approved by DaimlerChrysler
  for the relevant type of vehicle be used. The safety, reliability and suitability of these parts have been determined in a special test.

We can make no guarantee as regards reliability, safety and suitability:

If original parts or approved conversion parts and accessories have been exchanged for other parts or other changes have been made to the vehicle.
If bodies are not manufactured or mounted according to the valid Mercedes-Benz Body and Implement Mounting Directives or if, in the event of deviations, the approval of DaimlerChrysler is not sought.

Official acceptance by public testing bodies or official approval does not rule out safety hazards.

Further information can be obtained from the Unimog Sales Organization.

General technical data regarding the vehicle are not contained in this Implement Mounting Directive; see the currently valid version of the printed "UNIMOG Technical Manual", which can be obtained from the UNIMOG Sales and Marketing Department (PBU/VM). The Technical Manual may be used in the selection of a suitable vehicle. If required, detailed technical data and drawing documents may be ordered by fax from UNIMOG Technology/Development/Networks Department (PBU/TES), stating the name of the company and the proposed mounted implement; see under Chapter 1.3 "Technical advice and approval".

The following applies to the entire Body and Implement Mounting Directive and all drawings, sketches and technical data contained therein:

1.2 Vehicle and model designations

This Body and Implement Mounting Directive is valid for the following vehicles:

UNIMOG model/sales designation	Model (BM)	Wheelbase [mm]	Output[1] [kW/bhp]	Internal designation	Model according to ABE	
UNIMOG driving units						
U 130 T[5] [6]	418.000	-	103/140	MBU	418/00[4]	
U 1400 T	427.000	-	100/136	SBU	427/00[4]	
U 2100 T	437.002	-	155/211	SBU	437/00[4]	
Tractor and working units short and long wheelbase						Agricultural agricultural and forestry[3]
U 90[2]	408.100	2690	64/87[2]	LBU	408/10	
U 90 turbo	408.101	2690	85/115[7]	LBU	408/10	
U 130[6]	418.102	2830	103/140	MBU	418/10	418/50
U 1400	427.102	2650	100/136	SBU	427/10	427/50
U 1450	427.112	3250	100/136	SBU	427/11	
U 1600	427.105	2650	120/163	SBU	427/12	427/52
U 1650	427.115	3250	120/163	SBU	427/13	
U 1600 (214)	427.107	2650	155/211	SBU	427/12	427/52
U 1650 (214)	427.117	3250	155/211	SBU	427/13	
U 2100	437.105	2650	155/211	SBU	437/30	437/50
U 2150	437.117	3250	155/211	SBU	437/31	
U 2400	437.105	2650	177/240	SBU	437/30	437/50
U 2450	437.117	3250	177/240	SBU	437/31	

(1) Euro2 engine
(2) no longer available (Euro1 engine)
(3) agricultural or forestry version
(4) no ABE available
(5) no longer available
(6) formerly U140 or U 140T
(7) til July 1998: 90kw/122PS (Euro 2a engine)

Figure 1.1 Table A "UNIMOG model designation"

UNIMOG model/sales designation	Model (BM)	Wheelbase [mm]	Output[1] [kW/bhp]	Internal designation	Model designation according to ABE
UNIMOG chassis					
U 100 L[2]	408.215	3220	68/92[2]	LBU	408/20[3]
U 100 L Turbo	408.216	3220	85/115[4]	LBU	408/20[3]
U 140 L	418.117	3470	103/140	MBU	418/20[3]
U 1450 L	427.111	3250	100/136	SBU	427/20
U 1550 L	437.111	3250	120/163	SBU	437/20
U 1550 L/37	437.120	3700	120/163	SBU	437/20
U 1550 L (214)	437.116	3250	155/211	SBU	437/20
U 1550 L/37(214)	437.125	3700	155/211	SBU	437/20
U 1650 L	427.116	3250	120/163	SBU	427/21
U 1650 L (214)	427.118	3250	155/211	SBU	427/21
U 2150 L	437.118	3250	155/211	SBU	437/40
U 2150 L/38	437.136	3850	155/211	SBU	437/40
U 2450 L	437.118	3250	177/240	SBU	437/40
U 2450 L/38	437.136	3850	177/240	SBU	437/40
U 2450 L/6x6	437.156	3900 + 1400	177/240	SBU	437/42[3]
U 2400 TG	437.182	4100	177/240	SBU	437/41[3]

(1) Euro2 engine
(2) no longer available (Euro1 engine)
(3) no ABE available
(4) til July 1998: 90kW/ 122 PS (Euro2a engine)

Figure 1.1 Table B "UNIMOG model designation"

This directive may also apply to tractor units and agricultural tractors based on the vehicles listed above and for older vehicle models, which are not listed here, if there are no design differences in the vehicle/implement interfaces. The technical data of the actual vehicle equipment and the current registration documents are determinant in such case.

1.3 Technical advice

Department PBU/TES is responsible for answering technical and design questions

Telefax:	**07225- 61 5512**
Postal address:	**DaimlerChrysler AG**
	Department PBU/TES,
	HPC 268
	D-76568 Gaggenau

Note: In the case of fax requests, please state your postal address in the text, as addresses in the corporate logo may no longer be legible after transmission by fax.

1.4 Implement Mounting Review/Approvals/Letters of Confirmation/Type Approval

1.4.1 Legal obligations to the body builder/ implement manufacturer

In principle, no legal right to implement mounting review or to the issue of a letter of confirmation or body approval exists.

On the basis of the technical progress and knowledge based on the experience of DaimlerChrysler, implement confirmation or body approval may be withheld, even if comparable approval has already been granted previously. implement confirmation or body approval may be limited to individual vehicles. Subsequent implement confirmation or body approval may be refused for vehicles which have already been manufactured or delivered.

1.4.2 Review - Confirmation

With the appearance of this Implement Mounting Directive, no further implement approval will be carried out by DaimlerChrysler for the vehicles listed under 1.2. Review or confirmation are possible under the following conditions, if

- the implement or mounted implement fails in part to comply with the Implement Mounting Directive, thereby rendering the review of details necessary; any special confirmation then refers exclusively to the scope of the detail,
- permissible load values, axle loads or wheel load differences are exceeded, thereby making it necessary to check the prerequisites for individual confirmation.
- installation which penetrates the vehicle to such a depth that this is not covered by this Implement Mounting Directive, is carried out.

The basic prerequisite is always a concrete vehicle/customer order. Reviews within the framework of offers/invitations to tender are not carried out.

If review or confirmation is necessary, the following instructions must be noted:

For the review procedure, an agreement regarding the type and scope of review or confirmation must be reached between DaimlerChrysler and the manufacturer of the implement or body prior to commencement.

DaimlerChrysler reserves the right to specify deadline priorities.
The review of an implement or body should be carried out in the following stages:

- Fill in the "DATA SHEET - implement manufacturer's data" (see Appendix Chap. 9)
- In addition, the following documents are to be submitted initially along with the questionnaire:

1. implement or body drawing(s) with all relevant dimension data,
2. drawing regarding the mounting of the body on the chassis
3. calculations (wheel/axle loads, center of gravity coordinates of the implement and body components and calculation of the overall center of gravity of the vehicle and implement combination in its operable state, i.e. with possible operating materials, power requirements etc.),
4. photographs, prospectuses (not necessary in the case of prototype development)
5. any possible deviations from the DaimlerChrysler Body and Implement Mounting Directive,
6. expected conditions of use of the vehicle/implement combination, e.g.: use under off-road conditions, with high occurrence of dust, use at great altitude, use in extremely high or low ambient temperatures.

All documents are to be forwarded to Department PBU/TES, see Chapter 1.3 "Technical advice" for address.

DaimlerChrysler hereby confirms that all documents forwarded to the above mentioned address will be treated as strictly confidential and will not be passed to third parties (e.g. other implement manufacturers).

The following instructions and conditions for implements and bodies must be noted when drafting the documents listed:

- Provision of a free and non-binding sample body to DaimlerChrysler by the implement or body manufacturer.
- If necessary, DaimlerChrysler may make a test vehicle or a sales department demonstration vehicle available for a limited period of time within the framework of a "vehicle usage agreement"; otherwise, the implement manufacturer must ensure the provision of a UNIMOG.
- Free provision of the vehicle/implement or body combination for DaimlerChrysler.
- Depending on the vehicle/implement combination and the expected usage profile, it may become necessary to carry out an endurance test according to criteria based on the experience of DaimlerChrysler.
- If the result of the official acceptance is positive: Specification of the delivery range, delimitation of the purpose of use, specification of the content of confirmation.

Complete documentation leads to the avoidance of queries and speeds up the approval procedure.

The implement or body manufacturer is responsible for

- the function and safety of the implements and bodies which he manufactures and sells,
- all conversions and installed parts which are either not, or only partly, contained in the documents which are submitted,
- the secure and professional design and the clearance of the implement or body with regard to all vehicle components (also in the case of torsional flexion).

Official acceptance by public test bodies or official approval does not rule out safety risks.

1.5 Three-point mounting implements (agricultural and forestry) (code H60/Q45)

Review or examination of implements mounted on the vehicle by a three-pint mounting complying with ISO 730, is **not** carried out by DaimlerChrysler. It is assumed that the implement manufacturer/supplier applies the recognized rules of technology and assesses the loads occurring during operation, taking load values and lifting forces into consideration, and that he assumes responsibility for the implement, its function, compliance with regulations (see also Agricultural and Forestry Implement Code of Practice Chap.8) and the industrial safety and accident prevention regulations of the responsible employer's liability insurance associations. In addition, the implement manufacturer/supplier must, if necessary, confirm conformity with the EC Machinery Directive (89/392/EEC).

1.6 Issue of a certificate

Following the completion of implement review, the correspondence of the construction of the implement with the guidelines (including possible limiting criteria, limitations, conditions etc.) can be confirmed in writing by DaimlerChrysler, Department PBU/TES.

DaimlerChrysler reserves the right to select the form and scope of confirmation.

1.6.1 Implement approval

The implement approval

- can be issued for an implement or a special body which is manufactured and sold within the Federal Republic of Germany following successful technical review with the implement manufacturer if, contrary to Point 1.4.2 a special mutual interest exists for the vehicle and implement manufacturer and a resolution has been reached in this regard by the relevant management.
- is a **formal confirmation** with instructions, notes and conditions from DaimlerChrysler, "Technology/Development/Networks PBU/TES" Department regarding the use of a reviewed implement or body with the UNIMOG, and is subject to the **amendment service** at DaimlerChrysler. The **manufacturer of the implement or of the special body is obliged** to submit changes which affect the content of the implement approval to DaimlerChrysler , Department PBU/TES, for review purposes,

- is to be **countersigned by the implement or body manufacturer**. He receives a copyable version from PBU/TES,
- is, in the case of implement-speficic (customer) enquiries, **to be ordered from the implement manufacturer**.

1.6.2 Safety declaration

The safety declaration

- can only be issued for implements/bodies which are manufactured and/or sold exclusively outside of the Federal Republic of Germany following positive evaluation, taking possible reservations or conditions into consideration,
- is formless confirmation from DaimlerChrysler, Department PBU/TES, regarding the use of the implement or body with the UNIMOG,
- refers only to the version of the implement or body which was presented for evaluation.
- For prerequisites, see 1.4.2 and 1.6.1

The manufacturer of the implement or body is obliged to submit changes which affect the content of the safety declaration to Department PBU/TES for review. DaimlerChrysler reserves the right to subsequently examine the changed scope prior to reconfirmation of the safety declaration.

1.6.3 Implement confirmation/body authorization

In **individual cases**, implement confirmation may be issued for implements or bodies if it has been verified via a **drawing** and **description on the part of the manufacturer,** that the principles of the **Body and Implement Mounting Directive** have been adhered to. It does <u>not</u> include the evaluation of the body details, in particular implement/vehicle clearance, handling, braking stability and other criteria which prerequire <u>practical</u> acceptance; **the responsibility for this rests solely on the manufacturer**. All implement and body work on the chassis must be carried out according to the DaimlerChrysler "UNIMOG Body and Implement Mounting Directive". (In the case of the U 2400 TG, the "Truck Implement Mounting Directive", DB No. 650 584 01 00, Order No. 6550 6497 00, apply in the same manner for components on the vehicle which originate from trucks).

1.7 Warranty rights

Warranty rights can only be asserted within the framework of the purchase agreement between the purchaser and the vendor. The relevant vendor of the article which is supplied is then obliged to the purchaser as regards the warranty.

Warranty obligations are **not** assumed by DaimlerChrysler if

- our Body and Implement Mounting Directive has not been complied with ,
- the chassis which is used does not correspond to the country-specific equipment and the necessary equipment for the area of use,
- a reviewed vehicle/implement combination has subsequently been changed without the approval of Department PBU/TES.

The operating and driving safety must not be prejudiced by the implement or body. In the case of cabs, free movement for tipping must be guaranteed. In the case of implements and bodies, asymmetrical strain on the chassis must be avoided wherever possible.

If asymmetrical strain is unavoidable (e.g. in the case of a side-mounted loading crane, generator, mower etc.), the approval of Department PBU/TES is necessary if the difference in wheel loads exceeds 10 % of the relevant axle loads (see Chapter 4.7 center of gravity).
Driving trials may possibly be necessary.

1.8 Mercedes star and MB emblem

The Mercedes star and MB emblem are trademarks of DaimlerChrysler.

- They must not be removed or affixed in another position without approval .
- Loosely delivered Mercedes stars and MB emblems must be affixed in the position intended by DaimlerChrysler.

If the constructed vehicle does not correspond to the image and the quality standards of DaimlerChrysler:

- The DaimlerChrysler trademarks must be removed.
- The body manufacturer is, according to product liability law, the manufacturer of the entire vehicle and assumes full responsibility for this.

Third-party trademarks
- must not be affixed next to MB trademarks, or
- may only be affixed with the approval of DaimlerChrysler.

1.9 Maintenance instructions

The body manufacturer must note the following prior to the delivery of the vehicle:

- Servicing falling due must be carried out by a MERCEDES-BENZ service station.
- The headlamp adjustment must be checked and, if necessary, corrected following the mounting or attachment of an implement.
- The brake fluid in the hydraulic brake system must be replaced if the service life of the chassis is not known. The brake fluid must be replaced at least once every year.
- Following the completion of an implement or body, the automatic load-dependent brake proportioning valve (ALB) must be checked and, if necessary, adjusted, in a MERCEDES-BENZ service station or a specialist workshop.
- The batteries must be checked for output and condition and must be serviced in accordance with manufacturer's specifications.
- If a wheel has been removed or changed, the wheel nuts must be tightened with the corresponding tightening torque in accordance with the maintenance instructions.
- **Operating instructions and maintenance regulations for the maintenance operations which are to be carried out in the case of components which have been additionally installed by the implement manufacturer must be provided in the vehicle.**

- Instructions regarding road traffic and operating safety of the vehicle in connection with implement and body units are especially important.
- If components have been removed and installed by the implement or body manufacturer, the mounting must be checked to ensure that it is seated firmly. In the case of components which contain fluids (coolant, lubricant etc.), the filling levels must be checked and, if necessary, the specified operating fluids are to be topped up.

1.10 Anti-corrosion protection measures

If operations, which impede the anti-corrosion protection, have been subsequently carried out on the vehicle, sufficient anti-corrosion protection must be ensured following the operations.

In principle, the following points are to be noted:

- Avoid welding operations on inaccessible cavities,
- Remove drilling and grinding swarf,
- De-burr edges,
- Remove burnt paint,
- Prime and paint all bare parts with zinc-rich paint,
- Preserve cavities with wax preservative.

1.11 Accident prevention

The body manufacturer is responsible for damage,

- which is attributable to a lack of functional or operating safety on the part of the implements or bodies which he has manufactured,
- which is attributable to deficient operating instructions for the implements or bodies which he has manufactured.

The body and the attached or mounted implement must correspond to the valid laws, industrial safety or accident prevention regulations and the safety regulations of the communal insurance institutions. All technical possibilities for the avoidance of operating risks must be exploited.

In Germany, the*Traffic Technical Committee* of the employer's liability insurance association in 22757 Hamburg (Tel.: 040/381091), provides information on keeping vehicles for commercial goods transportation.

National laws and regulations shall be observed.
The manufacturer of the body or implement is responsible for compliance with these laws and regulations.

In principle, all of the accident prevention regulations listed in the operating instructions must be adhered to.
See also Chapter 8.1 "Safety instructions".

The driving speed must be adapted to the relevant road, road traffic and terrain conditions, with the influence of the implement/body on braking, cornering, driving on a slippery road surface or unfirm ground, in an oblique position, on inclines or on declines etc. being taken into consideration via an anticipatory style of driving.
The body manufacturer must ensure that the vehicle holder/customer is trained and familiarized with the theory and practice of operating the implement or the vehicle in conjunction with the implement.

1.12 Recycling - re-use of components

The following principles for environmentally-compatible construction and selection of materials should be taken into consideration from the design stage of the implement or body.

- Avoid materials with potential risks such as, for example, halogen additives, heavy metals, asbestos, CFCs, chlorinated hydrocarbons etc.
- Preferably use materials which enable the use of material recycling and closed material loops.
- Select material and manufacturing procedure so that only slight volumes of waste, which can easily be recycled, are incurred.

- In the case of plastics, particularly compound materials, use mutually tolerable materials from one material family.
- In the case of recycling-relevant components, keep the number of the types of plastic which are used as low as possible.
- Check whether a component can be manufactured from recycled material or with recycled additives.
- Ensure that recyclable components can be removed easily, e.g. via snap connections, nominal break points, good accessibility.
- Ensure that the removal of service fluids is simple and environmentally-compatible via the provision of drain screws etc.
- Avoid painting and coating components wherever possible, use colored plastic parts.
- Design components in areas which are subject to accidents to be damage-tolerant, repairable and easily replaceable.
- Only use plastics in places where they provide cost, functional or weight advantages.
- Identify all plastic parts in accordance with VDA guideline 260, e.g. > PP - GF30R <.

Further instructions regarding this can be seen in the Commercial Vehicle Recycling, Ecology and Economy brochure, order No. 6702 6187 00-00/0592.

1.13 Quality management recommendation system

In a study group, the VDA (Association of German Automobile Manufacturers) has developed the "Introduction to quality assurance for trailer, body and container manufacturers", issued as VDA Volume 8, based on ISO 9000ff.
Due to an increase in customers' quality requirements regarding the vehicle/implement combination, national and international product liability laws, increasing downward pressure on prices and competitive reasons, DaimlerChrysler recommends that implement manufacturers establish a quality management system with the following minimum requirements:

- Development, establishment and monitoring of a quality assurance system in the relevant company.
- Depiction of areas of responsibility in an organizational chart
- Nomination of a quality management representative.
- Ensuring that procedural, operational and inspection instructions are available and up to date in the departments and workplaces.
- Fulfillment of the required proof of qualification for the employees concerned.
- Documentation and archiving of necessary quality assurance measures on the product.
- Availability of suitable testing equipment (e.g. torque wrench) and maintenance of on-going testing equipment monitoring.
- Introduction of internal audits for monitoring the QA system and product quality

This list is not exhaustive.

2. Legal notes, product liability and C E

2.1 Legal notes

The implement and body manufacturer is obliged to ensure, at his own responsibility, that the current laws, regulations, standards, guidelines etc. are complied with to the full extent.

In mounting exchangeable implements or in the case of fixed bodies on the UNIMOG, the road traffic regulations of the relevant country must be adhered to if the vehicle is to be driven or used with implements or bodies on public roads.

2.2 Official acceptance/registration in the EC territory

In EC countries (with the exception of Germany), the UNIMOG series are classified as follows in vehicle class "N" (motor vehicles for goods transportation):

- Class N1, motor vehicles with permissible gross vehicle weight $\leq$ 3.5t
- Class N2, motor vehicles with permissible gross vehicle weight $>$ 3.5t to 12.0t
- Class N3, motor vehicles with permissible gross vehicle weight $>$ 12.0t

Following national type approval in the relevant country, the vehicles may be made commercially available in accordance with the local registration formalities.

2.3 Product liability

Within the framework of product liability, we would like to refer to the following points:

- Each manufacturer is liable for his product.
- DaimlerChrysler cannot be held liable for damage which occurs as a result of subsequently installed and defective part products from other manufacturers.

In the case of implements or bodies which are reviewed by DaimlerChrysler, the body manufacturer bears responsibility for:

- The stability and proper design and mounting of the implement or body
- The operating and road traffic safety of the implement or body,
- The operating and road traffic safety of parts and conversions which are not included in the documents which are submitted,
- The influence of parts or conversions on the chassis, which cannot be seen from the documents which are submitted.

In the case of bodies which are <u>not</u> reviewed by DaimlerChrysler, the body manufacturer bears responsibility for:

- The operating and driving safety of the entire vehicle/implement combination and (handling, braking and steering behavior must not be adversely affected by the body),
- Subsequent damage which occurs due to construction, installation or conversion,
- Subsequent damage which occurs due to the subsequent installation of electronic systems,
- Subsequent damage due to any influence on the existing vehicle electrical system
- The functional safety and the free movement of all moving parts of the chassis (e.g. axles, springs, propshafts, steering, engine regulation, shift linkage, brake components etc.) even in the event of diagonal torsion on the part of the implements and bodies.

Work on or modifications to the chassis or body must be entered in the maintenance manual, "Confirmation on the part of the body manufacturer" section.

The body manufacturer must indemnify DaimlerChrysler against all liability for damage which occurs due to the fact that

- the Implement Mounting Directive not having been complied with,
- the vehicle or the vehicle/implement combination not having been used in accordance with the regulations, particularly with regard to the use of implements,
- deficient design, manufacture or installation,
- failure to observe the appropriate basic principles in any other regard,
- the instructions in the implement's operating instructions are inadequate,
- the vehicle keeper/customer/driver has not been sufficiently familiarized or trained.

Only basic notes regarding product liability can be provided within the framework of this Body and Implement Mounting Directive.

Product liability in EC countries

The legal conditions which exist in the EC member states are described in EC Directive 85/374.

2.4 CE symbol

Machinery Directive 89/392/EEC including 93/68/EEC.

Only certain versions of the UNIMOG (e.g. tipper, power lifter) fall under the EC Machinery Directive.

We should like to point out that, from 01.01.1995 (etc.), all implement and body units represent the complete machine in the spirit of the EC Machinery Directive (see above), correspond to this, are subject to conformity certification and must be provided with a CE symbol.

Communauté **E**uropéenne

Figure 2.1CE symbol

For partial machines (machines which cannot be operated), the manufacturer must provide a manufacturer's declaration.
The CE symbol must not be affixed to a partial machine. Prior to the issue of the conformity certification or manufacturer's declaration, the product must be subjected to a risk analysis.
Vehicles which are registered as tractor units/agricultural tractors are exempt from the regulations of the EC Machinery Directive.
Commercially available trucks with permanently mounted beds and truck chassis are also exempt from the EC Machinery Directive.

3. Damage prevention and safety regulations

3.1 General notes

In the case of all operations on or with the vehicle or the vehicle/implement combination, the accident prevention regulations, especially the regulations listed in the operating instructions of the vehicle, instructions, guidelines etc. are to be complied with.
See also Chapter 8.1 "Safety instructions".

3.2 Delivery of chassis

Chassis in which the rear axle load is less than 33 % of the gross vehicle weight must **not** be delivered under their own power.
If the vehicle has to be delivered under its own power, the rear axle must be properly ballasted to the minimum rear axle load. See also Chapter 4.9 "Secure mounting of the implement/ballast on the vehicle".

The chassis must comply with the requirements of the StVZO and StVO (German Road Traffic Regulations) (e.g. lighting, wheel covers, wheel chocks etc.).

In the case of vehicles with special tyres (e.g. deep profile tyres for agriculture) the relevant maximum speed specified in the type approval must not be exceeded on the road.

DaimlerChrysler therefore recommends that chassis be delivered by truck or train.

3.3 Prevention of accidents on the vehicle

The implement or body manufacturer is responsible for compliance with laws and regulations. This also applies to interfaces between the vehicle and the implement and to safety on the installation and removal of exchangeable implements. Drive shafts must also be equipped with protection against accidental contact, so that shearing and crushing points are avoided. Connectable systems must be protected against improper use and unintentional actuation. Fans for oil coolers, etc. must be enclosed in such a way that access to the rotating fan is impossible. All types of sharp corners and edges are to be avoided. The implement or body manufacturer must ensure that servicing and maintenance operations are carried out safely.

3.4 Tilting the cab

Note operating instructions before tilting the cab

Standing in the area in front of the cab whilst this is being raised is **prohibited.** See illustration No. 3.1. For safety reasons, we recommend that the raised cab be blocked with a firmly installed support. In order to avoid damage to the cab, available space is to be checked prior to its being raised. Front-mounted implements and, if necessary, implement fittings are to be removed. In the case of implements mounted to the rear of the cab, free movement (tipping radius of rear edge of cab, see Chapter 7.1) must be guaranteed. Corresponding instructions must be included in the implement operating instructions.

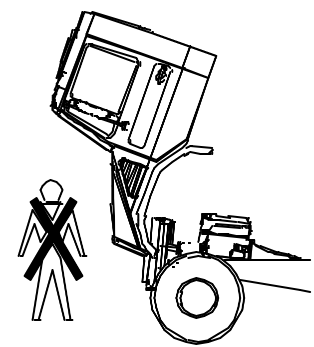


Figure 3.1 Cab raised

3.5 Plastic compressed air lines, fuel lines and vacuum lines and brake lines

Before welding, drilling, grinding and operations with cutting discs

- cover plastic lines and brake hoses,
- remove if necessary. After installation of the lines, the system must be checked for leaks.

If lines (e.g. hydraulic lines from implement or body units) have to be subsequently routed in the vehicle, these must not be attached to chassis lines (e.g. brake lines, electric cables etc.).
On routing lines, the relative movements which occur between body and chassis in the event of chassis diagonal torsion, and the related elongation or compression of the lines, must be taken into consideration.
On routing lines, we recommend that implement manufacturers manufacture and install brackets appropriate for the line or pipe routing in the chassis. The brackets must be attached to existing bore holes in the chassis.
They must **not** be attached to existing, highly-stressed threaded connections, such as e.g. longitudinal member-frame connections, engine mounting systems, stabilizer mountings, spring mountings etc.
For additionally required bores, e.g. in the chassis, see Chapter 6.2 .
Existing brackets on the chassis may be used under the proviso that the bracket can bear the additional load.
Subsequently installed lines must not rub on brake lines, electric cables, etc.; use spacers if necessary.
Changes to the brake system (e.g. wheelbase or frame extensions) may only be carried out using the pipe connection parts and plastic lines which have been approved by us. Plastic loops are required for mounting. The maximum distance between loops must be 500 mm. If no plastic lines are available, the installation of steel pipes with identical dimensions, which have been electrogalvanised both inside and out, is permissible.
As regards plastic lines, the following minimum bending radii must be adhered to:

Pipe∅ [mm]	Wall thickness [mm]	Bending radius [mm]
6	1	30
8	1	40
12	1.5	60
16	1.2	100

Figure 3.2 Table of bending radii for brake lines

Only original lines or lines of identical quality (e.g. PA11-PHLY, DIN 73378) may be used.

Attention
In the case of changes to the brake or supply lines, further type approval by a recognized test hose becomes necessary due to possible changes in time response.

3.6 Welding operations

See also Chapter 6.4.2 "Welding on the frame".
In the case of welding operations with electric welding units, note the following:

- Welding operations on the chassis must only be carried out by specialist personnel.
- Disconnect and cover battery positive and negative terminals.
- Connect the welding unit's ground terminal **directly** to the part which is to be welded
- Under no circumstances must the welding current be routed via electronic components

ATTENTION
Do not connect the welding unit's ground terminal to components (engine, transmission, axles).

- Do not touch the housing of electronic components (e.g. control units) or electric cables with the welding electrode or ground terminal of the welding unit .
- In cabs with insulated suspension, connect the ground terminal of the welding unit to the cab.
- Prior to welding operations, cover springs and shock absorbers against welding beads. Do not touch springs with welding electrodes or welding tongs.

Welding must not be carried out on the following:

- Components such as the engine, transmission, axles etc.,
- The chassis frame (for exceptions, see Chapter 6.4 and ff.).
- Hydraulic fittings such as valves, cylinders etc.,
- Cavities in which electric cables and other thermally-sensitive lines are routed.

Attention
In the case of welding operations on the vehicle, the ground terminal of the welding unit must not be connected to the transmission or its periphery. The welding current may lead to spark-over at bearing points inside the component. The resulting structural changes at the bearing contact points may be clearly verified as new areas of hardening. This preliminary damage leads to the premature failure of the transmission.

3.7 Springs

Only use MERCEDES-BENZ original springs which have been approved for the relevant model. The reinforcement of springs and changes to shock absorbers is **not** permitted.
Spring pads and spring elevations are only permitted in coordination with, and with the written approval of, Department PBU/TES.
In the case of installation operations, the surfaces and anti-corrosion protection of the springs must not be damaged.
The Truck Implement Mounting Directive applies accordingly to leaf springs in the UNIMOG U 2400 TG.
In the case of welding operations, the protective measures described in Chapter 3.6 must be ensured.

3.8 Painting operations

In order to avoid deviations in color on painting bodies, information regarding the primer coats and paint used in manufacturing may be requested from DaimlerChrysler, Gaggenau Plant, Department PBU/TES (MB color numbers).

Before painting, cover the following areas:

- The bearing surfaces between disc wheel and wheel hub, in the case of twin tyres (U 2400 TG only) also between the disc wheels.
- Bearing surfaces of the wheel nuts.
- All bearing surfaces of high-tensile threaded connections (e.g. engine mounting system, end transverse member, etc.).
- Coupling flanges of drive shafts, power take-off shafts and auxiliary power take-offs.
- Hydraulic cylinder push rods (cab tilting hydraulics, front/ rear power lifters etc.).
- All compressed air and hydraulic system control valves and the interfaces of these components.
- Breather pipes at transmission, axles etc.
- Disc brakes.
- Electrical terminals

Attention: Temperatures of 80°C must not be exceeded for drying paint.

3.9 Pushing and towing

On pushing or towing the vehicle, the instructions in the operating instructions must be complied with.

- Only push the vehicle with the battery connected.

Attention
If the instructions in the operating instructions are not adhered to, this may result in damage to the drive train.

3.10 Electrical system

- Never start the engine without the batteries being firmly connected (battery terminal bolts tightened).
- Incorrect supply voltage polarity may destroy the control units.
- Do not undo or remove the terminal clamps from the batteries whilst the engine is running.
- In the event of discharged batteries, the engine can be externally started with jumper cables and the batteries of another vehicle with the same battery voltage. Note operating instructions.
- Jump starting with a rapid charger (overvoltage) **not** permissible.
- Only push vehicle with batteries connected.
- Only charge batteries with rapid charger if they have been disconnected from the vehicle electrical system. Positive and negative terminals must be disconnected. Note operating instructions. (*Note:* Nato batteries must not be charged with a rapid charger.)
- As regards the installation of additional electrical consumers, see Chapter 5.4.1 and ff.
- Cables which are routed in the vicinity of exhaust systems must be protected against the high temperatures which predominate there.
- Cables must not be routed in the vicinity of the exhaust manifold or turbocharger.
- Route cables such that no rubbing or shearing (on torsional flexion of the vehicle and relative movement between vehicle and implements or body components) occurs, especially at intersections and sharp edges; if necessary use conduit or guides.
- Department PBU/TES must be contacted if a main battery isolator switch is to be retrofitted.
- Do not attach electric cables to brake lines .
- If a vehicle has to be operated without a battery, the governor connector must be disconnected before starting and the alternator cables (D+ ; D- ; DF) must be short-circuited (does not apply to U90 Turbo/U100LTurbo).
- Do not carry out measurements with unsuitable media (testing spikes, wire ends etc.) at the contact point of plug connections. This may lead to contact problems via the formation of contact resistance. Use suitable test leads.
- Prior to welding operations with an electric welding unit, the ground terminal must be connected to the part which is to be welded directly next to the weld point. Disconnect the battery positive terminal and connect with a good electric conductor to the battery negative terminal or the ground of the chassis.

3.11 Mobile communication systems

The following requirements must be met to avoid subsequent interference in vehicle operation if mobile communication systems (e.g. telephone, CB radio) are retrofitted:

3.11.1 Implement requirements

- The device must have a GFTA No. and comply with DIN VDE 0879, Part 2.
- The device must be securely installed.
- The operation of **portable or mobile units** within the cab is **only permissible via** a connection with an **antenna which is firmly installed outside of the vehicle**.
- **The transmitter must be isolated from the vehicle electronics.**
- Protect the unit against moisture, note permissible operating temperature, protect against severe mechanical shock.

3.11.2 Antenna

(in the case of radio units)

- Note manufacturer's instructions and installation regulations.
- The antenna must have a GFTA No. (GFTA = German Federal telecommunications agency).
- For possible mounting, see Chap. 7.1.5

3.11.3 Connection and cable routing

- Connection directly to terminal 30 via an additional fuse. Power supply for 12 volt units in vehicles with 24 volt system only via a voltage transformer, see Chapter 5.4.6. Before using a start-assist unit, disconnect the voltage transformer from the electric system.

- Before using external power generation, the radio unit must be disconnected from the vehicle electrical system.
- Route leads as short as possible (no loops and no twisting).
- Ensure that ground connections to the body are good (antenna and unit).
- Route antenna lead, connection lead between transmitter, receiver and controls away from the vehicle wiring loom in the vicinity of the body ground.
- Do not kink or crush antenna lead.
- Comply with the requirements of the GGVS (German Law on the Road Transportation of Hazardous Goods).

3.12 Electromagnetic compatibility (EMC)

In the UNIMOG, the electric and electronic components are checked in the factory as regards their electromagnetic compatibility in the vehicle.
If additional implement or body components which affect the electromagnetic compatibility of the vehicle components are installed, the implement or body manufacturer must ensure that the operating safety of the entire vehicle/implement combination is guaranteed. A further EMC test may be necessary.

The following standards may be used to test electric and electronic systems for electromagnetic compatibility:

- DIN 40839
- DIN 57879, Part 3
- VDE 0879, Part 3
- Mercedes-Benz standard 22100

3.13 Implement drives

Various auxiliary power take-offs and power take-off shaft versions with different speeds and take-off outputs are available to drive implements or special bodies which are driven via power take-offs by the UNIMOG engine (see also Chapter 5 and UNIMOG Technical Manual).

It must be ensured that the permissible drive loads are not exceeded, taking the type of operation (changing loads, shock coefficients, duration of usage, usage profile etc.) into consideration.

The necessary practical testing of the operation of the implement is the responsibility of the implement manufacturer.

All consumers (mechanical, hydraulic, pneumatic, electric) must be reviewed. In doing so, outputs, maximum consumption volumes, direction of rotation, speeds, etc. must be taken into consideration (see Chapter 5.3 and ff.).
In addition, it must be ensured that no impermissible drive system heating occurs. In the case of continuous consumers, the implement manufacturer must ensure that the maximum permissible temperature (engine oil, transmission fluid, coolant) is not exceeded under the expected conditions in which the vehicle is to be used. In the case of hydraulically-driven continuous consumers, the implement manufacturer must ensure, via the use of matched hydraulic components, that the maximum permissible temperature is not exceeded under the expected conditions in which the vehicle is to be used.

4. Implements and body design

4.1 General notes

Prior to the commencement of implement and body operations, a check must be carried out to see whether the selected chassis is suitable for the planned implement or body, and whether the chassis type and its equipment correspond to the conditions of use. For body planning purposes, tender drawings and technical data may be requested from Department PBU/TES (see Chap.4.14 Available general drawings).

Note:
Changes to vehicle components which are the object of the registration procedure or the type test (ABE) cause expiry of the operating permit and require new registration.

4.2 Clearance of major components and bodies over the chassis

The free movement and functional safety of all parts of the chassis, especially moving parts such as tyres, axles, transverse control arms, springs, propshafts, steering, etc. must be guaranteed following the installation of the implements or the bodies **even at maximum torsional flexion, maximum axle loads and maximum steering lock**. **Verification must be provided via trials**. In doing so, the diagonally opposing wheels of the front and rear axle are to be raised (min. 400 mm) so that the other two wheels **are just in contact with the ground.**

Attention:
When carrying out the torsional flexion test, ensure that the vehicle is standing securely. If approach ramps are used, these must be secured against slipping and tipping. On lifting ramps, the tyre contact surfaces are to be moistened in order to reduce (chassis) stresses.

Figure 4.1 Chassis torsional flexion (induced in the RA only in this case)

4.3 Vehicle modifications

Factory delivered vehicles correspond to the EC Directives and national regulations (vehicles for countries outside of Europe are partly excepted). The vehicles must meet the EC directives and the relevant applicable national regulations even after changes have been carried out.
No changes may be carried out to the scope of the vehicle's delivery without our approval. In particular, DaimlerCrysler AG must be consulted if the following modifications are planned:

- Shortening or lengthening the chassis overhang.
- Drilling and welding on the chassis frame or axles.
- Modification to the frame.
- Modifications to braking and steering systems (e. g. changing the length of brake lines).
- Modifications to the intake and exhaust system.
- Modifications to the wheels, tyres, suspension (e. g. blocking the suspension).
- Modifications prejudicing the safety of the cab (e. g. drilling in the a or b-pillar).
- Modifications to power take-off shaft trains (propshaft/size and position).
- Modifications to the hydraulic system.
- Modifications to the lighting system.
- Modifications to soundproofing.
- Modifications to the engine.
- Modifications to the electrical system, e.g. including moving electronic control units.

Vehicle type approval:
Department PBU/TES and, if necessary, an officially recognized expert, must be informed of modifications to the chassis by the body manufacturer.
If required, the approval of DaimlerCrysler AG (e. g. drawing with approval note) or the valid Implement Mounting Directive must be submitted. See also Chapter 2.2.3 "Registration”.

4.4 Dimensions and weight specifications

Dimensions and weight specifications can be seen in the tender drawings and technical data. Unless otherwise specified, these refer to the standard vehicle equipment. Weight tolerances of + 5 % in manufacturing are permissible according to DIN 70020 and must be taken into consideration.

Caution:
Optional equipment must additionally be taken into consideration, ask PBU/TES if necessary.
The load values specified in the Technical Manual

- permissible gross vehicle weight
- permissible front axle load
- permissible rear axle load

must be complied with.

In order to ensure that the vehicle can be steered sufficiently well, the front axle load in all load conditions must be at least
33 % of the relevant gross vehicle weight.
Statically, the rear axle load must also be at least 33 % of the gross vehicle weight, in order to achieve sufficient braking performance and in order to guarantee sufficient steering stability in the event of full braking.

Note:
On designing the implement or body, it must be noted that, if optional equipment is installed (such as e.g. different tyres, hydraulics, larger volume fuel tank, auxiliary power take-off, power take-off shafts, etc.), the specified chassis weight is increased.

With reference to compliance with the permissible axle loads and the permissible gross vehicle weight, no tolerance as regards these being exceeded is permitted by the legislator.

4.5 Weight distribution

Unilateral (asymmetrical) weight distribution is to be avoided.
The difference in wheel loads may be 10 % of the axle load at most.

Example:	permissible axle load 10,000 kg permissible wheel load distribution 5500 kg to 4500 kg (10% difference in wheel loads)

The disk wheel and tyre load-bearing capacity must be taken into consideration.
If the wheel load difference exceeds 10%, corresponding authorization must be sought from PBU/TES.
Differences in wheel loads **reduce** the maximum permissible height of the center of gravity (see Chap.4.7.4)

4.6 Coordinate systems

One significant advantage of CAD technology is that it enables the vehicle to be measured in the form of coordinates, whereby the determination of relative dimensions, which previously required the determination of all individual part dimensions, is limited to the addition or subtraction of spatial vectors or "direct measurement" in the CAD system. In addition, the specification of certain points, (such as, e.g. the center of the steering wheel or point of sight) in the form of coordinates is significantly more simple than relative measurement, which can generally only be clearly allocated from the drawing. One significant aspect of the vector technique is the definition of the coordinate systems, whereby the whole can be sub-divided into the vehicle and module systems.

4.6.1 Vehicle system

The following definition applies to vehicle coordinate systems:

x axis:	Longitudinal axis with positive direction contrary to the direction of travel
y axis:	Transverse axis with positive direction to the right side of the vehicle
z axis:	Vertical axis with positive direction to the top side of the vehicle

The *origin* of the *vehicle coordinate system* (x=0; y=0; z=0 / without index) in the case of model *427/437* is:
x = 0 Front edge of frame
y = 0 Center of vehicle
z = 0 Upper edge of frame

The *vehicle coordinate origin* in model *408* is
x = 0 Center of the first tubular transverse member
y = 0 Center of the vehicle
z = 0 Center of the first tubular transverse member

The *vehicle coordinate origin* in model *418* is
x = 0 20mm behind the center of the first tubular transverse member
y = 0 Center of the vehicle
z = 0 Center of the first tubular transverse member

Module coordinate system
Module-related coordinates, e.g. in the case of the cab, are identified in the general drawing with the corresponding indices. On converting modules into vehicle coordinates, the vehicle-related module zero point must be taken into consideration.

Note:
To a large extent, dimension data are CAD data, and are therefore partially not rounded and are to be exclusively regarded as construction dimensions **without** tolerance specifications.
Insofar as detailed information is required, this may be requested from the following address:

Telefax: **07225- 61 5512**
Postal address: **DaimlerCrysler AG,**
Department PBU/TES
HPC 268
D-76568 Gaggenau.

Defined abbreviations

FE, RE	front edge, rear edge
LE, UE, IE	Lower, upper, inner edge
FA, RA	front axle, rear axle
GVW	gross vehicle weight
"Left" / "right" specifications	regarded in the direction of travel
Cab	

Examples of calculations with coordinate dimensions

Note: *All numerical values used in the following examples are example values and serve merely for explanatory purposes.*

1st example: Center of steering wheel coordinates:
The coordinates are specified in a cab-related manner in the general drawing, (Index CAB) with
(x=704/ y=-490/ z=771 CAB). In relation to the cab, the cab zero point has the following coordinates (x=650 / y=0 / z=222). By adding the relevant x, y and z components, the chassis-related coordinates from the center of the steering wheel are revealed from:

	Coordinates			
Operand	**x**	**y**	**z**	**Dimension description**
	704	-490	771	Center of the steering wheel, cab-related
+	650	0	222	Cab zero
=	1354	-490	993	Center of the steering wheel, chassis-related

Figure 4.2 Table Calculation example coordinates

2nd example: Horizontal distance from the center of the steering wheel to the coupling level:
Only the relevant x coordinate is of significance for this dimension. In relation to FE / UE stop pouch, the coupling level is at x = -234 mm. Via subtraction, the space dimension is revealed as:

1354 - (-234) = 1588 mm (note reverse counting)

4.6.2 Definition of the chassis coordinate system LBU (BM 408)

Position of the coordinate zero point with positive x direction, y direction and z direction

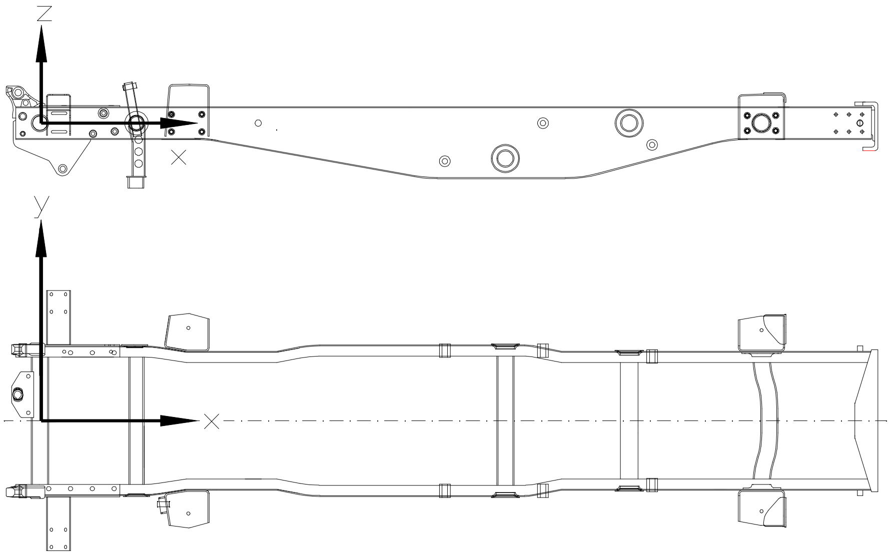


Figure 4.3 UNIMOG frame BM 408.101 (side view from left and top view)

4.6.3 Definition of the chassis coordinate system MBU (BM 418)

Position of the coordinate zero point with positive x direction, y direction and z direction

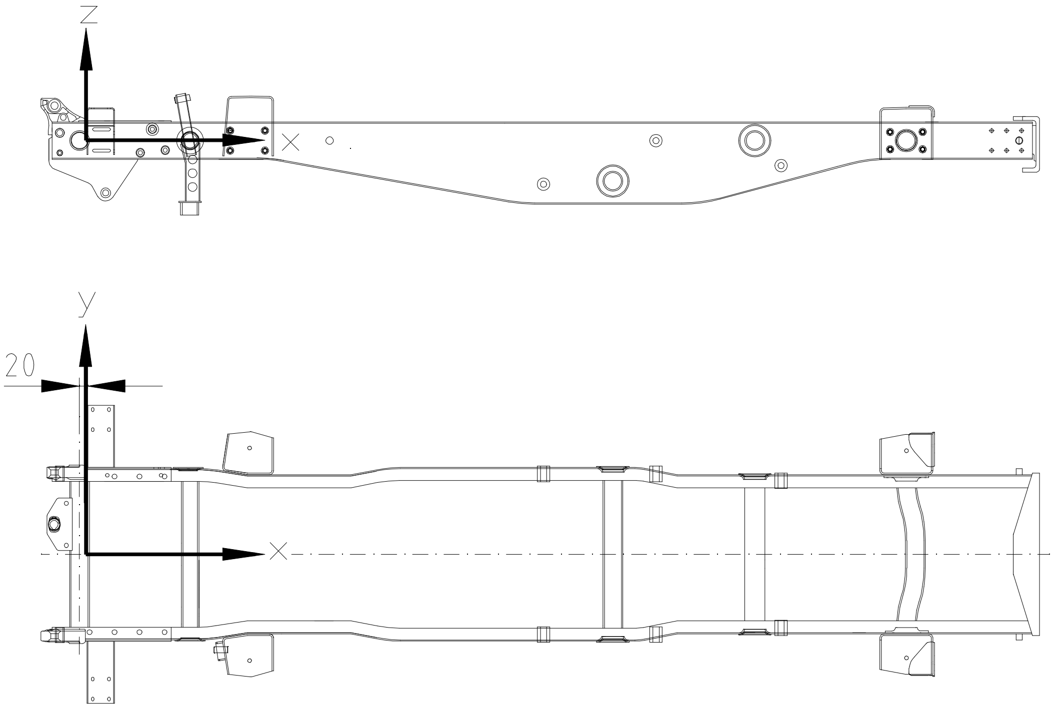


Figure 4.4 UNIMOG frame BM 418.102 (side view from left and top view)

4.6.4 Definition of the chassis coordinate system SBU (BM 427/437)

Position of the coordinate zero point with positive x direction, y direction and z direction

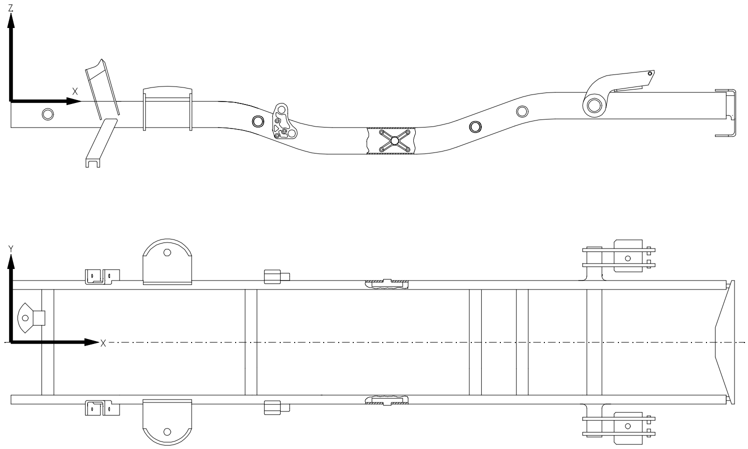


Figure 4.5 UNIMOG frame BM 427/437 (side view from left and top view)

4.7 Center of gravity

4.7.1 General notes regarding the center of gravity:

The overall height of the center of gravity (vehicle with implement or body without load) must be kept as low as possible.

In order to evaluate the handling of a vehicle-implement combination, only the position of the overall center of gravity at which the implements or bodies are found in transportation position, are of significance.

The implement or body manufacturer is responsible for the stability of the vehicle while operating implements and for compliance with the maximum permissible load values in (quasi)static operation e.g. in the case of operations with a hydraulic loading crane, lowering or raising a dumper body, slow
driving with a lateral boom mower etc.
Due to reasons of steering and braking safety and as regards driving dynamics, the front or rear axle load when the implement is in transportation position must be at least 33 % (reference value) of the relevant gross vehicle weight.

If a quick-release implement combination is mounted on the vehicle, e.g. snow plough attached at the front and quick-release gritting implement on the platform, the axle load distribution may not fall below the limit value mentioned above even if only one implement is removed (if necessary, secure by ballasting the minimum axle load).
The position of the center of gravity in the vehicle longitudinal direction is specified in relation to an axle, the height of the center of gravity is specified from the center of the wheel hub, in order to be independent of the tyres.

4.7.2 Determination of the center of gravity

4.7.2.1 Center of gravity coordinates in x direction (axle load distribution FA/RA)

Procedure:
For weighing purposes, the vehicle must be horizontal and on a level.
Firstly the individual axle loads (front and rear axle load), and then the gross vehicle weight of the vehicle, must be weighed.
The position of the center of gravity in the vehicle longitudinal direction can be calculated with the measured values.

l_v	Distance between center of gravity - center of front axle
l_h	Distance between center of gravity - center of rear axle
G_v	Front axle load
G_h	Rear axle load
G	Gross vehicle weight
l	Wheelbase

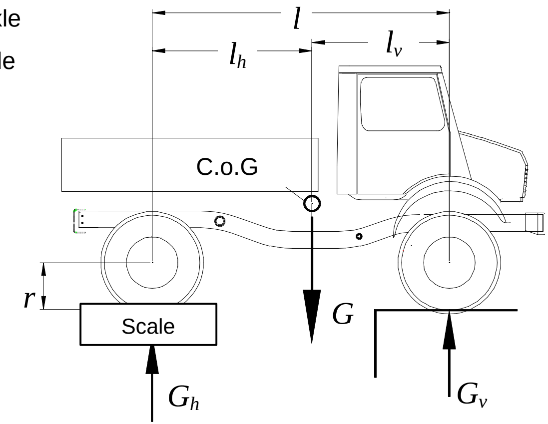


Figure 4.5 Center of gravity in x direction

The following formulae may be used to calculate the position of the center of gravity in the x direction:

Distance between the center of gravity and the center of the front axle

$$\boxed{l_v = \frac{G_h}{G} \cdot l}$$

Formula 4.7.2.1.1

Distance between the center of gravity and the center of the rear axle

$$\boxed{l_h = \frac{G_v}{G} \cdot l}$$

Formula 4.7.2.1.2

Example:

Wheelbase l = 3250 mm Front axle load G_v = 3900 daN Gross vehicle weight G = 8500 daN

Calculation: Position of the center of gravity

$$\boxed{l_h = \frac{3900[daN]}{8500[daN]} \cdot 3250\,mm = 1490\,mm}$$

i.e. the center of gravity is (calculated to be)1490 mm in front of the center of the RA.

4.7.2.2 Center of gravity coordinates in the z direction (height of the center of gravity)

In order to determine the overall height of the center of gravity h_S we recommend the following procedure:

- Check tyre air pressure, correct if necessary.
- Determine axle loads of the front axle G_v and the rear axle G_h on a plane surface.
- The vehicle springs must be blocked, e.g. by removing the shock absorbers and installing a suitable spacer to avoid spring deflection influences during measurement.
- Place the vehicle-implement combination in a horizontal and plane position with *one* axle on the scales.
- Raise the *other* axle by at least 1/3 of the wheelbase.
- Then weigh the existing axle load (Q_h with the front axle raised, Q_v with the rear axle raised) and measure the exact height h´ by which the vehicle was raised. As an alternative to the raised height, the angle α between the wheel hubs may also be determined.
- The position of the height of the center of gravity can be calculated with the measured values according to formulae 4.7.2.2.1 to 4 .

- Then raise the raised axle by a further e.g. 100 mm and again determine the height of the center of gravity in order to confirm the measurement result.

If the vehicle suspension cannot be blocked, several measurements must be carried out with various raising methods, e.g. h'_1 = 1/3 of the wheelbase, $h'_2 = h'_1 + 100mm$. $h'_3 = h'_2 + 100mm$, $h'_4 = h'_3 + 100mm$, in order to limit the measurement error via the formation of a mean value. The exact height of the center of gravity is revealed by the arithmetic mean value of the heights of the center of gravity; deviations from the individually calculated heights of the center of gravity of more than 50mm indicate measurement or calculation errors.

r_{stat} Static tyre loaded radius

Q_v Front axle load with vehicle raised at rear

Q_h Rear axle load with vehicle raised at the front

h_s Height of the center of gravity above the surface of the road

$$\boxed{h_S = h_a + r_{stat}}$$

h_a Height of the center of gravity above the center of the wheel

h' Height by which the vehicle was raised

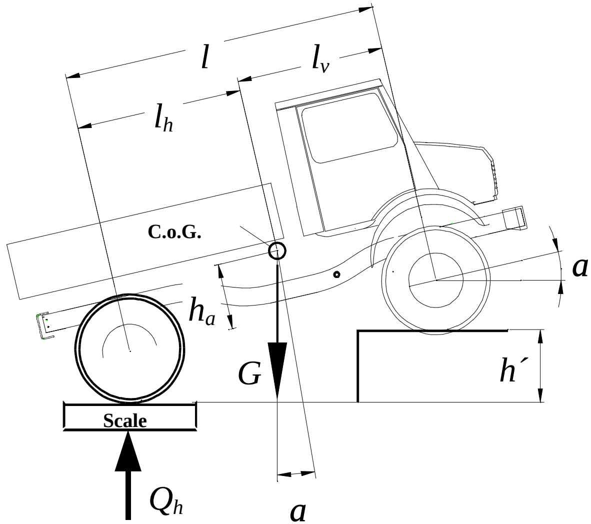


Figure 4.7 Determining the height of the center of gravity

Formula: for raised front axle 4.7.2.2.1 +2

$$\boxed{h_S = \left(\frac{Q_h - G_h}{G} \cdot l \cdot \frac{1}{\tan a} \right) + r_{stat}} \quad with \ \sin a = \frac{h'}{l}$$

Formula 4.7.2.2.1

$$\boxed{h_S = \left(\frac{Q_{HA} - G_{HA}}{G_G} \cdot \frac{l}{h'} \cdot \sqrt{l^2 - h'^2} \right) + r_{stat}}$$

Formula 4.7.2.2.2

Formula: for raised rear axle 4.7.2.2.3 +4

$$\boxed{h_S = \left(\frac{Q_v - G_v}{G} \cdot l \cdot \frac{1}{\tan \alpha} \right) + r_{stat}} \quad with \ \sin a = \frac{h'}{l}$$

Formula 4.7.2.2.3

$$\boxed{h_S = \left(\frac{Q_{VA} - G_{VA}}{G_G} \cdot \frac{l}{h'} \cdot \sqrt{l^2 - h'^2} \right) + r_{stat}}$$

Formula 4.7.2.2.4

Example: Calculation of the position of the center of gravity in the z direction above the center of the wheel

Q_V	= 4365 daN	
G	= 8500 daN	
G_V	= 3900 daN	
h´	= 800 mm	
r_{stat}	= 477 mm	with tyres: 12.5 R 20 MPT
l	= 3250 mm	

$$h_s = \left(\frac{4365\ daN - 3900\ daN}{8500\ daN} \cdot \frac{3250\ mm}{800\ mm} \cdot \sqrt{(3250mm)^2 - (800mm)^2} \right) + 477\ mm$$

$$\underline{\underline{h_s = 1177\ mm}}$$

Practical determination of the height of the center of gravity may only be carried out by **experienced** personnel using suitable lifting facilities.

4.7.2.3 Calculated determination of the overall center of gravity

To do this, the position of the centers of gravity of the individual components

- chassis,
- implement or body relative to the chassis,
- possibly position of remaining payload,
- possibly necessary ballast, etc.

must be known.
In addition, the deflection travel at the front and rear axle, induced by the body or the load, must be known.
This reveals the position of the overall center of gravity with a sufficient degree of accuracy:

$$\boxed{h_s = \left(\sum_{i=1}^{n} \frac{weight_n \cdot c.o.g.\ height\ h_n\ above\ ground}{GVW\ of\ vehicle/implement - combination} \right) - X_{Spring}}$$

Formula 4.7.2.3.1

with ***n*** = number of individual masses
X_{spring} = dimension by which the center of gravity has been lowered due to spring deflection at the front and rear axle

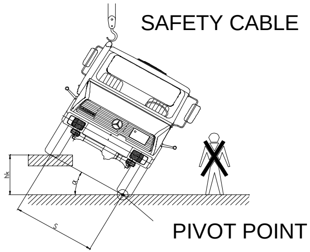
Example: vehicle with implements in transportation position

	Gross vehicle weight	Position center of gravity above the road surface:
Vehicle empty:	8000 daN	880 mm
Front-mounted implement	800 daN	700 mm
Center body	2000 daN	1800 mm
Rear-mounted implement	500 daN	750 mm
X_{spring}		25 mm

$$\boxed{\underline{\underline{h_s}} = \frac{8000\ \text{daN} \cdot 880\ \text{mm} + 800\ \text{daN} \cdot 700\ \text{mm} + 2000\ \text{daN} \cdot 1800\ \text{mm} + 500\ \text{daN} \cdot 750\ \text{mm}}{11300\ \text{daN}} - 25\ \text{mm} = \underline{\underline{1003\ \text{mm}}}}$$

In order to simplify the calculation, we determine the vehicle-side (as described in Chap.4.7.2.2) center of gravity of the empty vehicle in its spring deflected state*, thereby dispensing with the subtraction of the spring deflection travel X_{spring} in the above mentioned formula.
* To do this, the vehicle is loaded to its permissible GVW , spring blocking is installed and the vehicle is unloaded again, thereby simulating the fully loaded state as regards spring deflection in the empty vehicle.

4.7.2.4 Determination of the height of the center of gravity via tilting test



Close off danger area!

The height of the center of gravity h_s may also be approximated by carrying out a tilting test in a stationary vehicle. As this is a static test, $\mu = 1$ is assumed. One side of the vehicle is raised by the dimension h_K until the vehicle almost falls into the prepared safety cables. The following applies approximately to the axle-related tilting angle: $\sin \alpha = h_K / s$. With the tilting angle determined at the axle, the height of the center of gravity h_S can be calculated from: **$h_S = 0.5 \times s \times \tan \alpha$.**
Note: The tilting angle present in the frame/body is significantly greater as a result of unilateral spring deflection.
The static tilting test must only be carried out by **experienced** personnel using suitable restraining facilities of suitable dimensions.

More exact determination of the static tilting angle must be carried out on a tiltable ramp (avoidance of tyre deformation due to lateral camber force, as in the case of unilateral raising).

4.7.3 Chassis centers of gravity

Vehicle / type designation	**Model**	**Height of chassis center of gravity h_a (above center of wheel) Empty vehicle in its (at perm GVW) spring deflected state See 4.7.2.3**
UNIMOG chassis		
L variation		
U 100 L	BM 408.215	370 mm
U 140 L	BM 418.117	370 mm
U 1450 L	BM 427.111	370 mm
U 1550 L / U 1550 L/37	BM 437.111 / BM 437.120	370 mm / 370 mm
U 1550 L (214) / U 1550 L/37 (214)	BM 437.116 / BM 437.125	370 mm / 370 mm
U 1650 L / U 1650 L (214)	BM 427.116 / BM 427.118	370 mm / 370 mm
U 2150 L / U 2150 L/38	BM 437.118 / BM 437.136	370 mm / 390 mm
U 2450 L / U 2450 L/38	BM 437.118 / BM 437.136	370 mm / 390 mm
U 2450 L / 6x6	BM 437.156	360 mm
Tractor and operating unit		
short and long wheelbase Municipal version (with platform)		
U 90	BM 408.100	450 mm
U 130	BM 418.102	450 mm
U 1400 / U 1450	BM 427.102 / BM 427.112	430 mm / 430 mm
U 1600 / U 1650	BM 427.105 / BM 427.115	430 mm / 430 mm
U 1600 (214) / U 1650 (214)	BM 427.107 / BM 427.117	440 mm / 440 mm
U 2100 / U 2150	BM 437.105 / BM 437.117	420 mm / 420 mm
U 2400 / U 2450	BM 437.105 / BM 437.117	420 mm / 420 mm

Figure 4.8 Table "Chassis centers of gravity"

4.7.4 Maximal permissible height of the center of gravity

The design of implement or body must ensure that the overall height of the center of gravity (vehicle with all implements and bodies and payload) is as low as possible.
The maximum *permissible* height of the center of gravity h_{max} of the vehicle-implement combination can be calculated according to the basic rule ***slipping before tilting***, i.e. if the height of the center of gravity of the vehicle-implement combination is below h_{max}, the vehicle tends to slip away/swing in the limit range; if the value is greater than h_{max}, the vehicle tends to tilt in the limit range. The value h_{max} is, in initial approximation, dependent on the track width and the positive engagement of the tyres/road surface.

$$\boxed{h_{max} = \frac{s}{2\mu}}$$

static tilting formula with s = track width and μ = overall coefficient of friction tyres/road surface.

Formula 4.7.4.1

Note:
Formula 4.7.4.1 does <u>not</u> take the static and dynamic chassis and body inclination into consideration (see 4.7.6) .
With a coefficient of friction of $\mu = 0.7$, the following values apply to vehicles with standard tyres:

Vehicle type	**Rim size**	**ET [mm]****	**Track [mm]**	**h_{max} [mm]**
U90 Turbo / U100L Turbo	9x20	137	1476	1054
U130 / U140L	11x20	100	1690*	1207
U1400 / U1450 / U1450L	11x20	100	1725	1232
U1600 / U1650 / U1650L U1600(214) / U1650(214) / U1650L(214)	11-20 SDC	184	1680*	1200
U1550L / U1550L/37 U1550L(214) / U1550L/37(214)	11x20	100	1927	1376
U2100 / U2150 / U2150L / U2150L/38 U2400 / U2450 / U2450L / U2450L/38 U2450L 6x6	22.5x9.00	161	1928*	1377

**Standard track width as of 1/98* ****Rim off-set*

Maximum height of the center of gravity with different wheel loads

If asymmetrical strain is unavoidable due to the type of body (e.g. in the case of a loading crane, generator, mower mounted on one side etc.), approval must be sought from Department PBU/TES if the difference in wheel loads exceeds 10 % of the relevant axle loads. At all events, the permissible overall height of the center of gravity must, if the overall position of the center of gravity is asymmetrical, be lowered in proportion to the difference in wheel loads, i.e. in the case of maximum 10% asymmetry, the following applies e.g.: $h_{max\mathbf{new}} = 0.9 \cdot h_{max}$

Formel 4.7.4.2 Height of centre of gravity at asymmetrical wheel loads

4.7.5 Anti-roll bars

All UNIMOGs are equipped with standard anti-roll bars on the front and rear axle. This guarantees acceptable driving characteristics even in the case of implements and bodies with high centers of gravity. Anti-roll bars must not be removed without written authorization from DaimlerCrysler AG.

4.7.6 Calculation of the cornering tilt speed

If the height of the center of gravity h of the vehicle-implement combination and the track width s are known, the lateral friction value μ_K for induction of the tilting procedure can be calculated:

$$\boxed{\mu_k = \frac{s}{2 \cdot h}}$$

m_K = minimum lateral friction value for induction of the tilting procedure

Formula 4.7.6.1

If the actual coefficient of friction tyres/road surface μ is greater than μ_K, the vehicle tends to tilt in the limit range, if μ is less than μ_K, the vehicle tends to slip away in the limit range. The coefficient of friction μ is dependent on tyres, road surface and speed and any may involve values between almost 0 and 1 under normal road conditions.

Example:

- icy road surface	$\mu \approx 0.1$
- new Unimog tyre on dry road surface	$\mu \approx 0.7$

The following should therefore always apply in the design of a body: $m_K > \mathbf{0.7}$
In the case of m_K **= 0.6 to 0.7** evaluation of the vehicle-implement combination via a practical driving trial is necessary (influence of driving dynamics).
In the case of $m_K <$ **0.6**, approval is not generally possible without special conditions.

The cornering tilt speed may be calculated with the lateral friction value μ_K, **the tilting procedure may only occur when the following apply:**

$$\boxed{\mu_K < \mu}$$

$$\boxed{v_k = 11.3 \cdot \sqrt{\frac{\mu_k \cdot D}{2}}}$$

Approximation formula for the cornering tilt speed [kph]

Formula 4.7.6.2

(Formula applies only to stationary circling on a plane surface)

h	Height of the center of gravity of the entire vehicle [m]
s	Track width [m]
D	Curve diameter [m], the smallest diameter is the turning circle, see Chap.4.8.8

Practical determination of the cornering tilt speed may only be carried out by an expert driver on sealed-off premises.

We urgently advise against carrying this test out without vehicle-side tilt protection.

4.7.7 Turning circles in the individual models

Vehicle / type designation	**Model**	**Turning circle diameter**
Tractor and operating unit short and long wheelbase		
U 90Turbo	BM 408.101	11.85 m
U 130	BM 418.102	12.22 m
U 1400 / U 1450	BM 427.102 / BM 427.112	12.22 m / 14.10 m
U 1600 / U 1650	BM 427.105 / BM 427.115	12.26 m / 14.10 m
U 1600 (214) / U 1650 (214)	BM 427.107 / BM 427.117	12.26 m / 14.10 m
U 2100 / U 2150	BM 437.105 / BM 437.117	13.00 m / 14.51 m
U 2400 / U 2450	BM 437.105 / BM 437.117	13.00 m / 14.51 m
UNIMOG chassis		
L variation		
U 100 L Turbo	BM 408.216	12.85 m
U 140 L	BM 418.117	13.85 m
U 1450 L	BM 427.111	14.10 m
U 1550 L / U 1550 L/37	BM 437.111 / BM 437.120	14.32 m / 15.77 m
U 1550 L (214) / U 1550 L/37 (214)	BM 437.116 / BM 437.125	14.32 m / 15.77 m
U 1650 L / U 1650 L (214)	BM 427.116 / BM 427.118	14.10 m / 14.10 m
U 2150 L / U 2150 L/38	BM 437.118 / BM 437.136	14.51 m / 16.28 m
U 2450 L / U 2450 L/38	BM 437.118 / BM 437.136	14.51 m / 16.28 m
U 2450 L 6x6	BM 437.156	18.70 m.
UNIMOG driving units		Max. steering angle
U 130 T	BM 418.000	40°
U 1400 T	BM 427.000	40°
U 2100 T	BM 437.002	40°
Turning circle diameters refer to standard tyres. (See "UNIMOG Technical Manual")		

Figure 4.9 Turning circle table

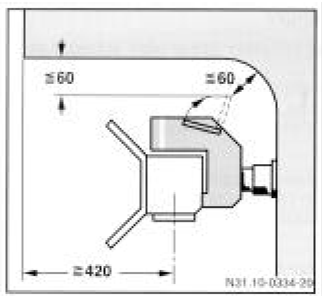
4.8 General notes regarding vehicle components

4.8.1 Technical Manual

For overhang, see implement projecting dimensions in the instructions for mounted implements, Chap. 8.3.2

Rear overhang:
Note permissible axle load, frame stability, legal regulations .
The rear overhang angle must correspond to the usage profile.
Clearance for trailer hitch, see Chap. 4.8.2

4.8.2 Trailer hitch



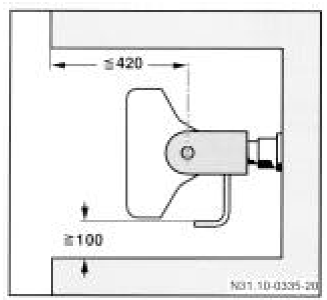


Figure 4.10 Clearance requirements at trailer hitch

- The attachment of the trailer hitch must comply with the regulations of the country in which the vehicle is registered. According to DIN 74050 and EC Directive 94/20/EC in Germany.
- Take clearance dimensions into consideration. According to DIN 74058 and EC Directive 94/20/EC in Germany.
- In the event of deviations from the accident prevention regulations, the employer's liability insurance association for vehicle keepers, 22757 Hamburg, Tel.040/381091 may have to be consulted in Germany.
- If trailer hitches are retrofitted, only those types approved by us and original DB end transverse members may be used; type approval by TÜV and entry in the vehicle documentation may be necessary (otherwise the ABE expires).
- In order to determine the coupling size, the hole pattern in the end transverse member must be noted.
- Trailer operation is only permissible if the trailer hitch is in its normal position and the clearance angles specified according to StVZO are adhered to:

  at least ± 60° around the vertical axis
  at least ± 20° around the transverse axis
  at least ± 25° around the longitudinal axis
- Distance between the center of the coupling pin of the trailer hitch to the end of the body, maximum 420 mm.
  In exceptional cases, the distance dimension of 420 mm may be exceeded:
  Maximum distance 650 mm, in vehicles with tippable bodies or rear-mounted implements.
  Maximum distance 1320 mm, if the clearance between the road surface to the lower edge of the body is at least 1150 mm.
- Safe operation of the coupling must not be impaired.
- The clearances around the coupling heads of the trailer brake system for trailer operation must not be restricted.

The size of the trailer hitch is determined according to the D value:

$$\boxed{D = g \cdot \frac{m_k \cdot m_a}{m_k + m_a} \quad \text{(kN)}}$$

Formel 4.8.2.1 D-value

with

D	= Drawbar value
m_k	= Permissible gross vehicle weight of the tractor (motor vehicle) in t
m_a	= Permissible gross vehicle weight of the trailer in t
g	= 9.81 m/s^2

Note: The data regarding the nose load on the trailer hitch and in the vehicle documents must be noted.

If one or more regulations regarding simple and safe operation cannot be met, a coupling with **remote control** must be used. The remote control must meet the following conditions:

- Perfect function.
- The actuating device must be firmly installed on the vehicle and must not be removable.
- The actuating device must be easily accessible, simple, present no risks and not be capable of confusion.
- The coupling must be able to be opened safety by at least ±10° even in the event of axial rotation.
- When the trailer is coupled, the operator must be able to determine without difficulty, via a visual check or a display, whether the coupling pin is engaged and secured.

Operating instructions, which refer to the special features and the operation of the coupling, must be enclosed in the vehicle. No changes may be made to the trailer hitch (e. g. bending, welding or removal of the manual lever).

4.8.3 Tyres

The implement or body manufacturer must ensure,
- that approved wheels and tyres with sufficient load capacity are used
- that the permissible axle loads are adhered to,
- that the tyre air pressure specified in the operating instructions is adhered to,
- hat there is sufficient clearance, even in the event of maximum torsional flexion, maximum axle loads and maximum steering lock, between the tyres and chassis components (wing, wheel well, etc ...),
- that there is sufficient clearance, even in the event of torsional flexion, if tyre chains are used if such a usage profile becomes necessary
- If the use of tyre chains is not possible due to the body (e.g. due to the position of the rear wings), this must be pointed out in the implement operating instructions.

See also "UNIMOG Technical Manual" Chapter C "General".

4.8.4 Cooling

For notes regarding temperature limit values, see Chap.5.2.9.3
The *cooling system* (coolant radiator, intercooler, fan, visco-clutch, radiator grille, air channels, coolant circuit, etc.) must not be modified. Sufficient cooling air throughput must be guaranteed.

- Keep the radiator air inlet free.
- Do not affix warning signs, badges or other trim parts in the area in front of the radiator.
- If possible, design implements such that the radiator is not exposed to dirt.

Provide auxiliary cooling facilities for major components if the usage profile leads to the expectation of temperature problems. In the case of a stationary vehicle and consumption of high continuous power, install optional equipment (e. g. oil cooler code G50/G51).
Do not install an auxiliary radiator in front of the standard coolant radiator or intercooler, only use complete units with their own fans, e.g. electrically-driven.

Disc brakes

- Disc brake cooling must not, in general use, be impaired by, for example, auxiliary wheel covers or brake disc covers, etc.

4.8.5 Engine air intake

In the event of modifications to the engine air intake system, note the following:

- In order to guarantee function, the standard parts such as filters, rain caps, hoses, mountings (vibration insulation) etc. which are used must be of equally high quality as the original standard parts.
- Changes to the engine air intake system, which result in an increase in intake pressure, lead to the expiry of the vehicle ABE due to a deterioration in emission values .
- Do not install the air intake system in the flow-related swirl area of the cab or body.
- The clean air-side and the connection maintenance indicator must not be changed.
- Do not change the mounting conditions in the area of the intake aperture.
- Clean air-side connection points must be 100% gas-tight.
- The flow speeds in the intake area, in front of and in the air intake channel must not be increased, i.e. do not constrict the free cross-section.
- Position intake apertures in zones which are low in dust and spray water.

- Using suitable measures, protect intake apertures against the ingress of rain and spray water and against water draining off the cab; in the case of fire brigade vehicles (forest fire), also protect against flying sparks
- If vehicles are used in extremely dusty conditions, provide auxiliary dust separator, in BM427/437:
  - Remove standard rain cap MB-Nr. 000 988 49 35 from the intake chimney.
  - Install auxiliary Donaldson dust separator type PBH 00-028, MB-Nr. 018 094 41 02 with intake pipe fitting MB-Nr. 437830 00 53.
  - Brackets MB-Nr. 437 830 00 14 and 437 830 01 14 support the large dust separator at the cab roof.

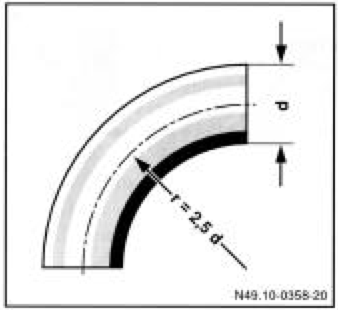
4.8.6 Soundproofing

Standard soundproofing components form part of the certified vehicle components in the ABE and must **not** therefore be removed, moved, cut out or modified in any other manner.
In the event of necessary modifications, coordination with DaimlerCrysler AG, Gaggenau, Department PBU/TES, is required.
National laws and regulations complied with. In the Federal Republic of Germany, the exterior noise regulations in accordance with EC Directive 70/157/EEC apply.
If modifications to soundproofing become necessary in the case of implements or bodies, the body manufacturer must guarantee and verify that the vehicle noise values are adhered to in accordance with the national regulations.
In the event of modifications to noise-relevant parts (e.g. engine, exhaust system, air intake system, etc.) or to soundproofing, the exterior noise must, in vehicles which are registered in Germany, be subsequently tested, e.g. by TÜV, and an entry must then be made in the vehicle documentation.
In the case of vehicles which are certified in EC countries in accordance with EC registration, the vehicle manufacturer's EC certificate would also have to be changed in the event of a change to the soundproofing. Changes to EC certificates may only be made by the applicant, i.e. the vehicle manufacturer. A change in certification involves a great deal of effort on the part of the vehicle manufacturer. In this case, the cost of this would have to be assumed by the body manufacturer.
We therefore advise in principle against changes in soundproofing .
Changing EC certificates at short notice is not generally possible, resulting lead-time delays must be taken into consideration by the body manufacturer.

Important note:

- Verification of compliance with the above mentioned regulations following a change to soundproofing is the responsibility of the implement manufacturer.
- The above mentioned legal regulations do not apply to noise emissions which result from the operation of the implements or bodies.

4.8.7 Exhaust system



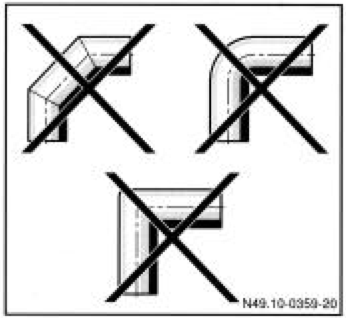


Figure 4.11 Bending radii

Changes to the muffler system are not permissible, as the type and position are specified in the ABE.
Repositioning of the tailpipe as a consequence of operational requirements is permissible. In the case of crane operation in stationary mode, for example, an extension pipe with the same cross-section may be connected to the tailpipe of the muffler. In the case of slow driving (e. g. working with plate compressors), the tailpipe may be rotated.

When driving on public roads, the original status must be recreated.
When routing the exhaust system, Department **PBU/TES** must be *consulted* in advance.

Instructions:

- In the event of modifications, use original Mercedes-Benz parts.
- The free cross-section of the exhaust pipe behind the muffler must not be reduced.
- Bends in pipes must be a maximum of 90°.
- Additional bends in pipes are to be avoided.
- Bending radii≥ 2.5 times pipe diameter, see Figure 4.11.
- Minimum distance from plastic lines, electric cables and spare wheel,
  - 200 mm in the case of exhaust systems without shields,
  - 80 mm in the case of sheet metal shields,
  - 40 mm in the case of sheet metal shields with additional insulation.
  If these distances cannot be complied with, replace plastic lines with tombac lines according to DIN 1755, material CuZn20F33, with the same internal diameter.
- Additional shields may be necessary in the area of operating facilities, major components and implements and installations.
- If parts of the exhaust system are modified, a supply of replacement parts must be guaranteed by the implement manufacturer. Corresponding notes must be included in the implement operating instructions.

4.8.8 Springs

If spring blocking becomes necessary due to great asymmetrical loads, e.g. induced by boom mower implements, Department PBU/TES must be consulted.
In the case of installation operations, the surface and anti-corrosion protection of the springs must not be damaged.
See also Chapter 3.7.

Spring/shock absorber combination

The spring/shock absorber combination must not be changed without the written authorization of DCAG

Changing springs

Springs must not be shortened. No shorter or longer springs or spring pads may be installed.
Changing the spring/shock absorber combination does not lead to the expiry of the operating authorization if a combination approved by DaimlerCrysler AG is selected and confirmation regarding conversion is obtained from PBU/TES.

Brake system

In vehicles with automatic load-dependent brake proportioning valves (ALB), the rear axle load must be determined for checking purposes following the completion of construction and equipping. In accordance with these values, check the setting of the ALB (see operating instructions) according to the sign affixed in the cab. If necessary, have the ALB adjusted by a UGV, a MERCEDES-BENZ Service Station or an authorized brake service.
Changes to brake lines, e.g. longer lines, influence the time response of the brake and must be checked according to EC directives. Changes to the ALB, e.g. changing the position or changes to the linkage (kinematics) are not permissible. If a change has to be made due to a body, DaimlerCrysler AG must be informed as early as in the planning stage.
In vehicles with ABS (code B02), no changes may be made to any part of the system.

4.8.10 Side marker lamps (§51a StVZO)

Vehicles which are to be registered in the EC and which have an <u>overall length in excess of 6 m</u>, must be equipped with side marker lamps with integrated rear reflectors (code L71) in accordance with EC Directive 76/756/EEC. The lamps mounted on the cab in the case of L71 must be repeated on both longitudinal sides of the vehicle at intervals of less than 3 m. One lamp must be positioned in the vehicle longitudinal direction in the center third of the vehicle. The maximum distance from the rear of the vehicle must be 1m. At most, the lamps must be positioned 900mm above the road surface. If the form of the body does not enable a maximum of 900mm to be achieved, the lamps may be mounted at a maximum height of up to 1500mm.
The lamps with integrated rear reflectors have the MB-Nr. 002 820 34 56 and can be ordered as individual parts.
When equipped with code L71 4 further lamps are loosely enclosed with the chassis; a cable connection is located on the rear lamp bracket for the power supply.

Side marker lamps are not prescribed for agricultural or forestry tractors or operating machines.

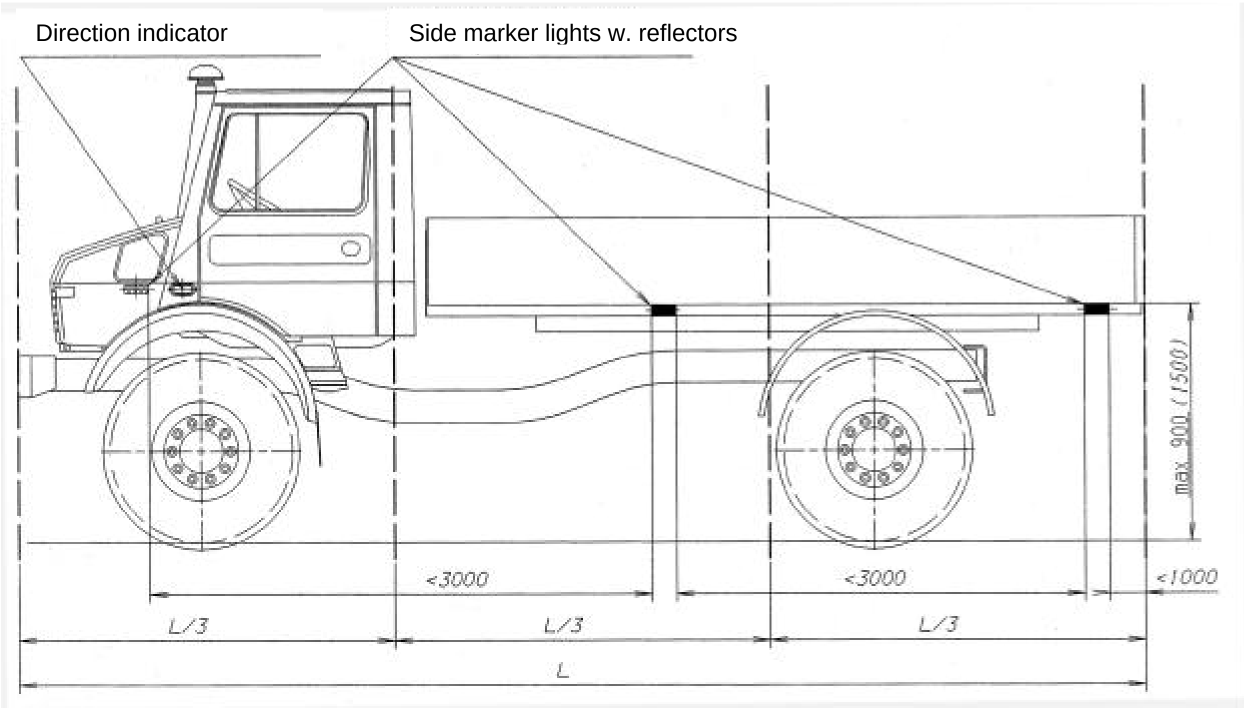


Figure 4.12 Position of the side marker lamps

4.8.11 Maintenance and repair

Maintenance and repair of the vehicle must not be made unnecessarily difficult due to the body. Maintenance points and major components must be easily accessible. In the case of a body, the accessibility of the brake fluid reservoir, in particular, must be guaranteed.

We recommend the following:

- Install maintenance flaps or removable rear walls.
- Note operating instructions.

If, in exceptional cases, these requirements cannot be adhered to, the implements and special bodies or parts thereof must be of a quick-release design.
Additional work caused by the implement or body in the case of warranty, maintenance or repair operations will be additionally invoiced by DAIMLERCRYSLER AG.

4.8.12 Load values

The data in the vehicle documentation or in the accompanying insert regarding permissible gross vehicle weight, permissible front and permissible rear axle load must not be exceeded.
Depending on the use of the vehicle, prescribed load value levels have been specified. In accordance with the usage profile (e.g. snow clearance) increased load values may be used with certain implements. In conjunction with increased load levels (code X18 / X19 / X20), speed limits may be necessary (see UNIMOG Technical Manual)**.**

4.8.12.1 Load value increase

Load value increases may be applied for from PBU/TES under fax No. 07225-61-5512 (type test).
In the case of enquiries regarding load value increases, a copy of the vehicle registration document and exact data regarding the planned implements and bodies and the subsequent conditions under which the vehicle will be used are required.

Subsequent confirmation of increased load values for vehicles which have already been delivered is only possible on **verification of the corresponding equipment or retrofitted equipment**; maximum speeds restricted in accordance with the operation or limitations regarding operation with trailers may be necessary.

Note:
A load value level means that, regardless of the model,

- the frame has been reinforced (closed profile, reinforcement plates, etc.),
- the axles (axle tubes) and the wheel bearings have been reinforced,
- wheels and tyres of sufficient load-bearing capacity have been installed,
- the steering has been reinforced,
- etc.

This means that when, depending on the model, a load value level is retrofitted, a considerable amount of time and financial effort is involved.
Prerequisites of subsequent load value confirmation are that the work has been carried out properly and that the vehicle is in a technically flawless condition.

4.8.12.2 Load value levels

Further load value increases, e.g. for special machines which are not used on public roads, are possible, whereby DaimlerCrysler AG, Department PBU/TES reserves the right to exclude warranty rights for individual components from the load value confirmation.

4.9 Secure mounting of the implement/ballast on the vehicle

The implement manufacturer is responsible for the secure mounting of the implement, especially in its transportation position. On designing the mounting components and transport restraints, particular attention must be paid to the fact that, depending on the usage profile,

- increased longitudinal, transverse and vertical acceleration
- increased shock factors (e.g. when driving off-road) with constantly changing magnitude and frequency may occur.

This means that all bodies must be secured against slipping and lifting. This also applies to loads, with the exception of bulk goods.
The necessary testing is the responsibility of the implement manufacturer.

Counterweights or **ballast** must be positioned so that they **are unable to move** and must be secured **against lifting**. The **transportation position** must be clearly specified, e.g. UNIMOG with rotary snow plough attached at the front and secured counterweight on the platform. Movable implement parts must be tensioned so that they cannot move and must be mechanically **locked** if possible.

4.10 Bodies with overall center of gravity which may change during operations

In the case of implements which move during operation and thereby continuously change the overall position of the center of gravity, e.g. swiveling a hydraulic arm with a mowing head, the tests described in Point 4.10.1 and 4.10.2 are also necessary.
The additional tests are explained in the following on the basis of boom mowers. They can, however, be applied to all vehicle-implement combinations with comparable usage profiles.

4.10.1 Static test

Test conditions:
Adjust boom mower to maximum boom length, heaviest operating tool, movement or telescopic devices fully extended. In doing so, the tool must be positioned **freely floating** above the ground.
If ballasting is required, (e. g. in the case of front-mounted implements) weighing must be carried out with ballast weight. In doing so, the smallest wheel load must be at least 10% of the relevant axle load. The lower absolute value is 400 daN.
If the implement is extended *transverse to the direction of travel*, the sum of the opposing wheel loads must **not** be less than ¼ of the relevant gross vehicle weight.
These limit values must also be adhered to if several implements are operated simultaneously. Insofar as corresponding combinations are to be approved (e. g. verge mower in conjunction with rear boom mower), the corresponding wheel load conditions must be fulfilled and verified by weighing.

4.10.2 Dynamic test

Stability is also to be tested by suddenly intercepting the most rapid possible lowering movement of the outstretched boom:

The wheel opposite the boom must not be raised.

4.11. Front mounting

General notes regarding front mounting of implements

The UNIMOG offers several possibilities for front mounting implements. The mounting points of each UNIMOG model are described in the following.
The following points must be noted for the front mounting of implements.
Maximum permissible front axle load

- Axle load distribution
- Implement front dimensions
- Field of visibility
- Implement drive

4.11.1 Front mounting plate

The front mounting plate (FAP) is available in three different sizes, whereby size 3 is standardized according to DIN 76060 Form B and size 5 according to DIN 76060 Form A.

The following front mounting plates are available:.

FAP size 1 for BM408 (*LBU)*	(code D01)
FAP size 3 for BM418/427 (*MBU/SBU)*	(code D11)
FAP size 5 for BM427/437 (*SBU)*	(code D12)

In the case of the size 5 front mounting plate, the implement manufacturer may reduce the dimensions to those of the size 3 front mounting plate via a (self-manufactured) adapter plate. An adapter for increasing from size 3 to size 5 is <u>not</u> permissible (Risk of overloading) .

Front mounting plate (implement) size 1

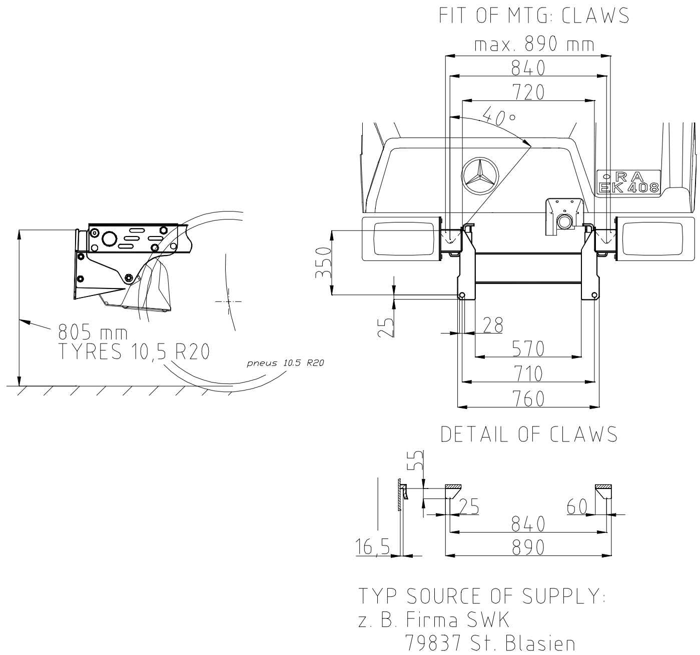


Figure 4.13 Front mounting plate size 1

Front mounting plate size 3 according to DIN 76060-B

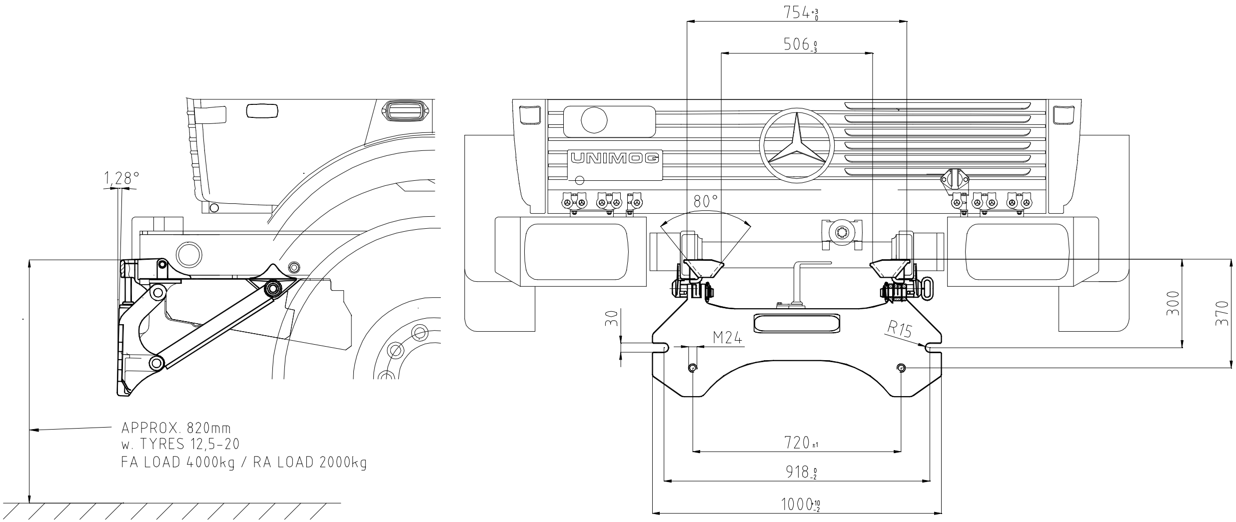


Figure 4.14 Front mounting plate size 3

Front mounting plate size 5 according to DIN 76060-A

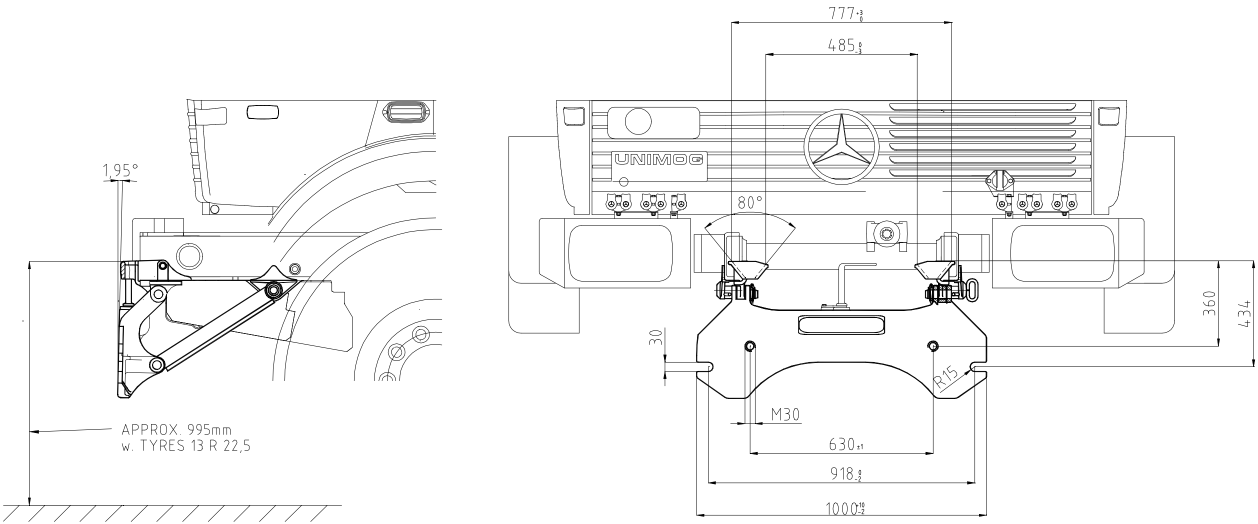


Figure 4.15 Front mounting plate size 5

4.11.2 Front mounting support (code D10)

UNIMOG model	Mercedes-Benz parts number	
	Right version	*Left version*
BM 408	A 408 317 01 42 1.)	A 408 317 00 42 1.)
BM 418	A 418 317 16 42	A 418 317 15 42
BM 427	A 424 552 02 18	A 424 552 01 18
BM 437	A 425 552 07 18	A 425 552 06 18
1.) Integrated into the frame/welded on.		

Figure 4.16 Front mounting plate allocation table

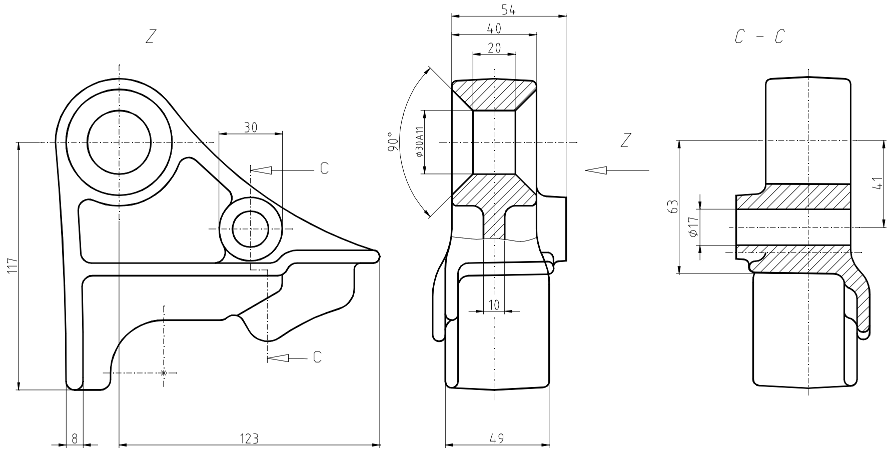


Figure 4.17 Front mounting support BM 408 (right version; welded onto the frame) MB-Nr. A 408 317 01 42

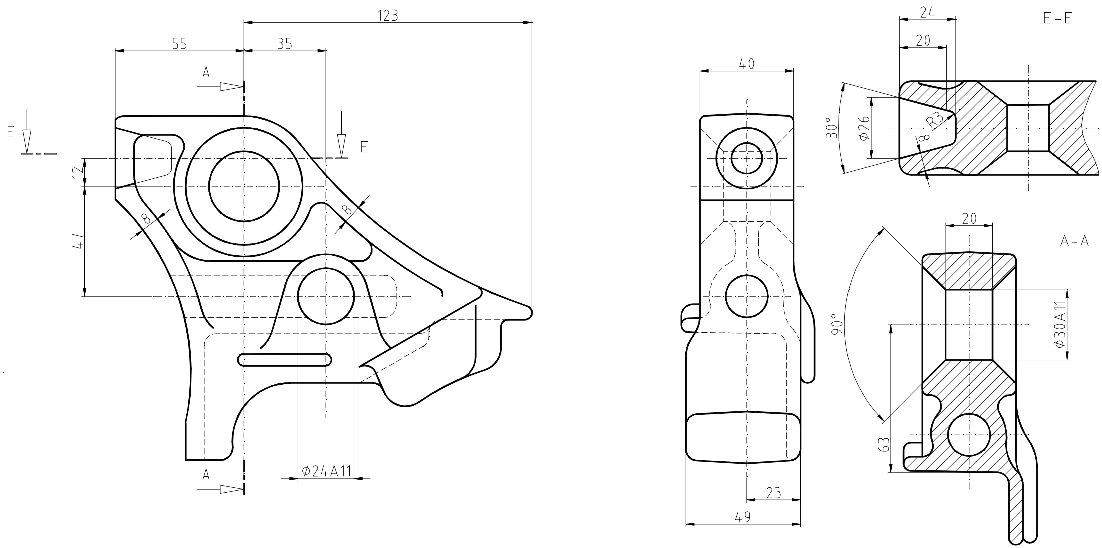


Figure 4.18 Front mounting support BM 408 (left version; welded onto the frame) MB-Nr. 408 317 00 42

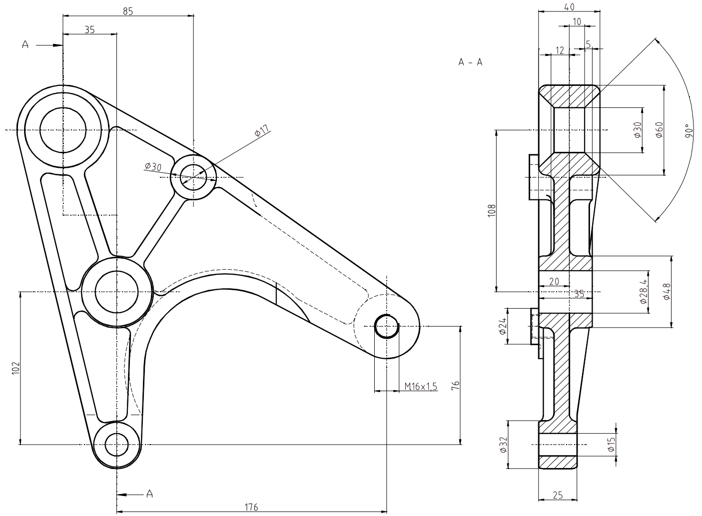


Figure 4.19 Front mounting support BM 418 (right version) MB-Nr. A 418 317 16 42

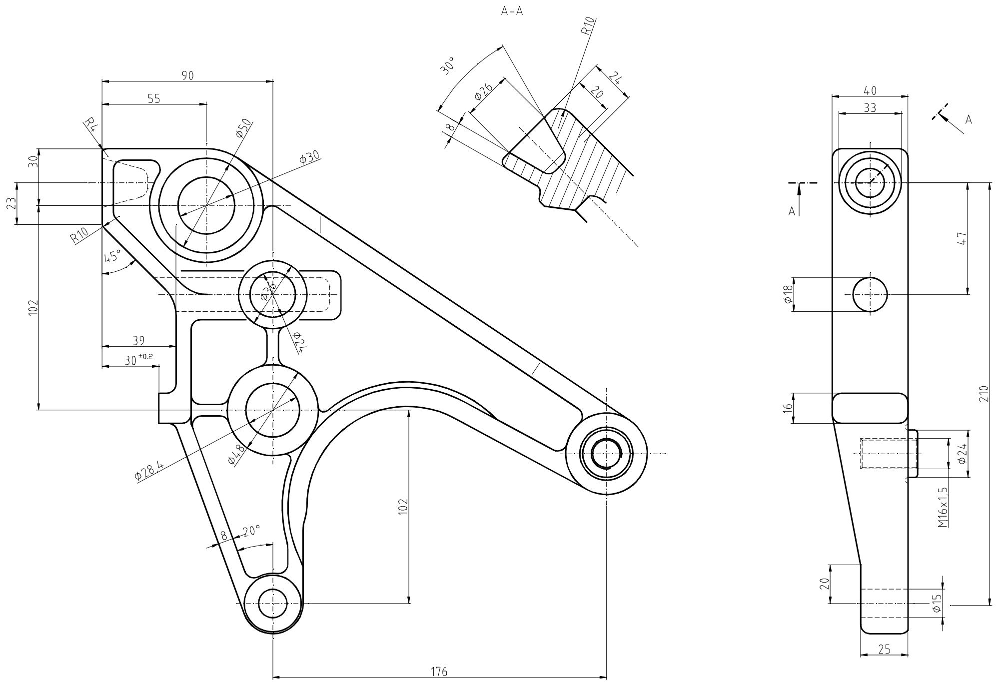


Figure 4.20 Front mounting support BM 418 (left version) MB-Nr. A 418 317 15 42

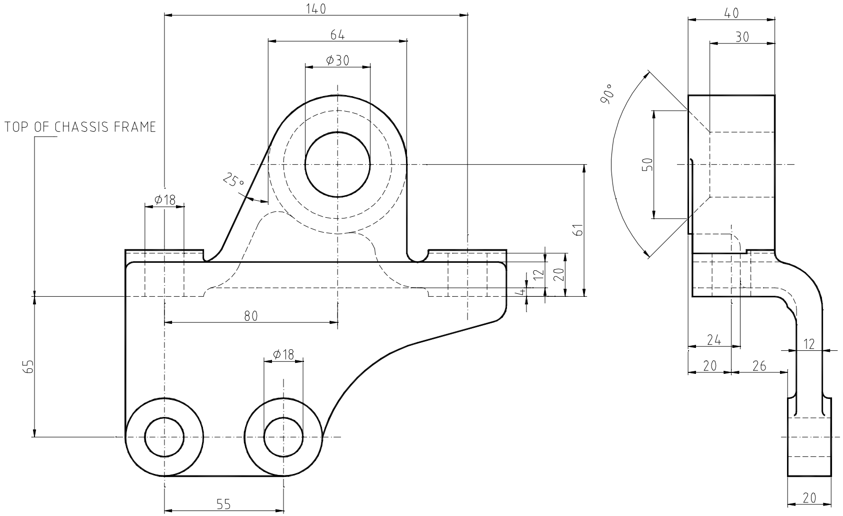


Figure 4.21 Front mounting support BM 427 (right version) MB-Nr. A 424 552 02 18

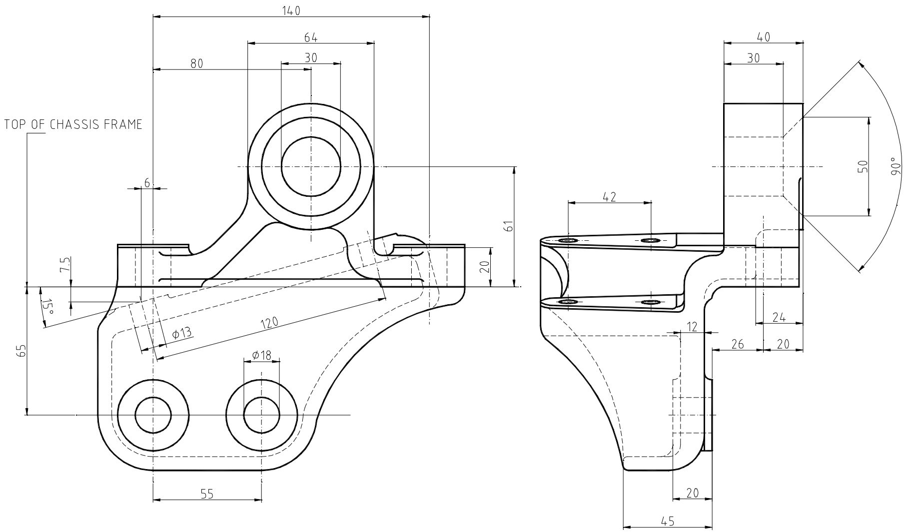


Figure 4.22 Front mounting support BM 427 (left version) MB-Nr. A 424 552 01 18

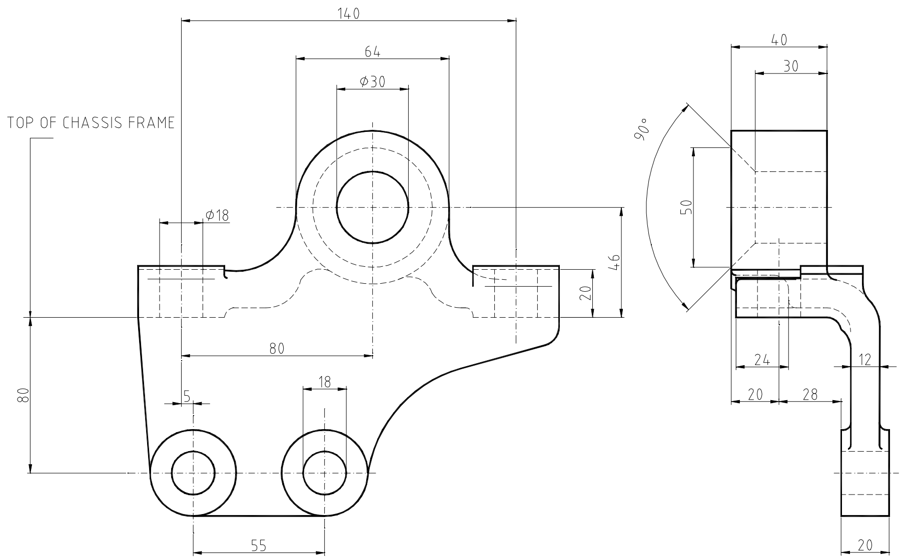


Figure 4.23 Front mounting support BM 437 (right version) MB-Nr. A 425 552 07 18

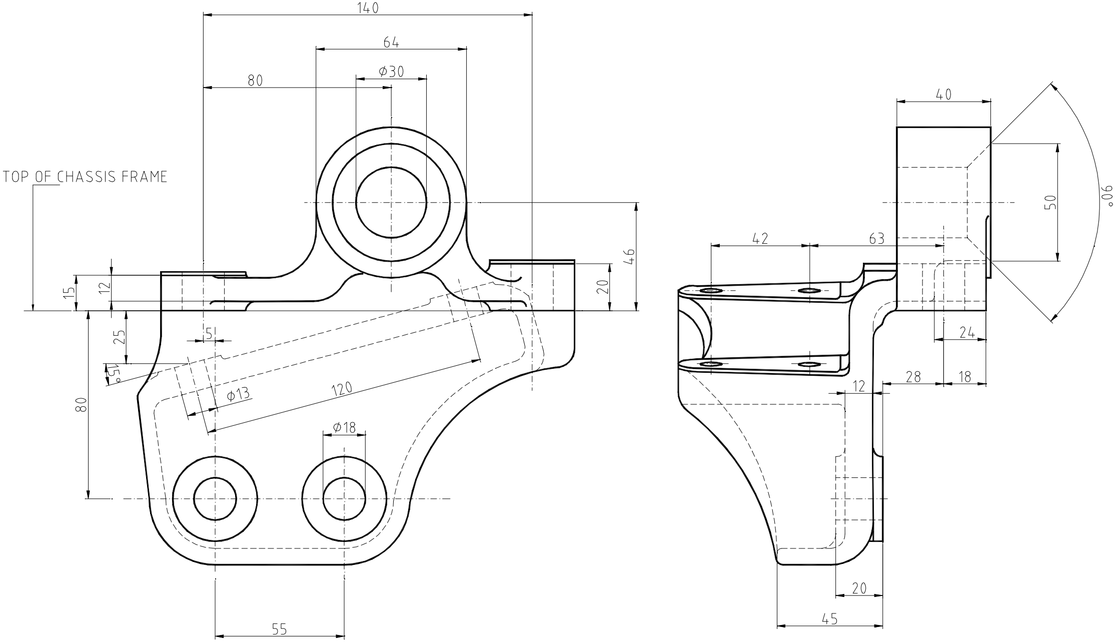


Figure 4.24 Front mounting support BM 437 (left version) MB-Nr. A 425 552 06 18

4.11.3 Cable winch bracket for front cable winch

Special mounting points which have been developed for the use of cable winches are available for mounting front cable winches (code D35). The forces resulting from the operation of the front cable winch are passed into the frame via these mounting points.

Overview of front cable winch brackets (code D35)

Vehicle	Left cable winch bracket	Right cable winch bracket
408.100 U90 408.101 U90 Turbo 408.215/216 U100L/Turbo (only with mounting supports D61)	418 566 00 40	408 566 00 40
418.102 U130 418.117 U140L (only with front mounting supports D10) 418.217 U140L (only with front mounting supports D10)	418 566 00 40	418 566 01 40
427.000 U1400T 427.102 U1400 427.111 U1450L 427.112 U1450	425 566 00 04 * * is bolted onto front mounting support code D10	424 566 00 04 * * is bolted onto front mounting support code D10
427.105 U1600 427.107 U1600(214) 427.115 U1650 427.116 U1650L 427.117 U1650(214) 427.118 U1650L(214)	427 566 00 40 * * is bolted onto front mounting support code D10	427 566 01 40 * * is bolted onto front mounting support code D10

Vehicle	Left cable winch bracket	Right cable winch bracket
437.111 with C 46 (Belgium)	435 566 02 04 without frame insert (185 frame)	435 566 01 04 without frame insert (185 frame)
437.111 U1550L 437.116 U1550L(214) 437.141 U1550L hose carriage	435 566 02 04 and 435 553 01 38 (frame insert) (165 frame)	435 566 01 04 and 435 553 00 38 (frame insert) (165 frame)
437.111/116 with D10+ X18/19/20	425 566 00 04 without frame insert (185 frame)	425 566 01 04 without frame insert (185 frame)
all others 437	425 566 00 04	425 566 01 04

The interface dimensions (cable winch/ vehicle) are universal in the Unimog 408/418/427 and 437 series.
For detailed information, the relevant mounting drawings (AO) may be requested from PBU/TES:

BM	AO
408	408 000 05 99
418	418 000 05 99
427	427 000 00 56
437.111/116/141 without X18/19/20	435 000 00 55
all others 437	425 000 03 55

4.11.4 Front power lifter

In the case of LBU/MBU, the front power lifter is attached to the front mounting plate and is not available as optional equipment ex-works.
In the heavy series (SBU), the front power lifter is integrated into the vehicle and can be obtained as optional equipment (code H60).

Front power lifter table

Vehicle / type designation	Model	Front power lifter		
Tractor and operating unit short and long wheelbase		Lifting power in *N*	Double acting cylinder	Mounting dimensions
U 90 Turbo	BM 408.101	*	Yes	*
U 130	BM 418.102	*	Yes	*
U 1400 / U 1450	BM 427.102 / BM 427.112	18000	Yes	according to cat.II
U 1600 / U 1650	BM 427.105 / BM 427.115	18000	Yes	according to cat.II
U 1600 (214) / U 1650 (214)	BM 427.107 / BM 427.117	18000	Yes	according to cat.II
U 2100 / U 2150	BM 437.105 / BM 437.117	18000	Yes	according to cat.II
U 2400 / U 2450	BM 437.105 / BM 437.117	18000	Yes	according to cat.II
UNIMOG chassis L variation				
U 100 L Turbo	BM 408.216	----	----	----
U 140 L	BM 418.117	----	----	----
U 1450 L	BM 427.111	18000	Yes	according to cat.II
U 1550 L / U 1550 L/37	BM 437.111 / BM 437.120	----	----	----
U 1550 L (214) / U 1550 L/37 (214)	BM 437.116 / BM 437.125	----	----	----
U 1650 L / U 1650 L (214)	BM 427.116 / BM 427.118	18000	Yes	according to cat.II
U 2150 L / U 2150 L/38	BM 437.118 / BM 437.136	18000	Yes	according to cat.II
U 2450 L / U 2450 L/38	BM 437.118 / BM 437.136	18000	Yes	according to cat.II
UNIMOG driving units				
U 1400 T	BM 427.000	18000	Yes	according to cat.II
U 2100 T	BM 437.002	18000	Yes	according to cat.II
** not available as optional equipment from DaimlerCrysler AG, manufacturer e.g. BAAS, mounting on front mounting plate*				

Figure 4.25 Table Lifting power of the front power lifters

4.11.5 Front loader

Front loader fittings and bearers are required to pass force into the frame when a front loader is mounted. If necessary, approved and tested types must be used. New adaptation/review is no longer carried out due to the comprehensive testing required (approx. 500 hours).

4.11.6 Front end dimensions

Front end dimension data are provided in the following. Due to the different vehicle combinations, these dimensions cannot be provided for every vehicle combination. The values stated are reference values and can, in the majority of cases, be transferred to other vehicle combinations. In the event of further questions, please contact DaimlerCrysler AG in Gaggenau

Telefax:	**07225- 61 5512**
Postal address:	**DaimlerCrysler AG,**
	Department PBU/TES
	HPC 268
	D-76568 Gaggenau.

4.11.6.1 Front end dimensions in the various models

Model	Dimension A	Dimension B	Dimension C
408	820	714	810±30*
418	872	725	900±60*
427[1)]	1080	365	900±60*
437[2)]	1110	365	980±60*

1) FAP size 3
2) FAP size 5

* Dimension "C" depends on the tyres and the available front and rear axle load,.see Chap. 5.2.6.3

Position 1: Coupling level, FE/UE stop pouch

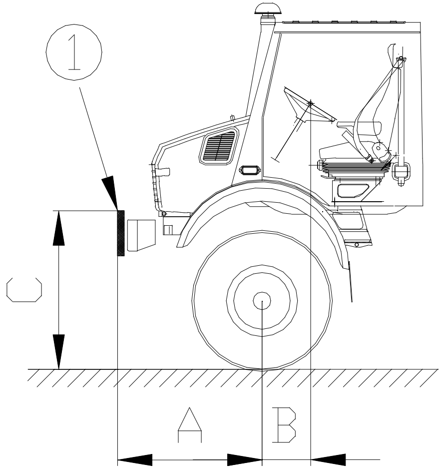


Figure 4.26 Front end dimensions

4.12 Center body

4.12.1 General notes regarding the center body

Torsion-proof bodies must not influence the torsional flexion capability of the UNIMOG chassis frame. They must be connected to the chassis in a torsional flexion-capable manner in accordance with the stipulations of the Implement Mounting Directive. To achieve this, fixed bearings and pivot bearings are used. A pivot bearing is a bearing which absorbs force in the vehicle transverse direction
(y direction) and in the vertical direction (z direction), but which can be moved (pivoted) (around the x axis) in the vehicle longitudinal direction. The geometrically optimum position of the pivot bearing is in the center of the frame at the level of the upper edge of the frame longitudinal member (instantaneous center of rotation of movement on torsional flexion).

There are five possible methods of using the **CENTER** body space in the Unimog:

- Mounting on the platform, see 4.12.4
- Mounting on the platform subframe
- Mounting on the center mounting points, see 4.12.8
- Mounting on the fastening parts for third-party bodies, see 4.12.10
- Mounting on the floor assembly for special bodies, see 4.12.12

In the case of heavy bodies, especially if the implement is able to lift the vehicle via outriggers, the center mounting points (code D60) are used for fastening the front pivot bearing of the 2x3-point mounting, the bearing bushings and bearing shells from the fastening parts for third-party bodies (code D65) are the center fixed bearings and a transverse member with a bearing point is the rear pivot bearing (see implement example 4.12.8).

4.12.2 Torsional flexion/relative movement/clearance to vehicle components

The free movement and functional safety of the body must also be guaranteed in the case of maximum torsional flexion. See also Chapter 4.2 "General notes", "Torsional flexion capability of the chassis frame" section.
As regards the constructive design of a body, the necessary clearances can be calculated approximately with the formulae in Figure 4.27.

On construction of a body, attention must be paid, as early as during the design stage, to the availability of sufficient clearance to vehicle components and to the fact that the accessibility of checking and maintenance points (e.g. brake fluid reservoir) is not impaired by the implement or body. The accessibility of these points may be solved via a cut-out in the body/implement or via a flap in the floor of the body. In the event of questions, please contact Department PBU/TES.

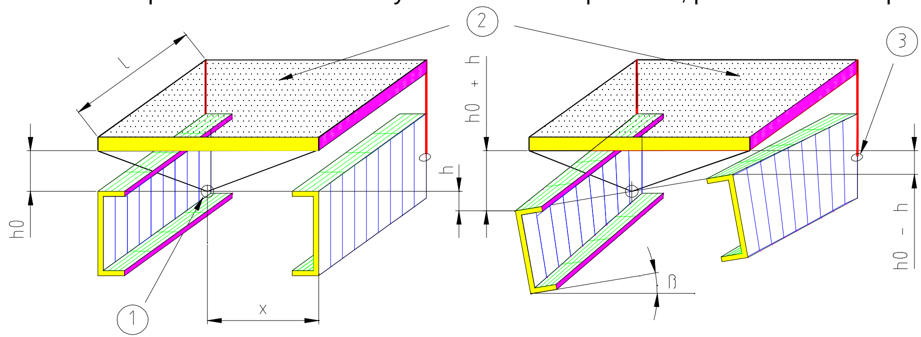


Figure 4.27 Relative movement on torsional flexion

Figure 4.28 Relative movement in the 3-point mounting

h = Relative movement in millimeters

$$\boxed{h = x \cdot \tan\beta}$$

Formula 4.12.2.1 Torsional flexion travel

β = Torsional flexion in degrees

Positions:

1: Center bearing (pivot bearing)

x = Distance to the center of the vehicle in millimeters

$$\boxed{\begin{array}{l} \beta = l \cdot \dfrac{4^\circ}{m} \\ l \quad \text{in} \quad \text{Meter} \end{array}}$$

Formula 4.12.2.1 Angle of torsional flexion

2: Implement basic frame (torsional flexion-proof)

l = Distance from outer bearing to center bearing in meters (in vehicle longitudinal direction)

3: Outer bearing (fixed bearing)

Note: Instantaneous center of rotation at the level of the upper edge of the frame (Experimental value; geometrically ideal position of the center bearing).

4.12.3 3-point mounting / torsional flexion-capable 4-point mounting (2 x 3-point mounting)

Depending on the type of vehicle, the center body is to be equipped with 3-point mounting or equally torsional flexion-capable 4-point mounting (2x3-point mounting). Two points must be designed as fixed bearings, the other points are pivotable bearings. No other mountings are permissible. The bearing designs in the following table must be complied with:

Vehicle type	3-point mounting	2x3-point mounting
U 90 Turbo	X	
U 100 L Turbo		X
U 130	X	
U 140 L		X
U 1400 / U 1600	X	
U 1450 / U 1650		X
U 1450 L / U 1650 L		X
U 1550 L		X
U 1550 L/37		X
U 1550 L/37 crewcab (code F07)	X	
U 2100 / U 2400	X	
U 2150 / U 2450		X
U 2150 L / U 2450 L		X
U 2150 L/38 / U 2450 L/38		X
U 2150 L/38 / U 2450 L/38 crewcab (code F07)		X
U 2450 L/6x6		X *)
U 2400 TG	**)	**)

*) And one further pivot bearing (i.e. 2 fixed bearings, 3 pivot bearings)
**) Usual truck body with additional mounting frame

In the simple 3-point mounting, the pivot bearing must basically be positioned at the rear and the two fixed bearings at the front, so that force is passed through the body (e.g. centrifugal forces on cornering) into the center of the vehicle. In the 2x3-point mounting, the fixed bearings must always be positioned in the center.

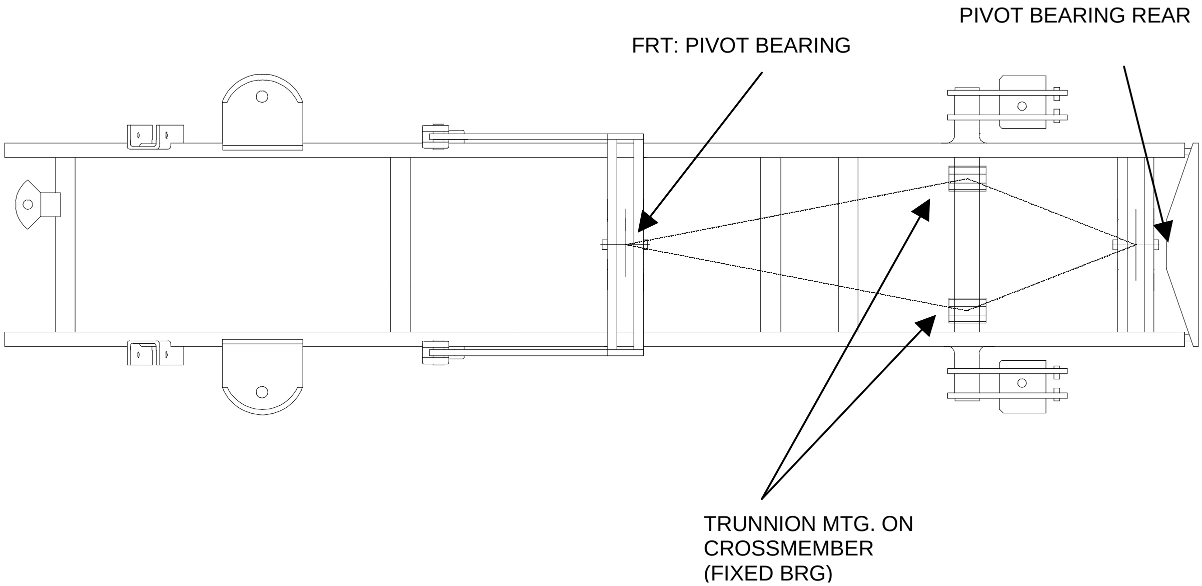


Figure 4.29 Layout of 2 x 3-point mounting

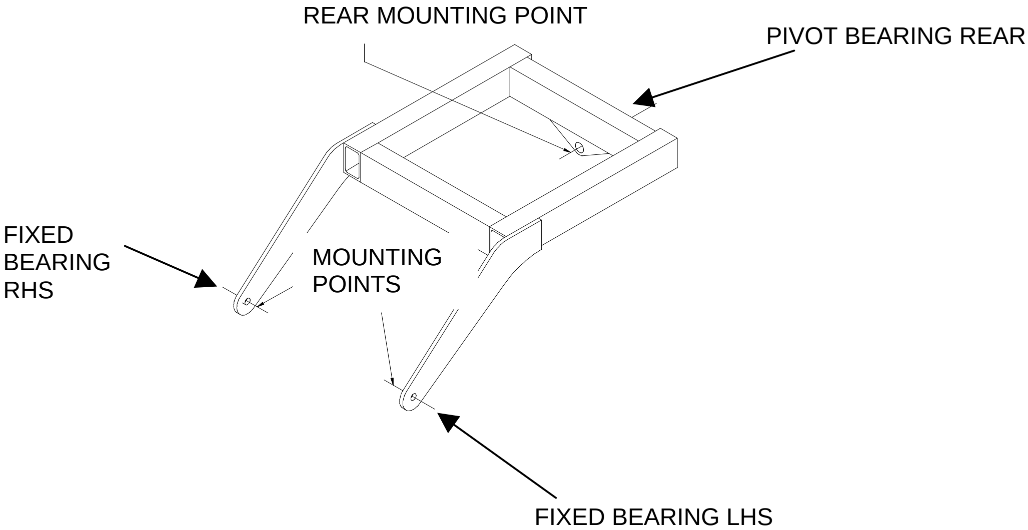


Figure 4.30 Example of the layout of 3-point mounting

4.12.4 Platform body

The body mounting on the platform must be designed by the body manufacturer so that the dynamic load from operating load and transportation (on-road and off-road) can be transferred safely.
In the case of bodies on the platform, mounting points are available in certain platform models
(see Table 4.33).

In the case of a body, the following must be noted:

The **body** must be fastened without play and **so that it cannot move** on the platform and is to be secured **against lifting**. The **transportation position** must be clearly specified, movable implement parts must be tensioned so that they cannot move and mechanically **locked** if possible. On construction, it should be ensured that the body's center of gravity and the resulting overall center of gravity of the vehicle-implement combination are kept as low as possible above the road surface. (For "Determination of the center of gravity" see Chapter 4.7 and ff.).
In order to fasten the body securely on the platform, the forces (static and dynamic) must be calculated and the attachment at the mounting points must be checked. If necessary, mounting points of adequate dimensions must be created on the floor of the platform.
See also Chapter 4.9 "Secure mounting of the implement/ballast on the vehicle".
In all Unimog models with a tipping cylinder, the diameter of the ball at the tipping cylinder/platform hinge point is 35mm.

Explanations regarding Figure 4.31 *"Platform body"*

Attachment at the side may only be carried out in the area of the side hinges. These sites "A" are designed for attachment and prevent the deformation of the platform floor of the side. The sites which are suitable for attachment are marked in
Figure 4.31 with a circle.
Supporting the body in a punctiform manner on the platform may only be carried out at the sites marked "B". At these sites, the body weight forces are passed directly to the platform chassis ball points. In this manner, permanent platform floor deformation is prevented. The platform is only designed for a surface load, such as e.g. that which occurs on transporting sand. If point force is passed outside of the sites marked with "B", the platform may be damaged.

The body manufacturer is responsible for proper stress and strain proportioning and proper execution, testing and the spatial free movement of the body to all vehicle components (including in the event of torsional flexion).

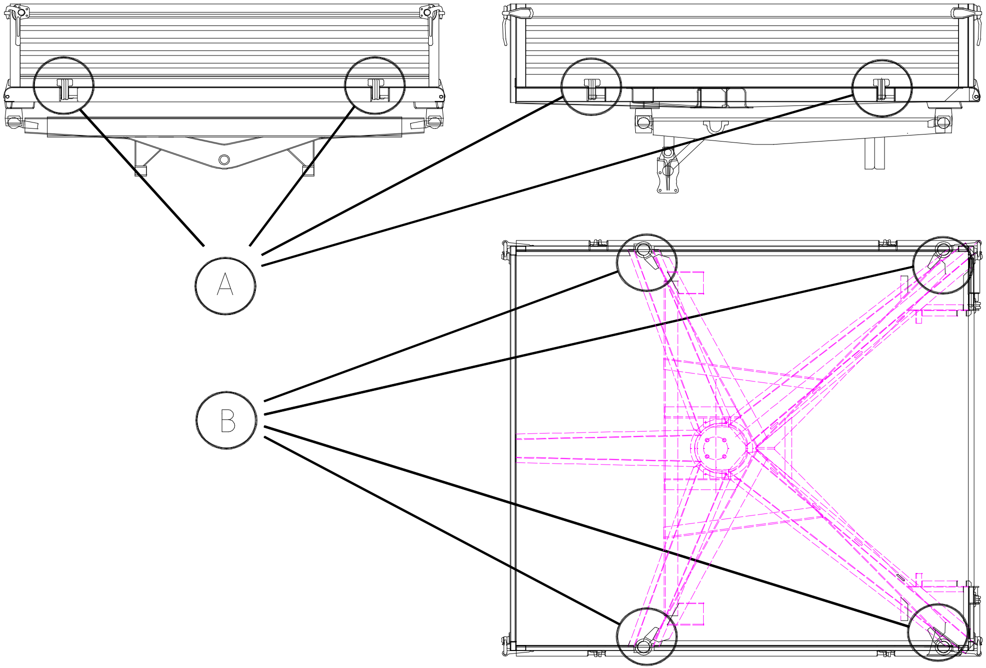


Figure 4.31 Platform body

A Side bearing
B Force passage areas for point loads

4.12.5 Table of platform dimensions

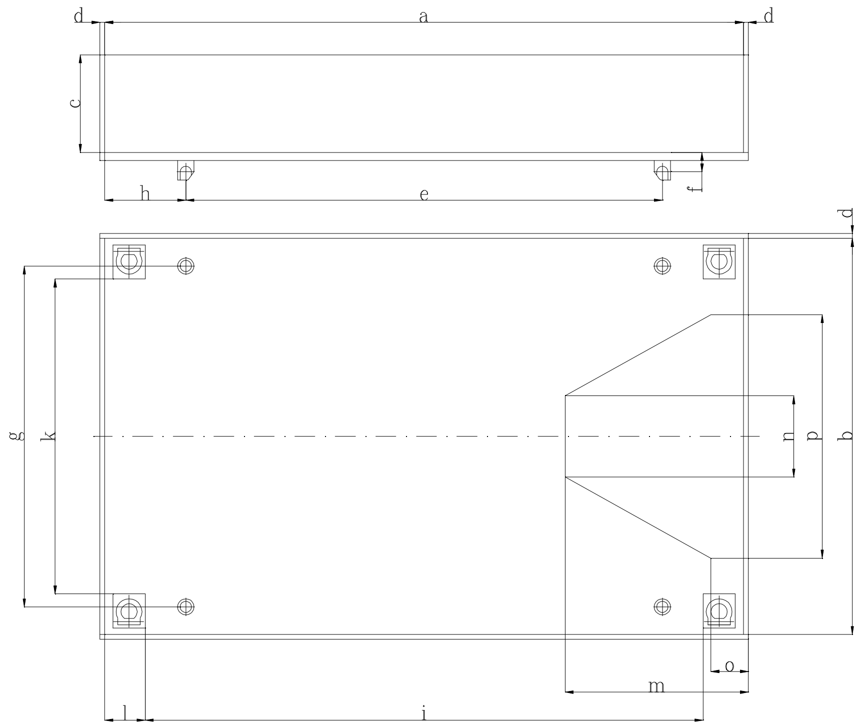


Figure 4.32 Platform dimensions

LBU

Vehicle	Model	SA code	*Dimension* a	*Dimension* b	*Dimension* c	*Dimension* d	*Dimension* e	*Dimension* f	*Dimension* g	*Dimension* h
U 90	408.100	P 09	1750	1700	400	30	1252	120	1630	422
		P 10	1475	1700	400	30	1252	120	1630	147

MBU

Vehicle	Model	SA code	*Dimension* a	*Dimension* b	*Dimension* c	*Dimension* d	*Dimension* e	*Dimension* f	*Dimension* g	*Dimension* h
U 130	418.102	P 11	1475	1890	400	30	1265	93	1840	130
		P 17	1950	1890	400	30	1265	93	1840	605

SBU

Vehicle	Model	SA code	*Dimension* a	*Dimension* b	*Dimension* c	*Dimension* d	*Dimension* e	*Dimension* f	*Dimension* g	*Dimension* h
U 1400	427.102	P 11	1475	1890	400	30	1265	93	1840	130
U 1600	427.105	P 17	1950	1890	400	30	1265	93	1840	605
U 1600 (214)	427.107	P 21	2320	2140	450	30	1540	155	2160	655
U 2100 / U 2400	437.105	P 21	2320	2140	450	30	1540	155	2160	655
U 1450	427.112	P 11	1475	1890	400	30	1265	93	1840	130
U 1650	427.115	P 17	1950	1890	400	30	1265	93	1840	605
U 1650 (214)	427.117	P 21	2320	2140	450	30	1540	155	2160	655
		P 23	2320	1950	400	30	1867	147	1870	409
		P 28	2800	1950	400	30	1867	147	1870	673

All dimensions in mm

SBU

Vehicle	Model	SA code	*Dimension* a	*Dimension* b	*Dimension* c	*Dimension* d	*Dimension* e	*Dimension* f	*Dimension* g	*Dimension* h
U 2150 / U 2450	437.117	13	1680	2140	450	30	1540	155	2160	15
		P 21	2320	2140	450	30	1540	155	2160	655
		M 26	2550	2200	500	30	1785	170	2160	544
		39	3000	2200	500	30	1785	170	2160	734
U 1450 L	427.111	P 11	1475	1890	400	30	1265	93	1840	130
		P 17	1950	1890	400	30	1265	93	1840	605
		P 21	2320	2140	450	30	1540	155	2160	655
U 1550 L	437.111	13	1680	2140	450	30	1540	155	2160	15
U 1550 L (214)	437.116	P 21	2320	2140	450	30	1540	155	2160	655
U 1550 L/ 37	437.120	13	1680	2140	450	30	1540	155	2160	15
U 1550 L/ 37 (214)	437.125	P 21	2320	2140	450	30	1540	155	2160	655
		27	2600	2200	500	30	[1])	[1])	[1])	[1])
		P 42	3800	2200	500	30	[1])	[1])	[1])	[1])
U 1650 L	427.116	P 11	1475	1890	400	30	1265	93	1840	130
U 1650 L (214)	427.118	P 17	1950	1890	400	30	1265	93	1840	605
		P 21	2320	2140	450	30	1540	155	2160	655
U 2150 L / U 2450 L	437.118	13	1680	2140	450	30	1540	155	2160	15
	437.136	P 21	2320	2140	450	30	1540	155	2160	655

All dimensions in mm
[1]) No ball points

LBU

Vehicle	Model	SA code	Mounting eyes *Dimension* i	*Dimension* k	*Dimension* l	Insert floor *Dimension* m	*Dimension* n	*Dimension* o	*Dimension* p	Ball Ø mounting
U 90	408.100	P 09	990	1440	360	620	--	--	1036	47
		P 10	973	1448	100	620	--	--	1036	47

MBU

Vehicle	Model	SA code	*Dimension* i	*Dimension* k	*Dimension* l	*Dimension* m	*Dimension* n	*Dimension* o	*Dimension* p	Ball Ø mounting
U 130	418.102	P 11	1040	1640	155	750	350	320	1205	47
		P 17	1265	1635	410	750	350	320	1205	47

SBU

Vehicle	Model	SA code	*Dimension* i	*Dimension* k	*Dimension* l	*Dimension* m	*Dimension* n	*Dimension* o	*Dimension* p	Ball Ø mounting
U 1400	427.102	P 11	1040	1640	155	750	350	320	1205	47
U 1600	427.105	P 17	1265	1635	410	750	350	320	1205	47
U 1600 (214)	427.107	P 21	[2])	[2])	[2])	999	315	332	1495	60
U 2100 / U 2400	437.105	P 21	[2])	[2])	[2])	999	315	332	1495	60
U 1450	427.112	P 11	1040	1640	155	750	350	320	1205	47
U 1650	427.115	P 17	1265	1635	410	750	350	320	1205	47
U 1650 (214)	427.117	P 21	[2])	[2])	[2])	999	315	332	1495	60
		23	1830	1680	270	515	--	--	1340	60
		28	2080	1660	265	[3])	[3])	[3])	[3])	60

All dimensions in mm
[1]) No ball points
[2]) No mounting eyes
[3]) No insert floor

SBU			Mounting eyes			Insert floor				Ball Ø mounting
Vehicle	**Model**	**SA code**	***Dimension* i**	***Dimension* k**	***Dimension* l**	***Dimension* m**	***Dimension* n**	***Dimension* o**	***Dimension* p**	
U 2150/ 2450	437.117	13	[2])	[2])	[2])	999	315	332	1495	
		P 21	[2])	[2])	[2])	999	315	332	1495	
		P 26	[2])	[2])	[2])	[3])	[3])	[3])	[3])	80
		P 39	[2])	[2])	[2])	[3])	[3])	[3])	[3])	80
U 1450 L	427.111	P 11	1040	1640	155	750	350	320	1205	47
		P 17	1265	1635	410	750	350	320	1205	47
		P 21	[2])	[2])	[2])	999	315	332	1495	60
U 1550 L	437.111	P 13	[2])	[2])	[2])	999	315	332	1495	60
U 1550 L (214)	437.116	P 21	[2])	[2])	[2])	999	315	332	1495	60
U 1550 L/ 37	437.120	P 13	[2])	[2])	[2])	999	315	332	1495	60
U 1550 L/ 37 (214)	437.125	P 21	[2])	[2])	[2])	999	315	332	1495	60
		P 27	[2])	[2])	[2])	[3])	[3])	[3])	[3])	[1])
		P 42	[2])	[2])	[2])	[3])	[3])	[3])	[3])	[1])
U 1650 L	427.116	P 11	1040	1640	155	750	350	320	1205	47
U 1650 L (214)	427.118	P 17	1265	1635	410	750	350	320	1205	47
		P 21	[2])	[2])	[2])	999	315	332	1495	60
U 2150 L / U 2450 L	437.118	P 13	[2])	[2])	[2])	999	315	332	1495	60
	437.136	P 21	[2])	[2])	[2])	999	315	332	1495	60

All dimensions in mm
[1]) No ball points
[2]) No mounting eyes
[3]) No insert floor

Figure 4.33 Table "Overview of platform dimensions"

4.12.6 Body on the platform chassis

Ball points and ball half shells (for position and size see Table 4.33) serve for mounting the platform on the chassis.
If an implement is mounted on the chassis in the same manner - ball points on the platform chassis and implement subframe, ball half shells on the implement - it must be ensured that there is sufficient clearance between the ball half shell and ball yoke (see sketch).
The load on the balls must not exceed the load which results from a platform which is loaded to its maximum permissible value.

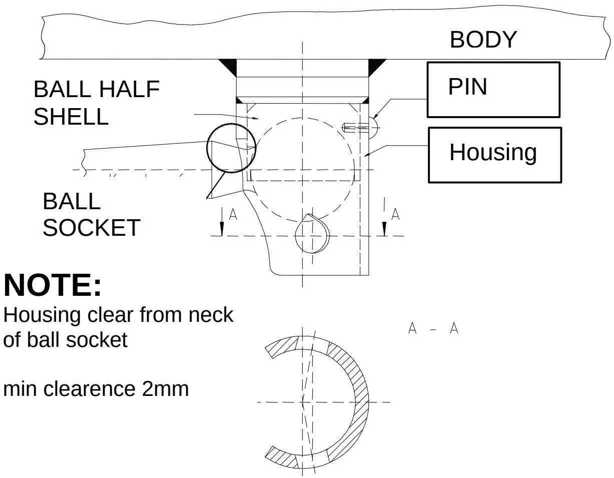


Figure 4.34 Body plan at the subframe

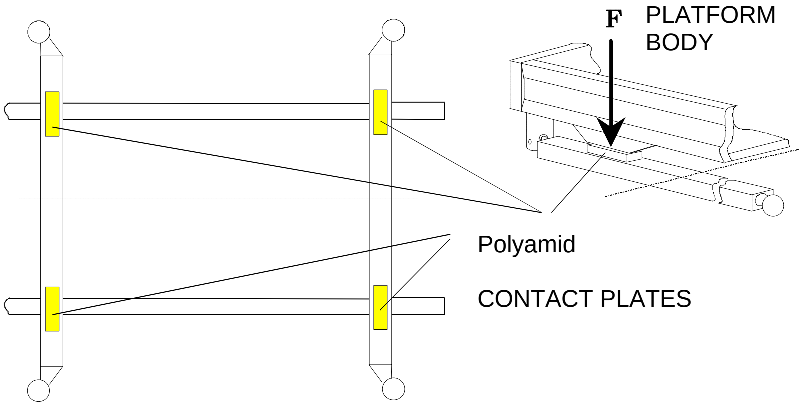
A unilateral load on the subframe must be avoided.

The following parts are available as RP for BM 418/427:

Tipping shell	418 615 00 75
Ball half shell	406 615 54 75
Locking pin with chain	408 610 00 32

Note:

Polyamide plates can be found on the platform subframe transverse members (see Figure 4.35).
The plates serve to pass load peaks from the body, which are caused by driving dynamic influences e.g. vertical forces when driving over an obstacle, rolling, transverse acceleration, etc., directly into the vehicle frame, thereby relieving the load on the ball points.
The distance is to be selected so that, at maximum permissible load, the implement frame lies flat on the polyamide plates (see Figure 4.35).



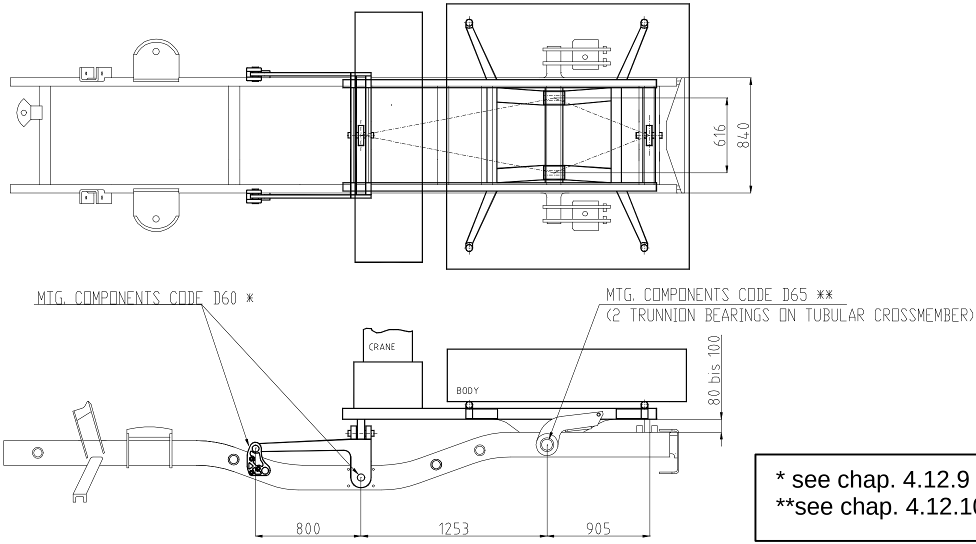
The body must be secured (without play) against lifting .
In accordance with the platform, the implement frame must run on bearings on the platform chassis.

Figure 4.35 Platform subframe with polyamide plates

4.12.7 Boom mower mounted on the platform

In the case of platform mounting, it must be ensured that the implement and ballast etc. are sufficiently secured against slipping and lifting. To do this, the implement subframe is "tensioned" via the ball points of the platform chassis on the platform. On using the implement, the boom torque is passed directly to the rear wheels via a wheel support (which is to be disconnected during transportation). In this case, the permissible operating position of the boom must be transverse to the direction of travel.
If the mower boom is extended, this may not be swung over the rear of the vehicle, as the platform subframe is otherwise overloaded due to the passage of excessive force into the rear platform balls (wheel support is not effective when the boom is in this position).

4.12.8 Implement examples for center body



* see chap. 4.12.9
**see chap. 4.12.10

Figure 4.36 Implement proposal for a center body in U 2150L, torsional flexion-capable 4-point mounting

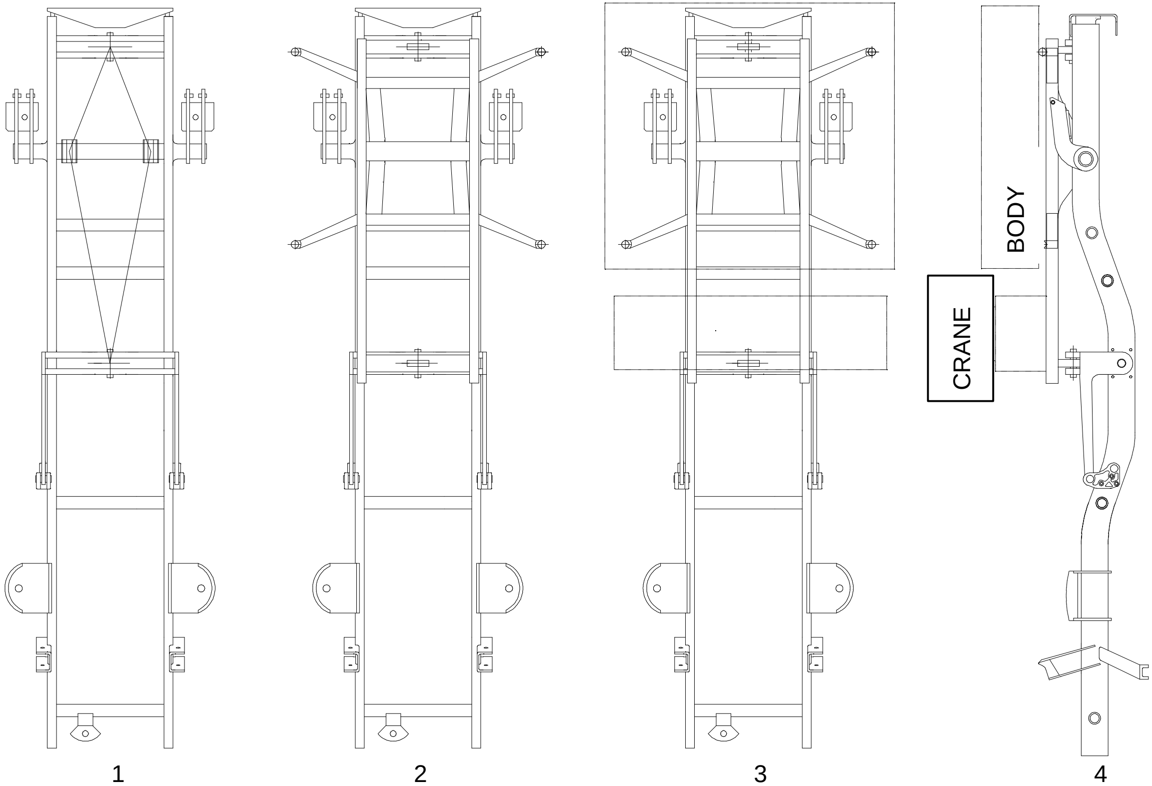


Figure 4.37 Schematic layout of a center implement (parts layout in stages)

Explanation of the illustration

1 Position 1 shows a frame with prepared 2 x 3-point mounting and the layout of the 2 x 3-point mounting.

2 Position 2 shows the layout with the subframe.

3 Position 3 shows the example of a crane which is mounted in the center of the subframe in front of the platform.

4 Position 4 shows a left side view of the layout of Position 3.

4.12.9 Center implement points (code D60)

The "center implement points" for the conventional models are listed in the following. These illustrations and schematic drawings serve to explain the position of the implement points on the frame. The version and layout of the implement points depend on the load value stage (code X18 / X19 / X20) of the vehicle.
The implement points are in the optimum positions for torsional flexion. An implement or body in the center of the chassis frame may only be installed at these defined points.

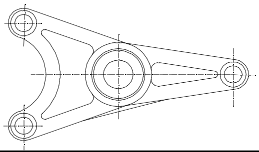
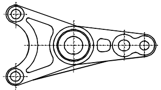
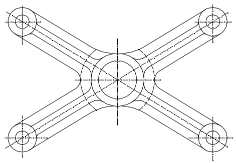
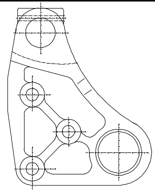
								
Version	right	left	right	left	right	left	right	left
MB number	A 424 551 07 21	A 424 551 07 21	A 427 551 03 21	A 427 551 03 21	A 425 551 12 21	A 425 551 12 21	A 425 551 13 21	A 425 551 13 21
UNIMOG-Model								
BM 408 [1]			X [2]	X [2]				
BM 418			X	X				
BM 427			X [3] [4] [5]	X [3] [4] [5]				
BM 437	X [7]	X [7]			X [6]	X [6]	X [6]	X [6]

Figure 4.38 Table Arrangement of the center implement points

Explanations:

1) Bushings are welded into the frame
2) Only in U100L Turbo, BM 408.216, with code D61
3) Not with code X18/19/20 up to construction year 12/95, in these types, bushings are welded into the frames.
4) From construction year 01/96 also in types with code X18/19/20
5) Bushings welded in at front, mounting support bolted on at rear
6) Not with code X18/19/20 and with U2150L/38, U2450L/38 and U2450L/6x6, in these types, bushings are welded into the frame.
7) Only in U1550L and U1550L/37

Center mounting support

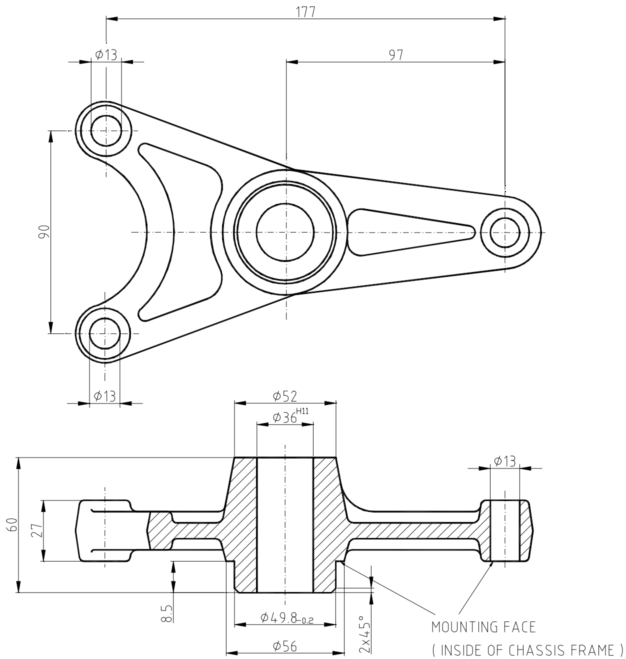


Figure 4.39 Center mounting support parts number: A 424 551 07 21

Center mounting support

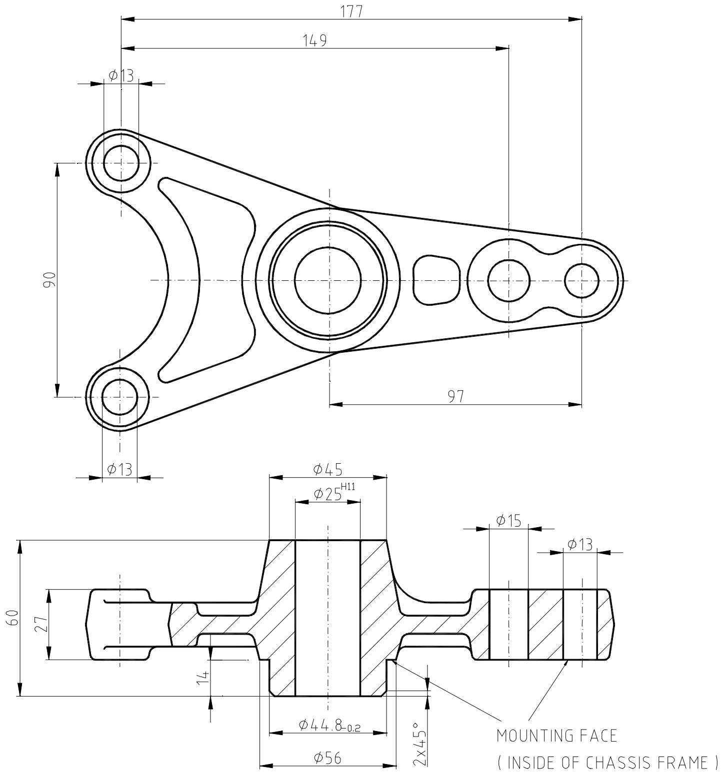


Figure 4.40 Center mounting support parts number: A 427 551 03 21

Center mounting support

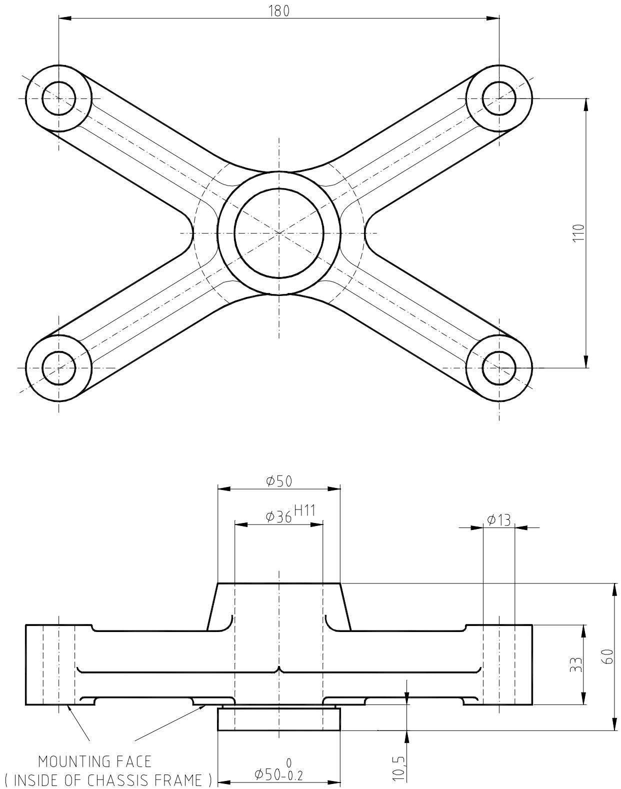


Figure 4.41 Center mounting support parts number: A 425 551 12 21

Center mounting support

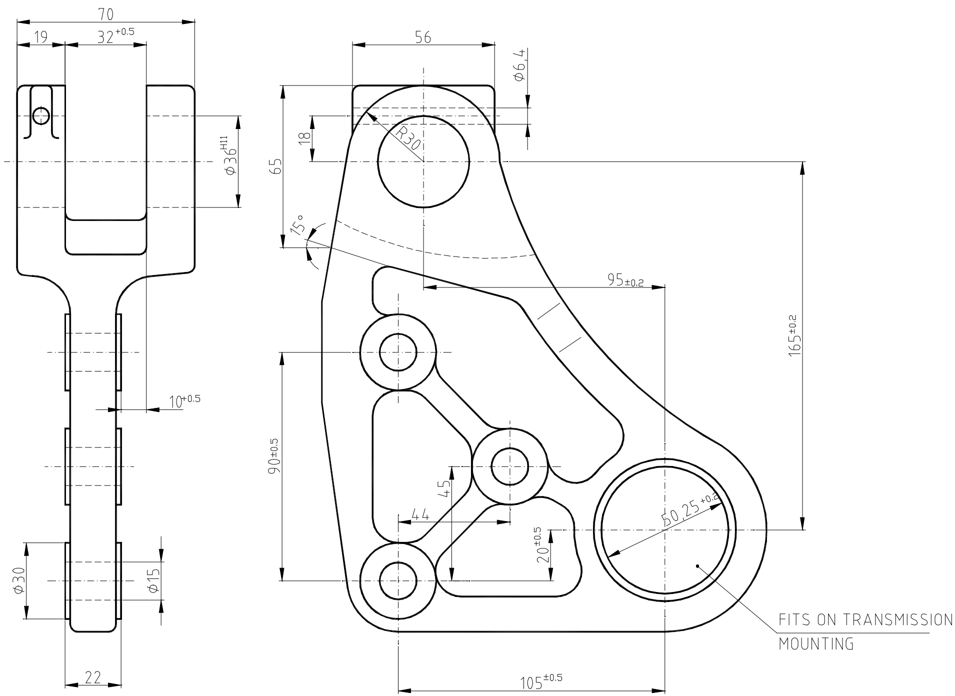


Figure 4.42 Center mounting support parts number: A 425 551 13 21

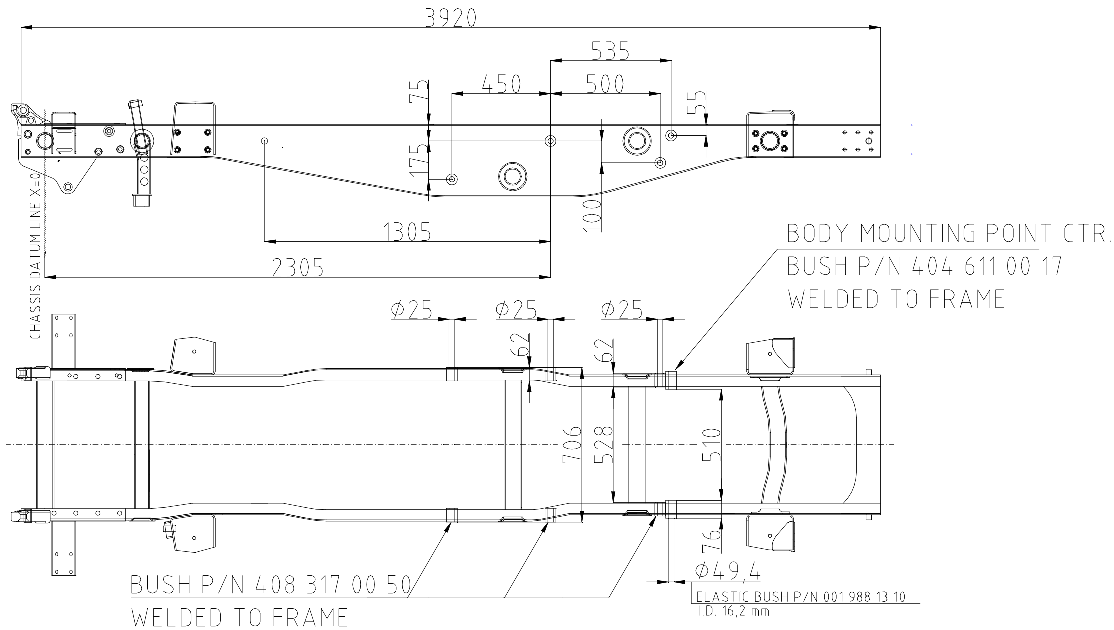


Figure 4.43 Center implement points, frame U 90 Turbo, BM 408.101 (standard, bushings welded in)

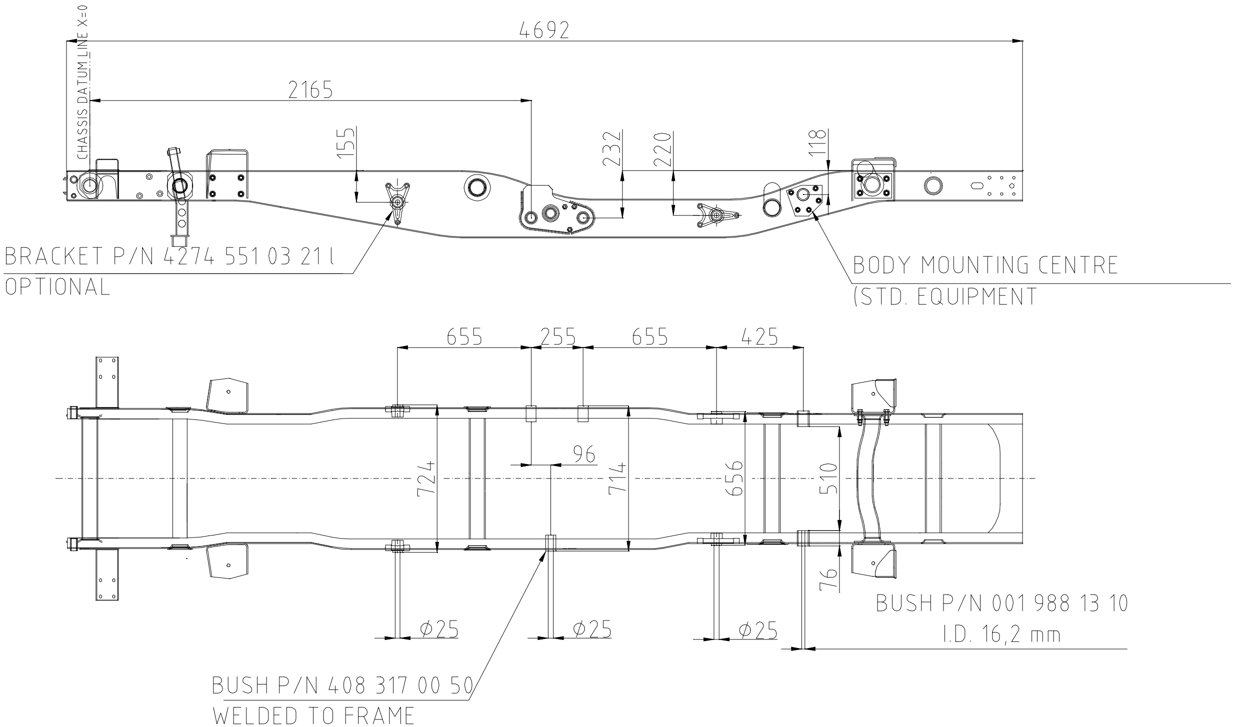


Figure 4.44 Center implement points, frame U100L Turbo, BM 408.216 (code D61, 3 bushings welded in and 2 mounting supports 427 551 03 21)

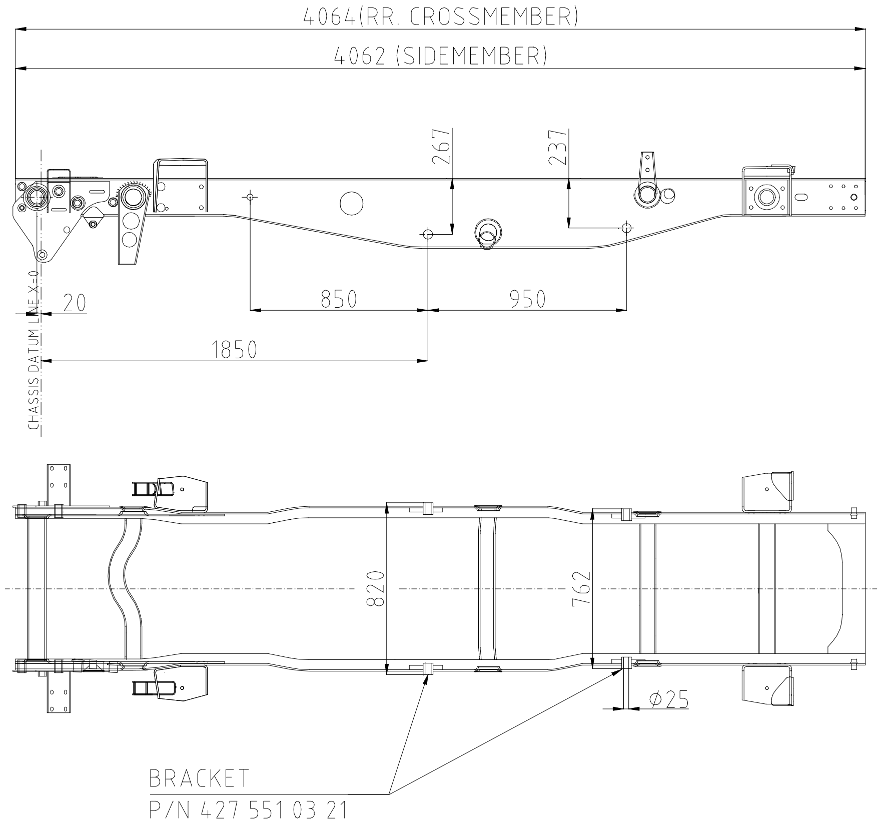


Figure 4.45 Center implement points, frame U130, BM 418.102 (code D60, 4 mounting supports 427 551 03 21)

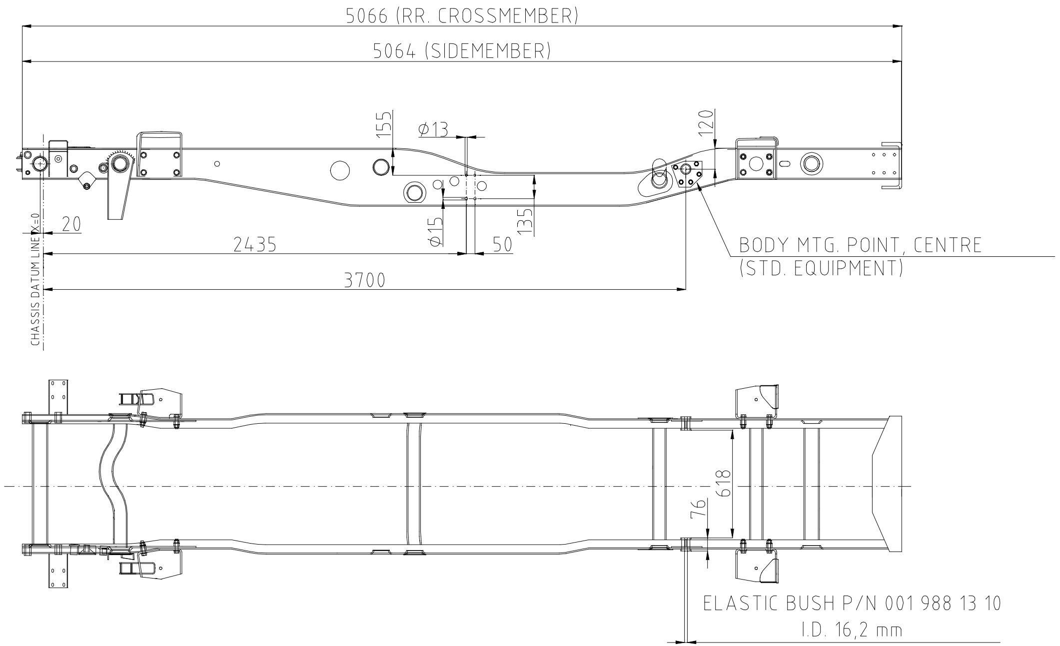


Figure 4.46 Center implement points, frame U140L , BM 418.117

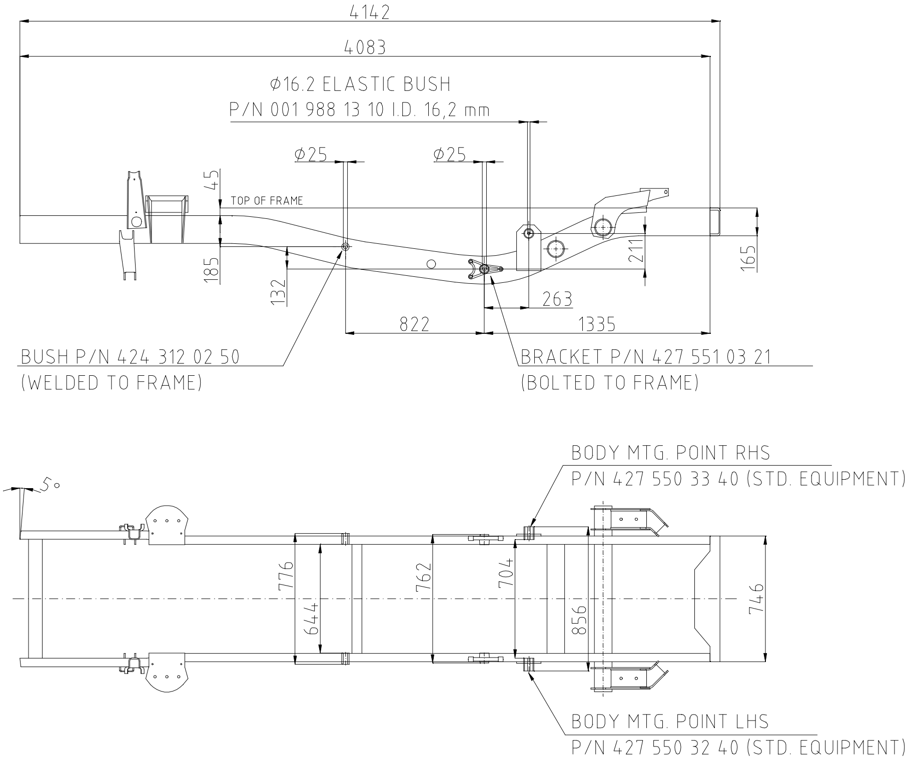


Figure 4.47 Center implement points, frame in U 1400/U 1600/U 1600 (214), BM 427.102/105/107, with code D60 (in U 1400 with code X19 and in U1600/1600(214), BM 427.105/107 the outer side of the frame is equipped with a reinforcement plate, without influence on the implement dimensions)

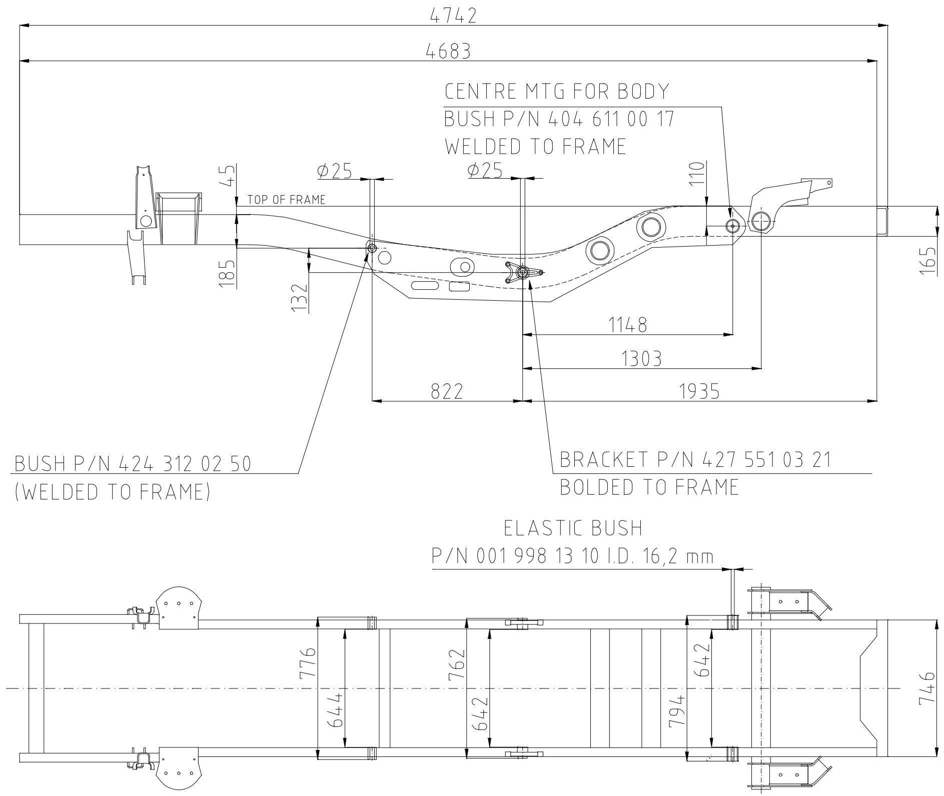


Figure 4.48 Center implement points, frame in U 1450/ U 1650/ U 1650 (214), BM 427.112/115/117 with code D60

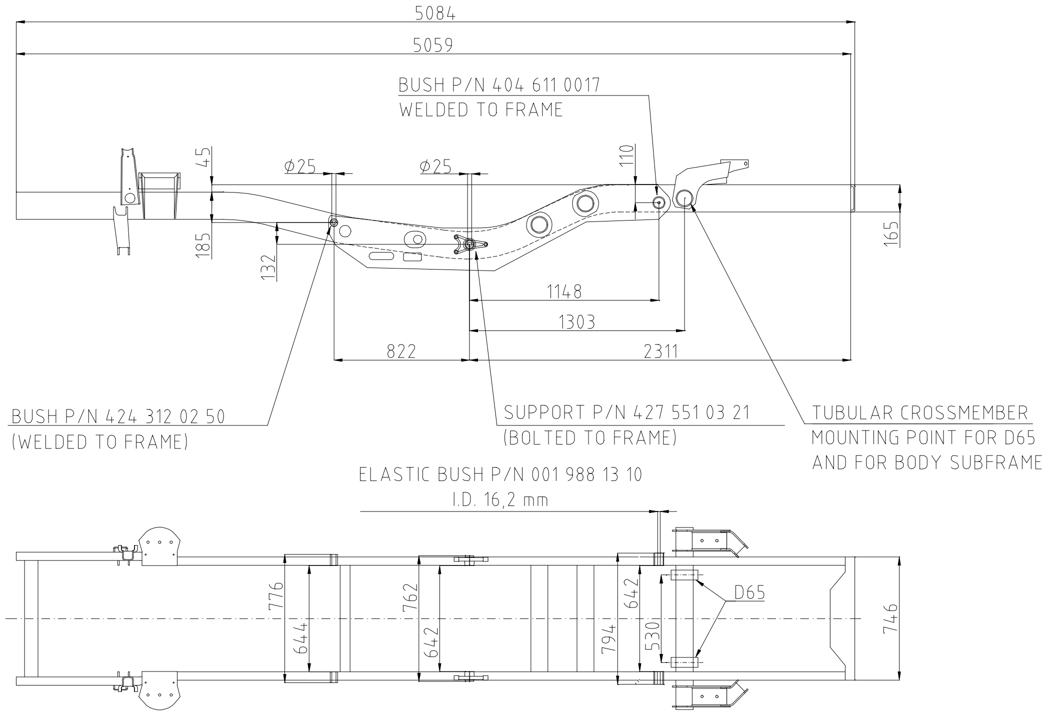


Figure 4.49 Center implement points, frame in U 1450L/U 1650L/U 1650L (214), BM 427.111/116/118 with code D60

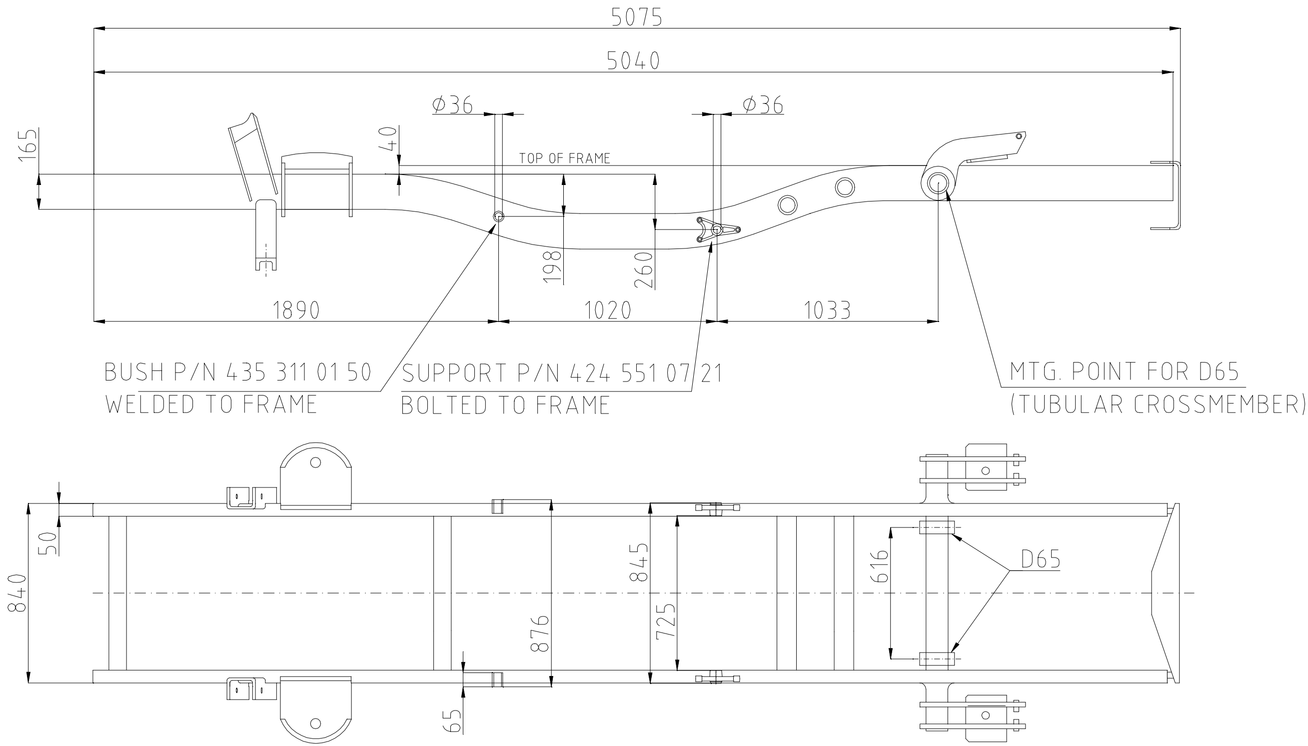


Figure 4.50 Center implement points, frame U 1550L (code D60), BM 437.111/116, with code C01 frame for implement, not with code X18/19/20

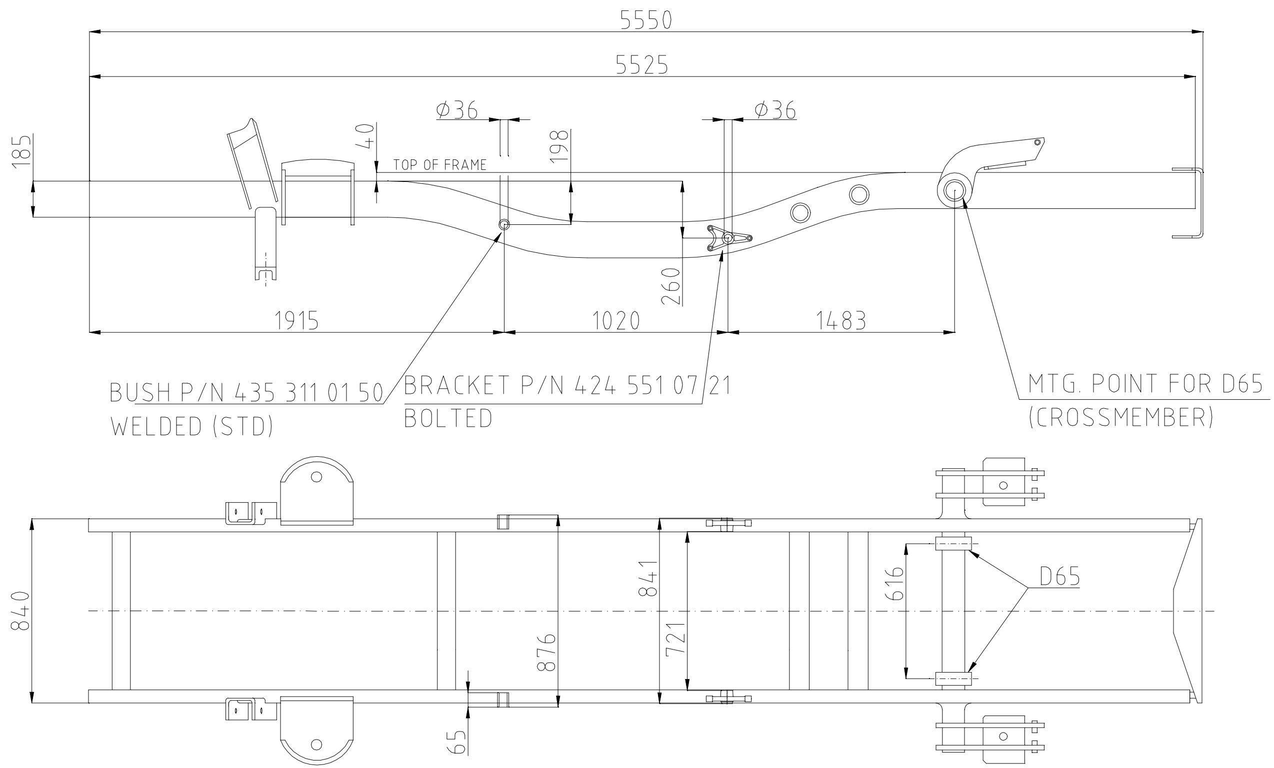


Figure 4.51 Center implement points, frame U 1550L/ 37 (code D60), BM 437.120/125

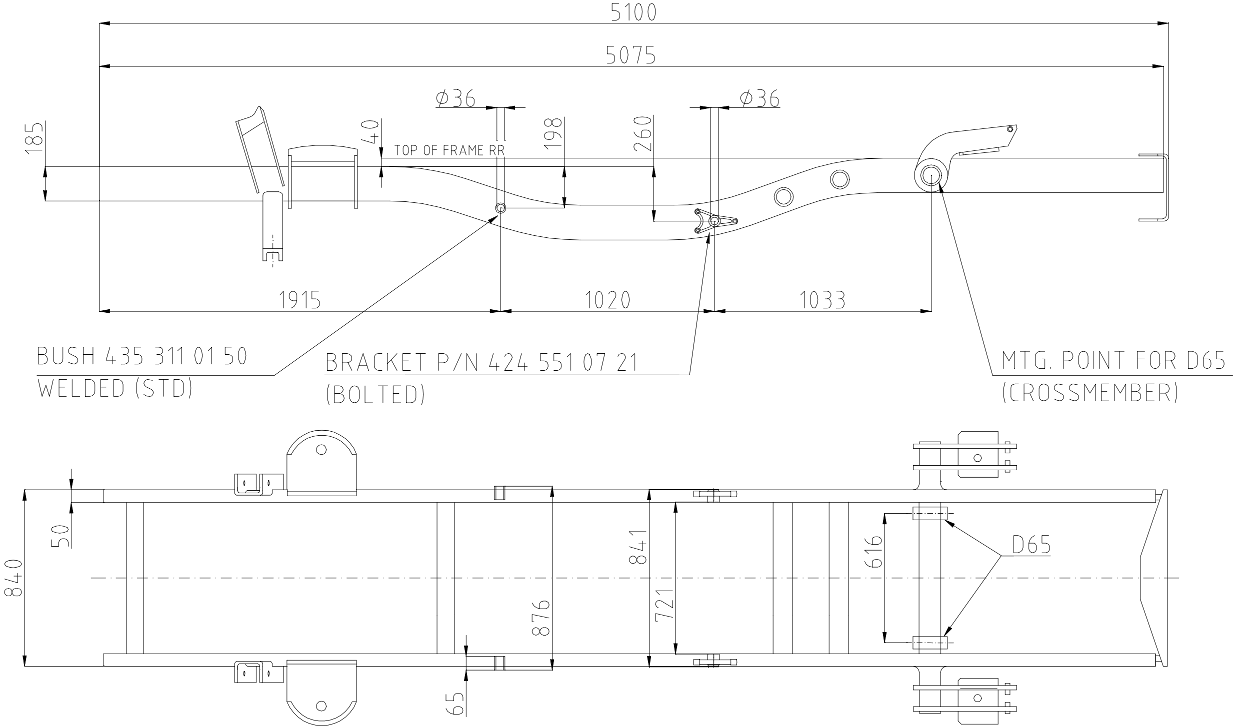


Figure 4.52 Center implement points, frame in U 1550L, 437.111/116, with code X18/ 19/ 20

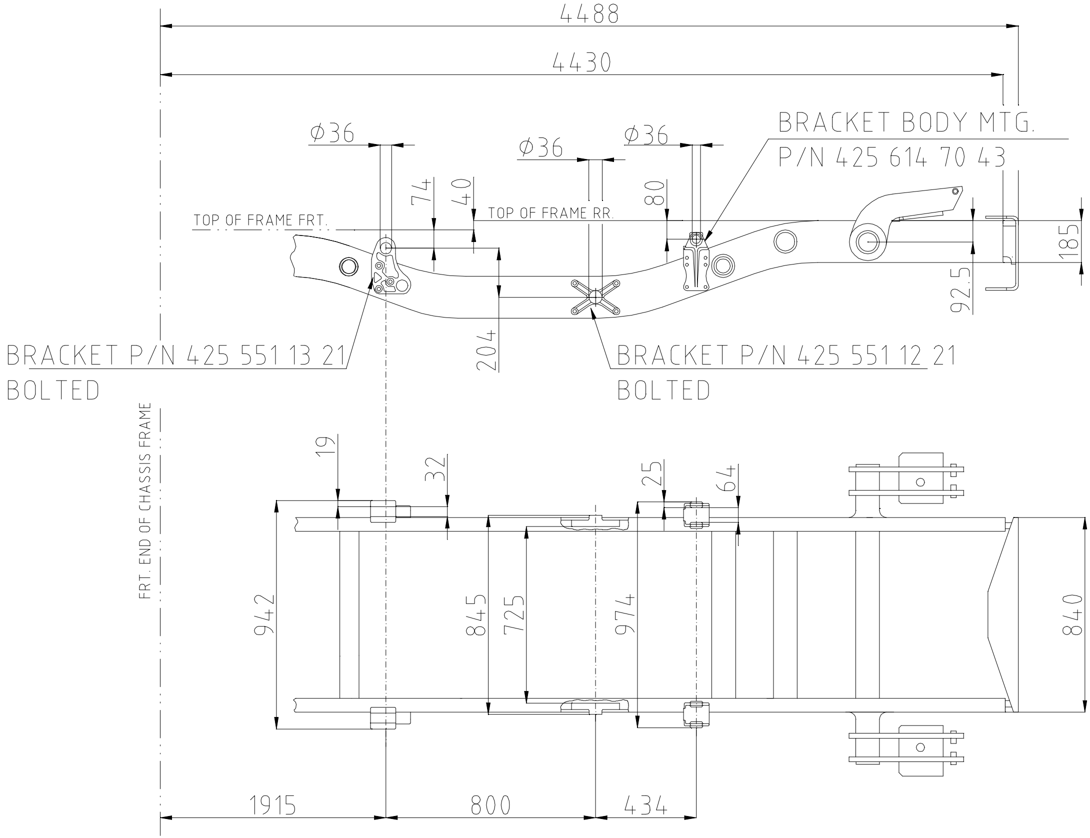


Figure 4.53 Center implement points, frame in U 2100/ 2400, BM 437.105, with code D60

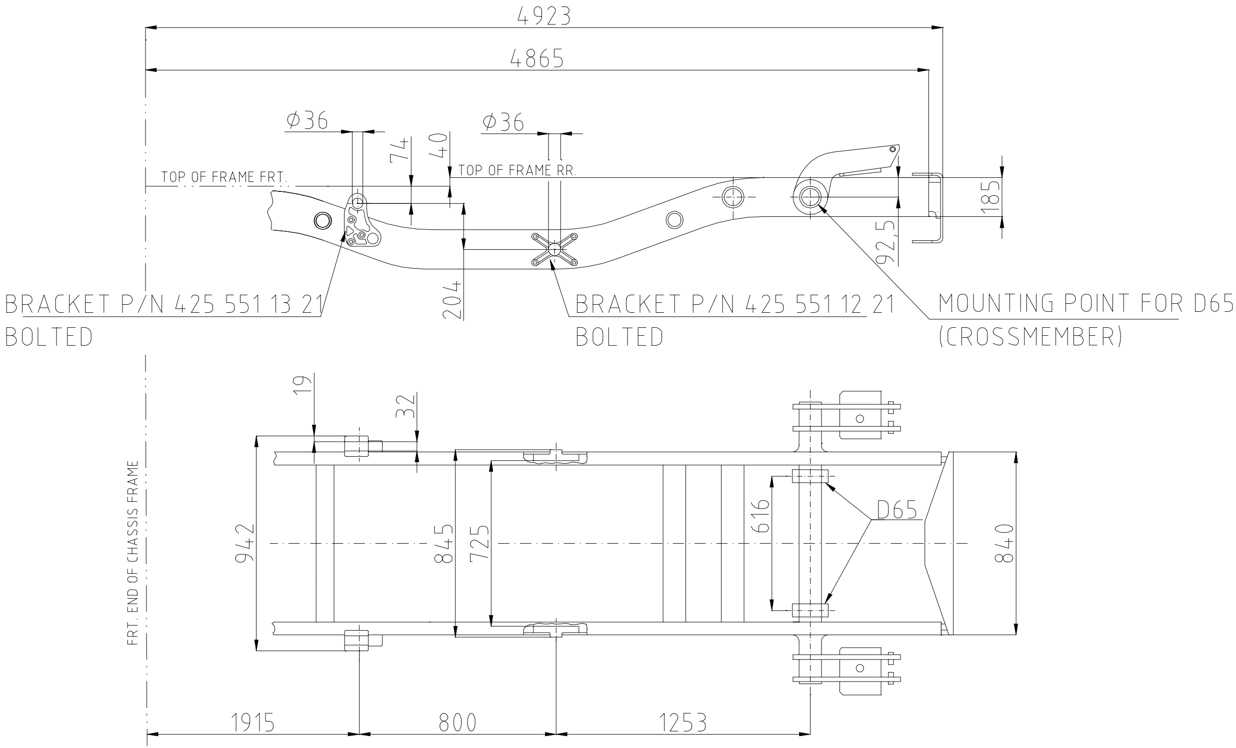


Figure 4.54 Center implement points, frame in U 2150/ 2450, BM 437.117, with code D60, not in X19

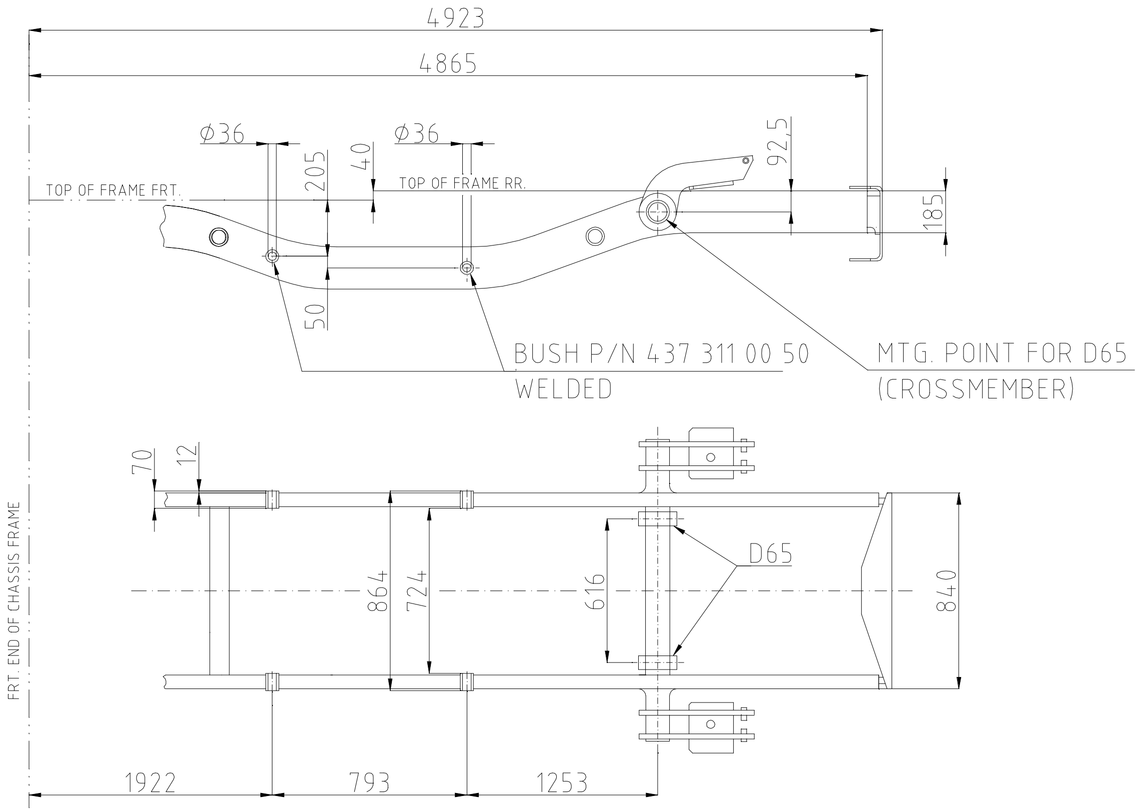


Figure 4.55 Center implement points, frame in U 2150/ 2450, BM 437.117 with code X19

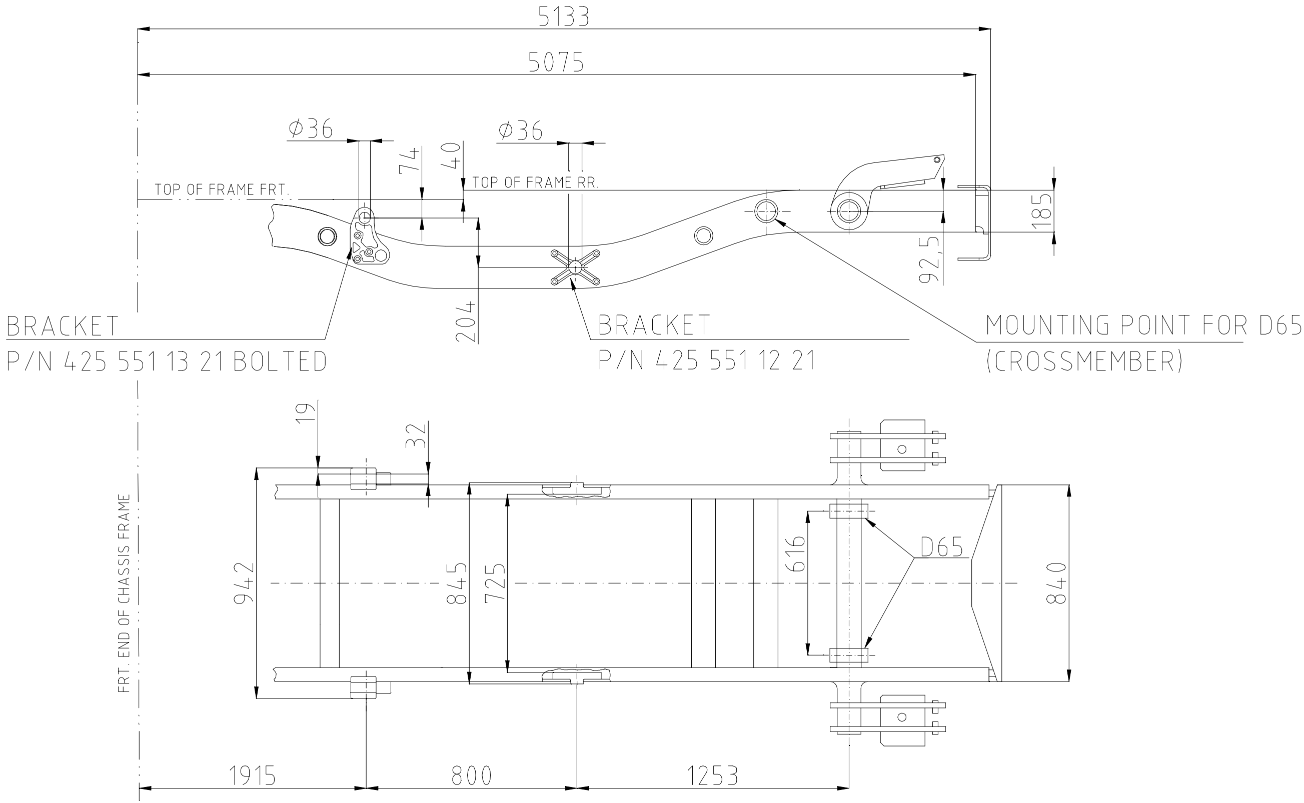


Figure 4.56 Center implement points, frame in U 2150L/ 2450L, BM 437.118, with code D60, not in X19

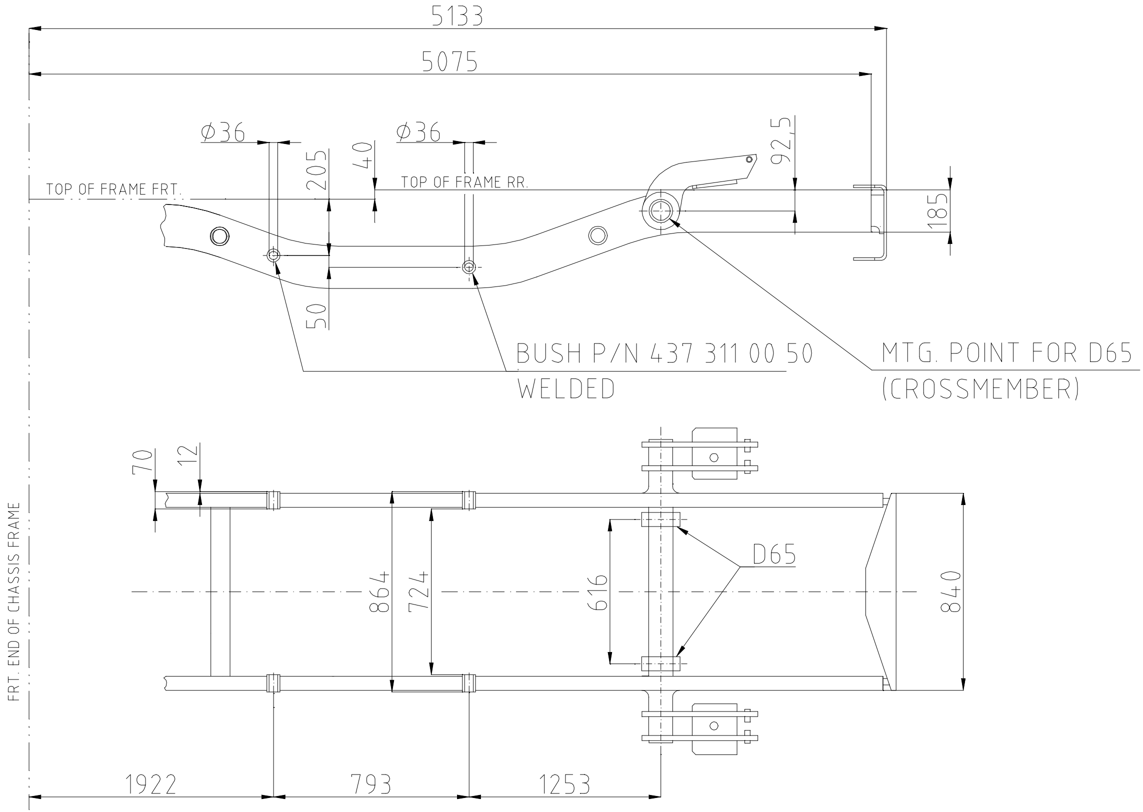


Figure 4.57 Center implement points, frame in U 2150L/ 2450L, BM 437.118 with code X19

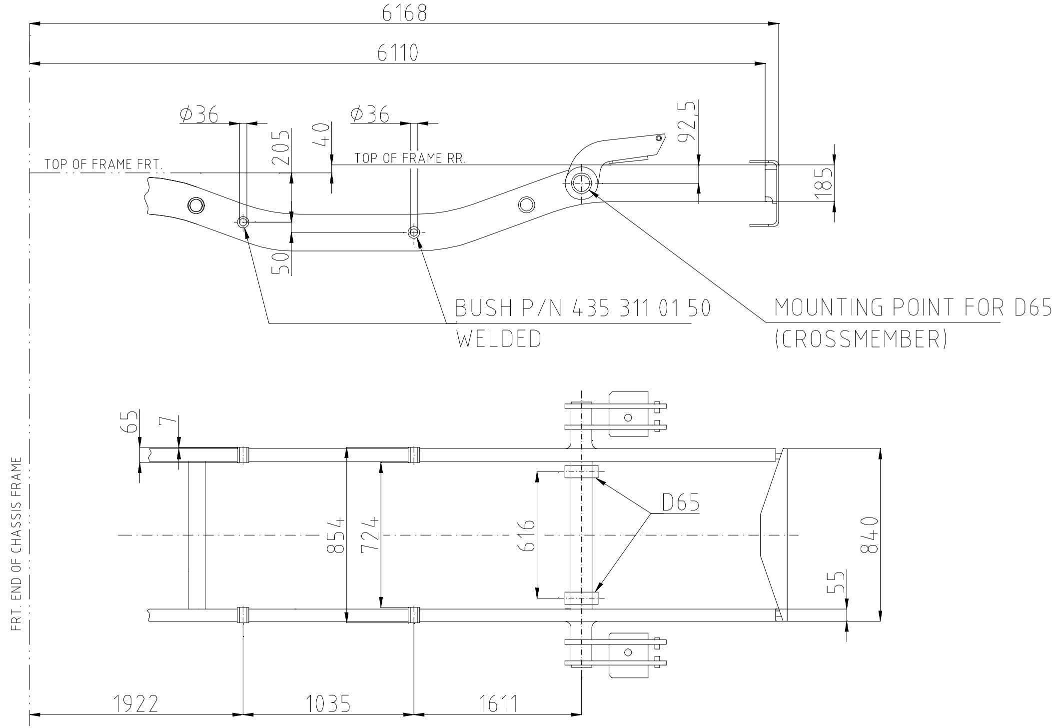


Figure 4.58 Center implement points, frame in U 2150L/ 38 and U 2450L/ 38, BM 437.136 (standard)

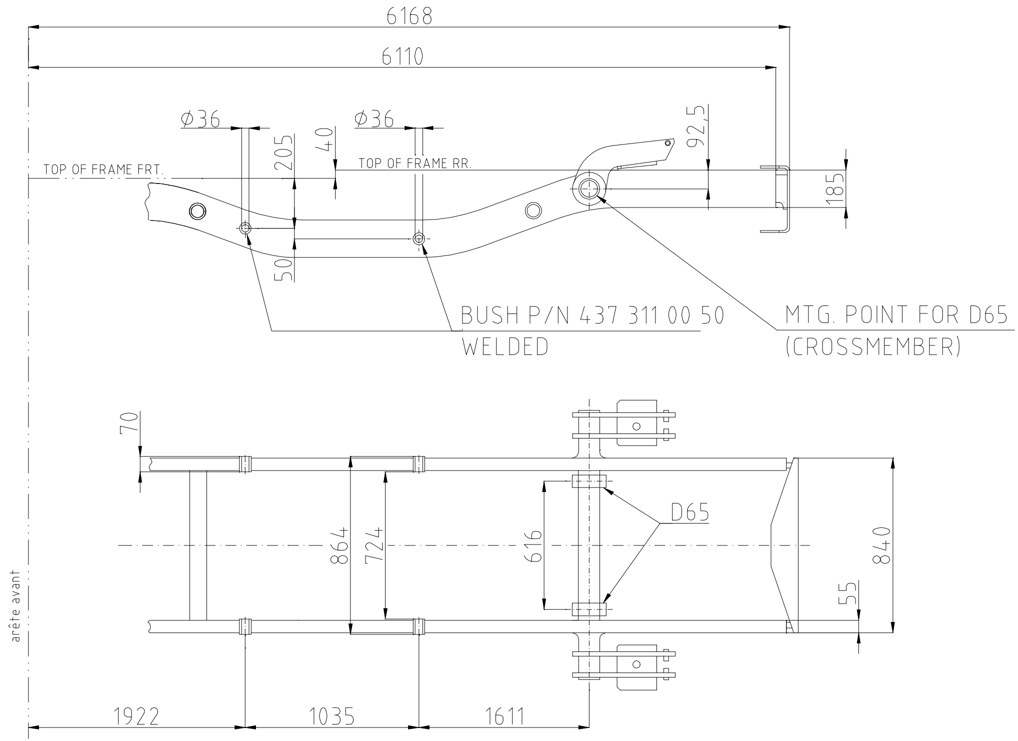


Figure 4.58 Implement mounting points centre (code D60) of Chassis U 2150/2450, BM 437.136 with code X19

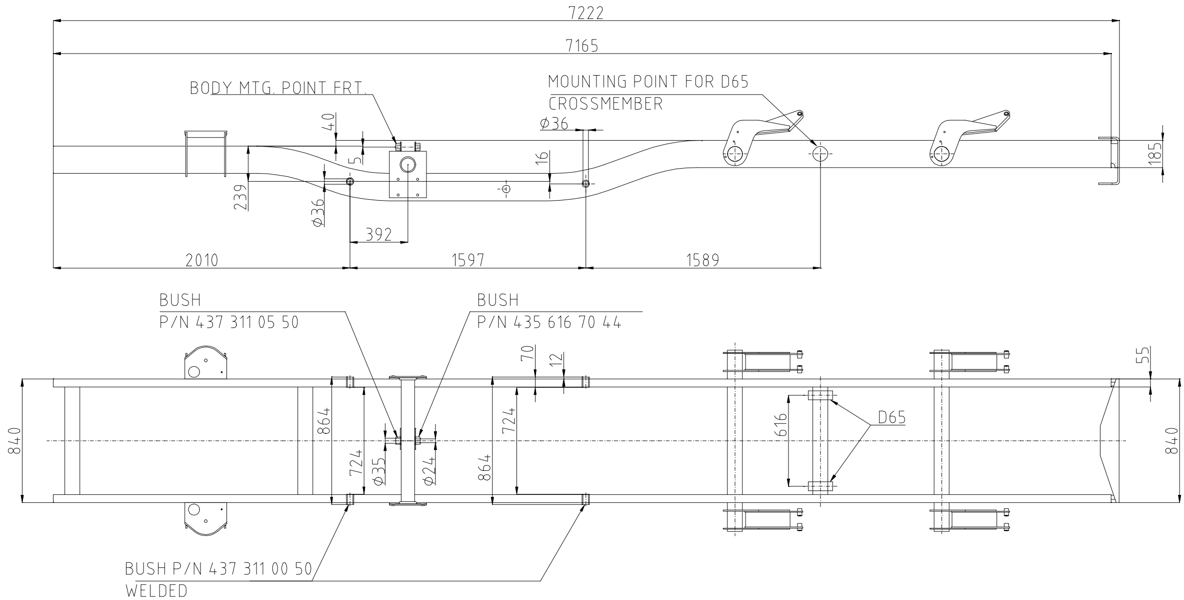


Figure 4.59 Center implement points, frame U 2450L/ 6x6, BM 437.156 (standard)

4.12.10 Fastening parts for third-party bodies (code D65)

For bodies such as, e.g. fire brigade box bodies with their own floor assembly, in which the *floor assembly for special bodies* (code P61) available ex-works is not used, the *fastening parts for third-party bodies* (code D65) must be used.

In the case of heavy bodies (BM427/437), which are fastened to the center implement points at the front (code D60), we recommend that bearing shells corresponding to code D65 be used for the center fixed bearings.

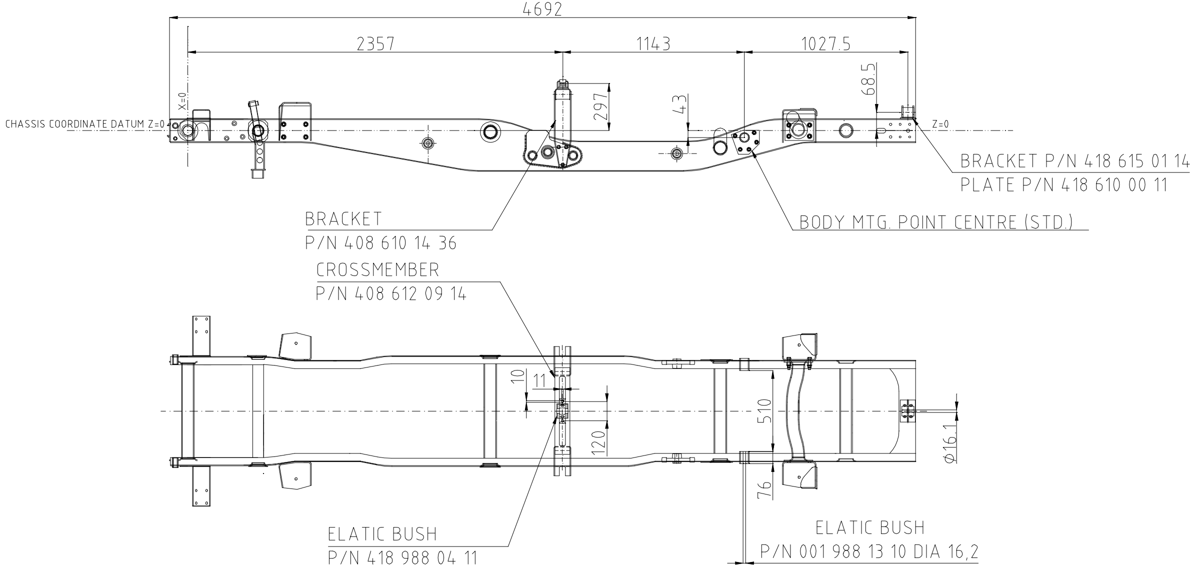


Figure 4.60 Fastening parts for third-party bodies U 100L Turbo BM 408.216 (code D65)

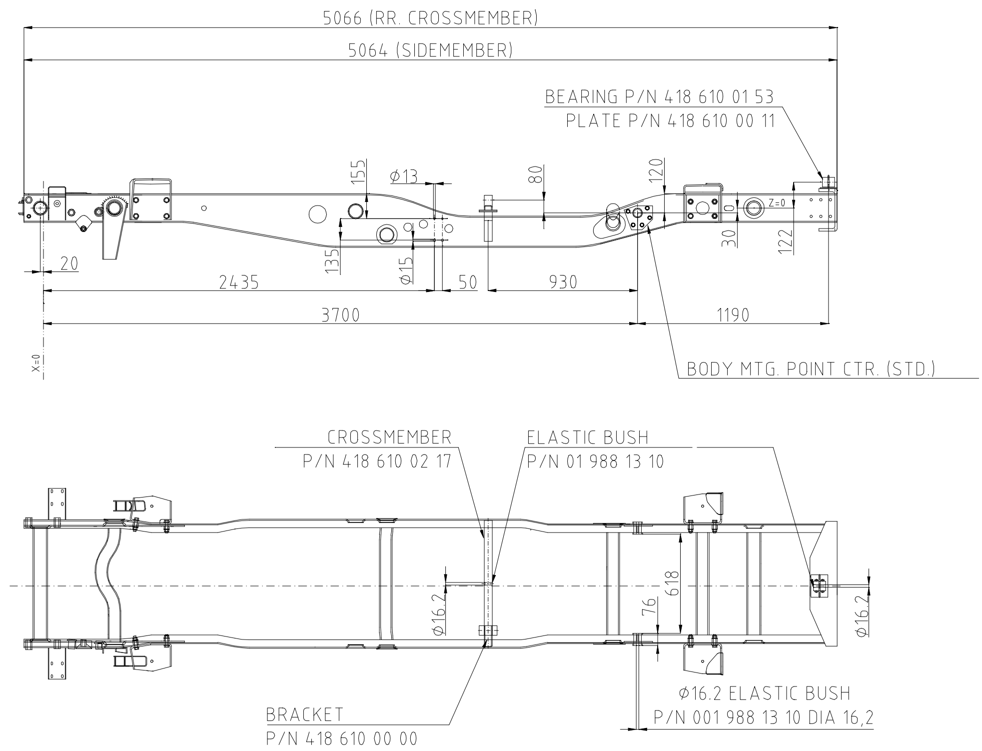


Figure 4.61 Fastening parts for third-party bodies U 140L, BM 418.117 (code D65)

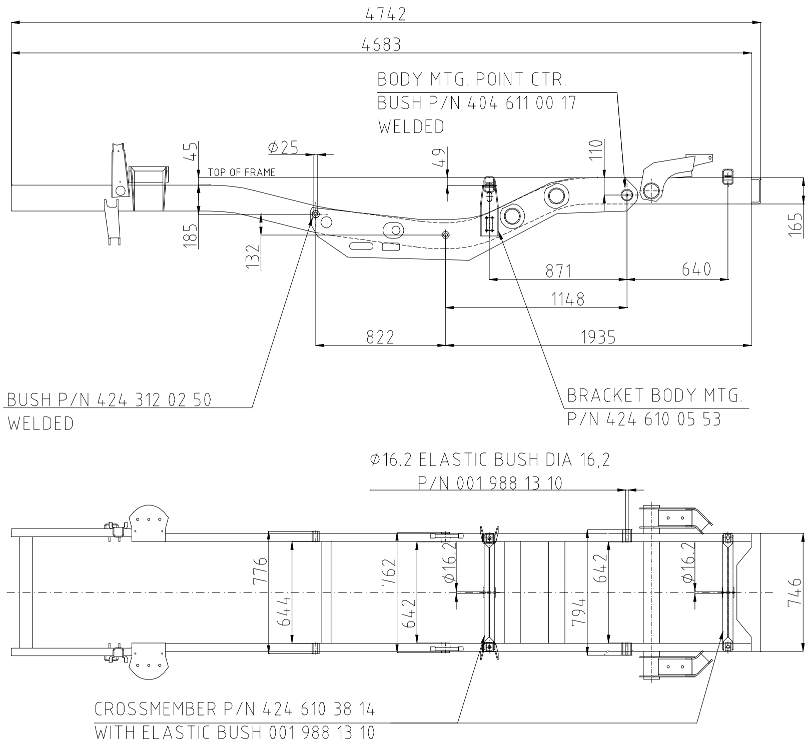


Figure 4.62 Fastening parts for third-party bodies U 1450/ U1650/U1650 (214), BM 427.112/115/117 (code D 65)

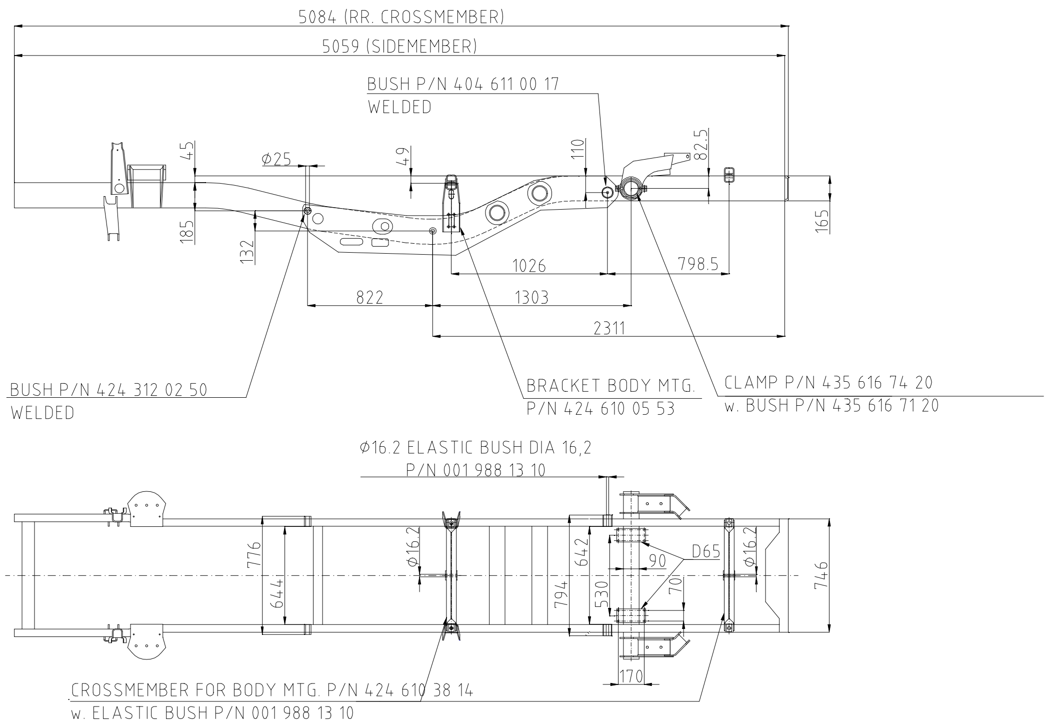


Figure 4.63 Fastening parts for third-party bodies U 1450L / U1650L / U1650L (214), BM 427.111/116/118 (code D 65)

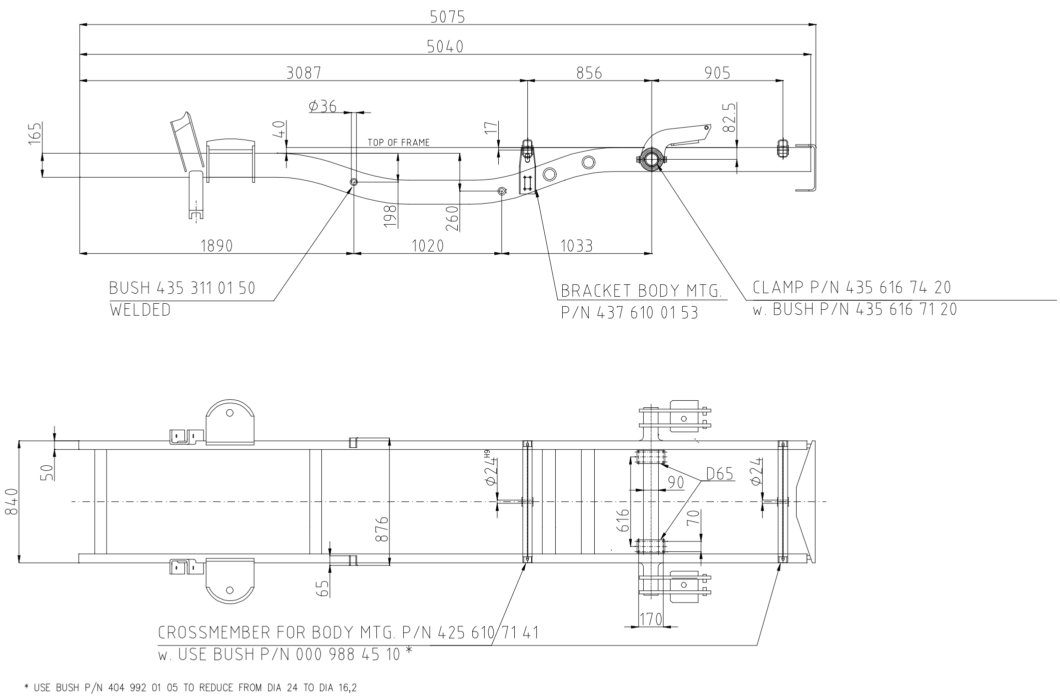


Figure 4.64 Fastening parts for third-party bodies U 1550L, BM 437.111/116 (code D65)

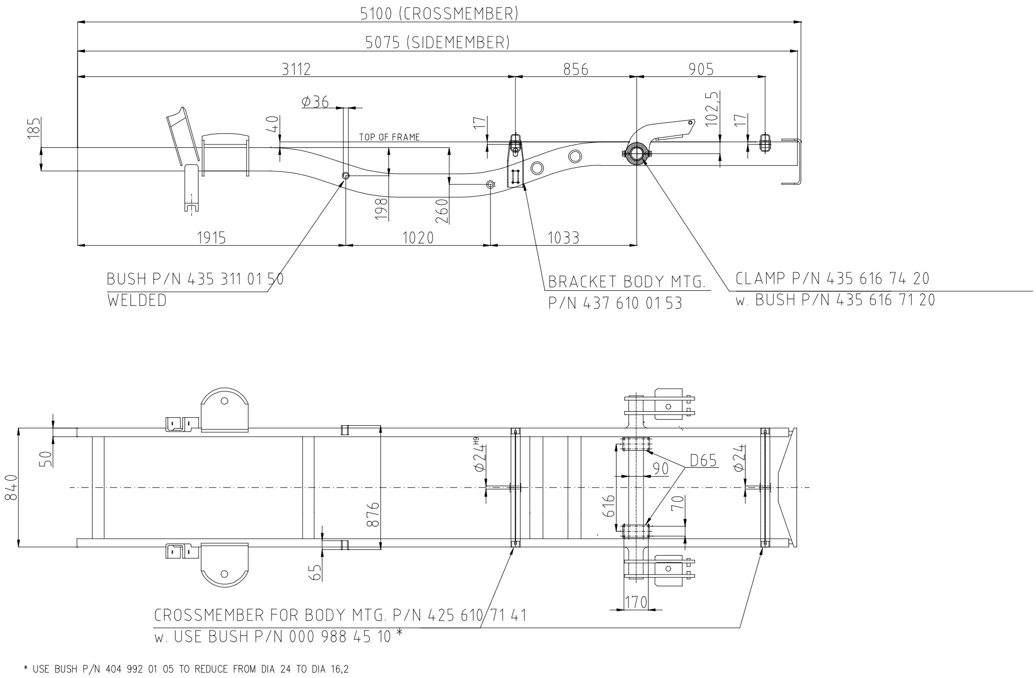


Figure 4.65 Fastening parts for third-party bodies U 1550L BM 437.111/116 with code X18/19/20 (code D65)

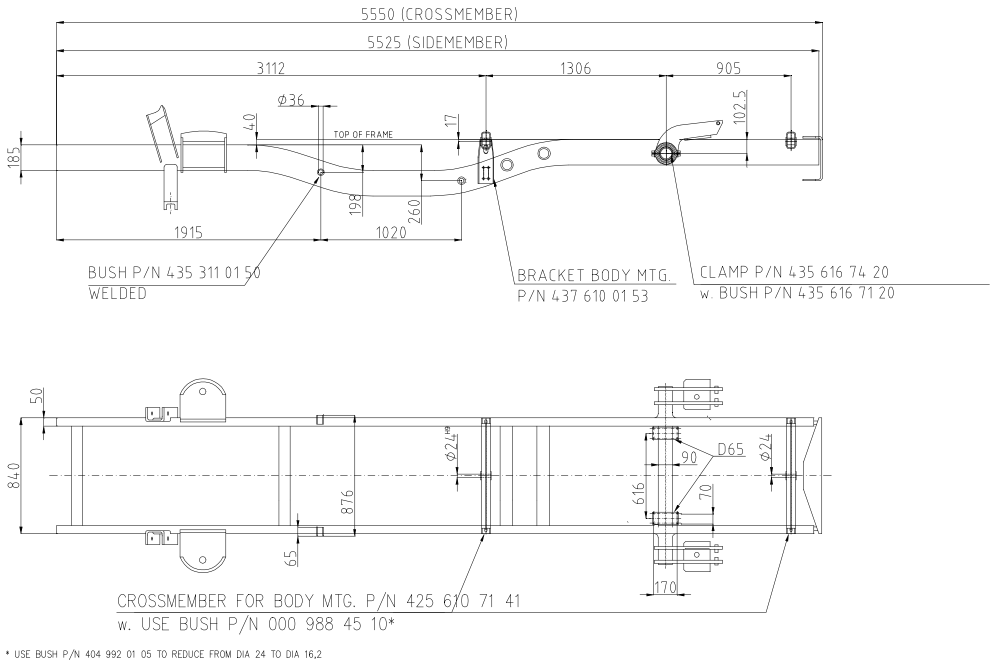


Figure 4.66 Fastening parts for third-party bodies U 1550L/ 37 BM 437.120/125 (code D65)

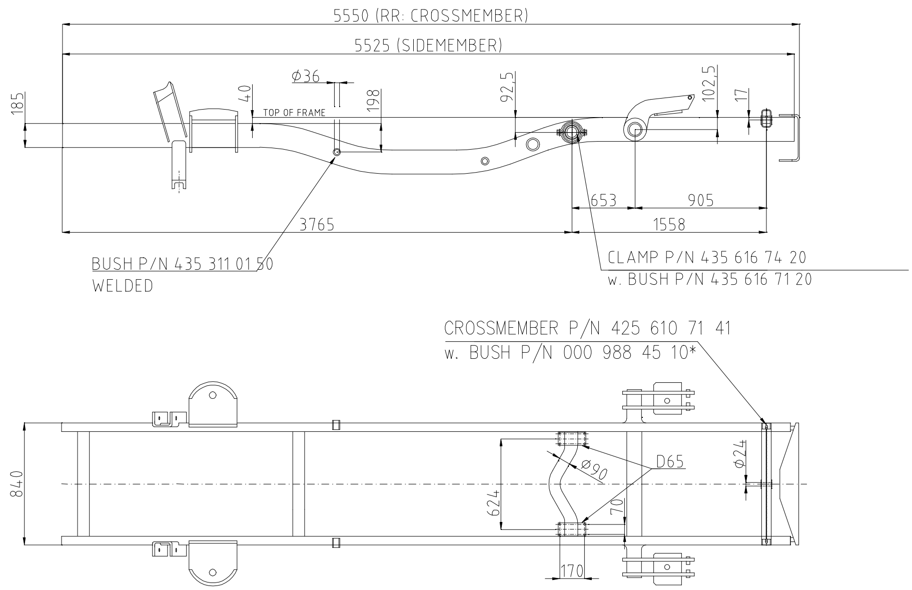


Figure 4.67 Fastening parts for third-party bodies U 1550L / 37 with crewcab, BM 437.120/125 with code F07 (code D65)

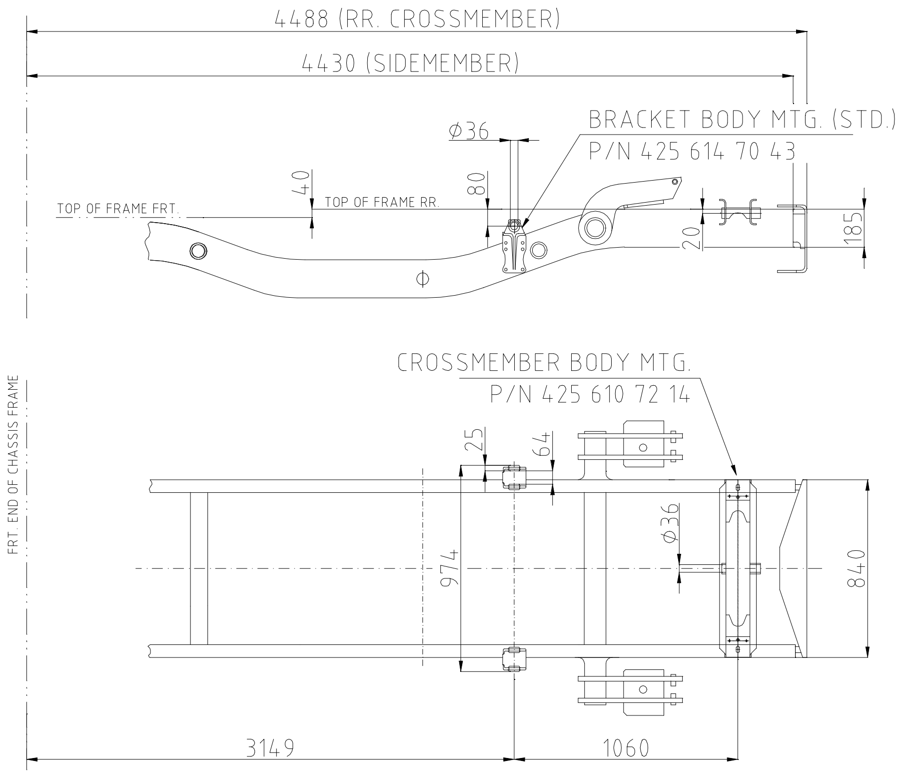


Figure 4.68 Fastening parts for third-party bodies U 2100/ U2400, BM 437.105 (code D65), (only loosely enclosed in conjunction with platform)

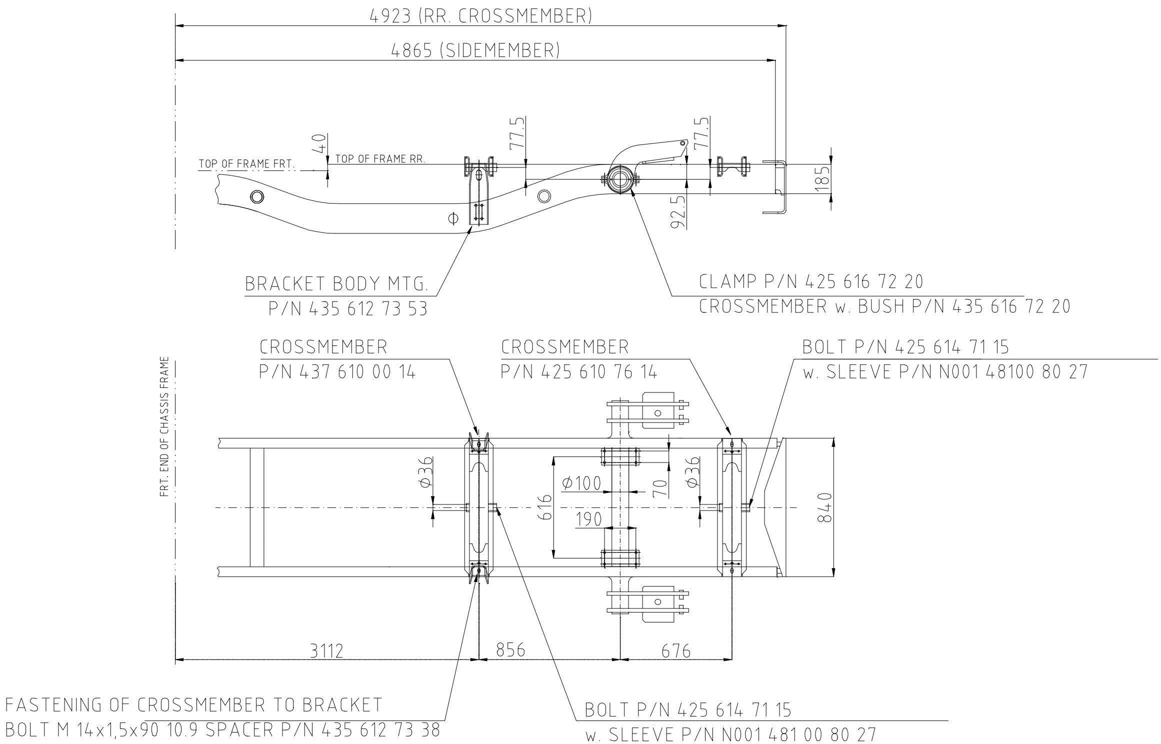


Figure 4.69 Fastening parts for third-party bodies U 2150/ 2450, BM 437.117 (code D65)

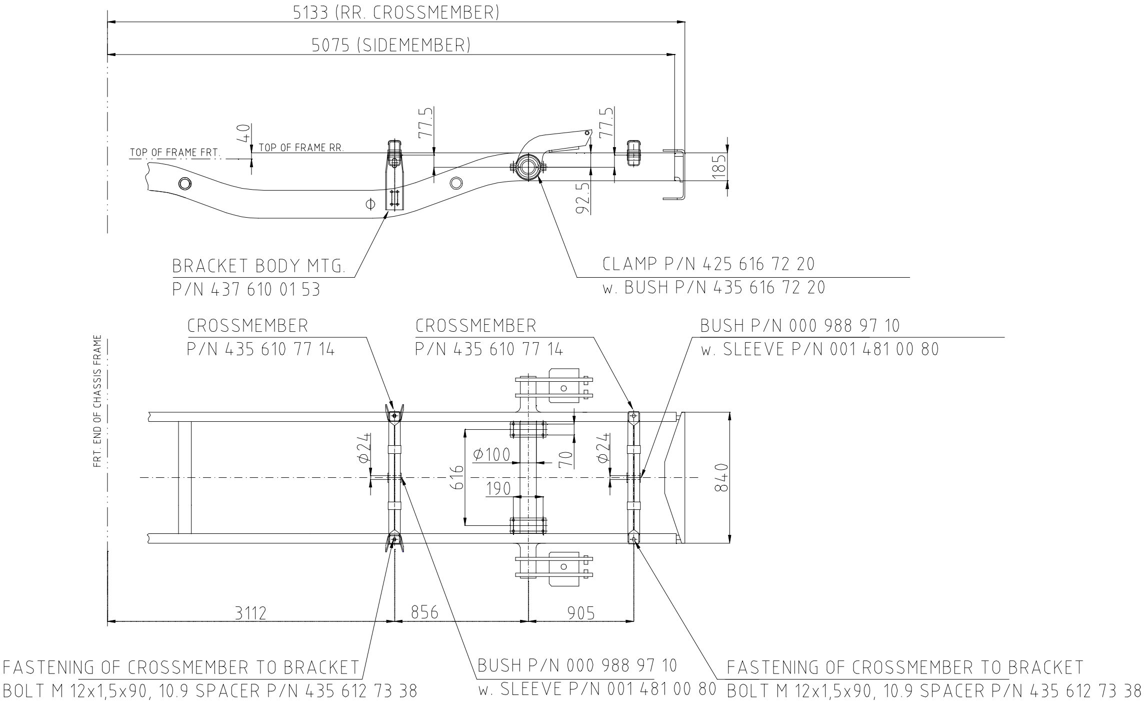


Figure 4.70 Fastening parts for third-party bodies U 2150L/ U 2450L, BM 437.118 (code D65)

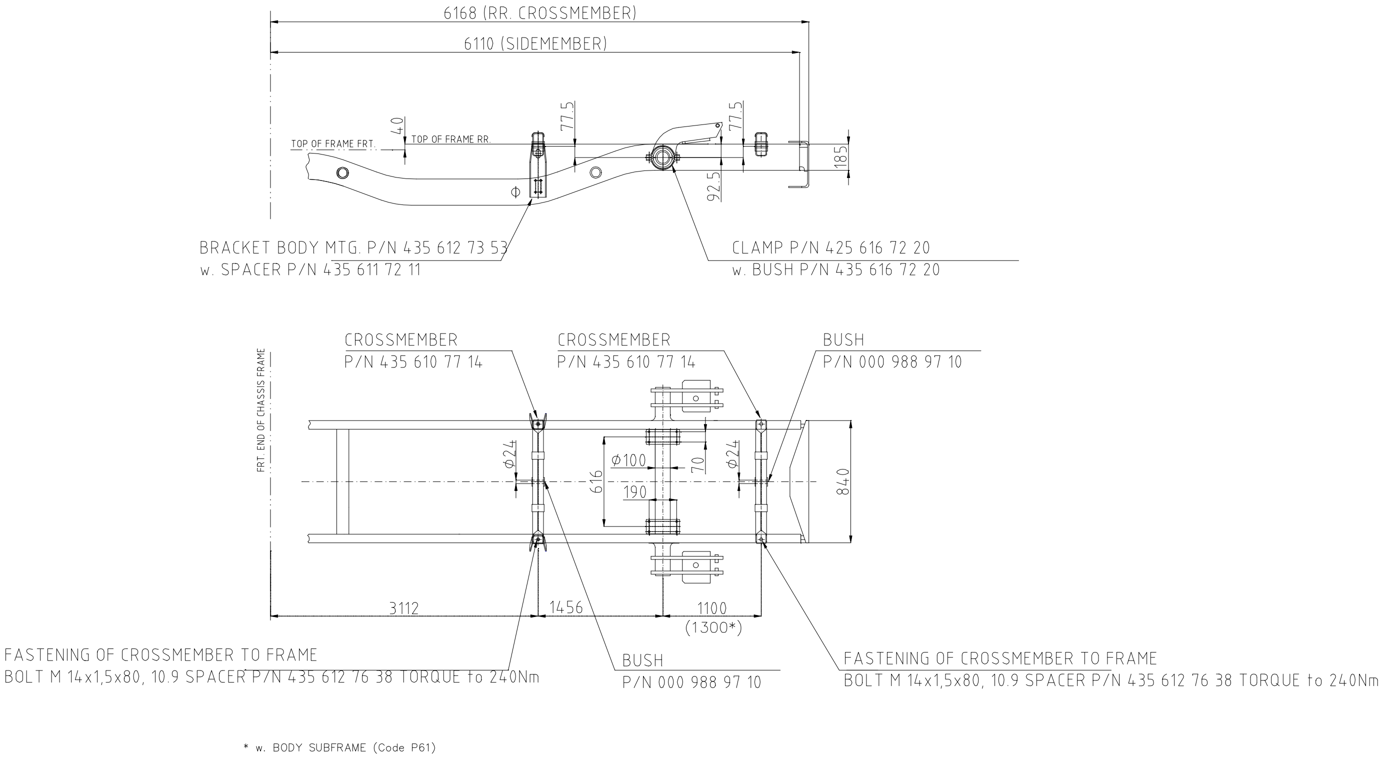


Figure 4.71 Fastening parts for third-party bodies U 2150L/ 38 and U 2450L/38, BM 437.136 (code D65)

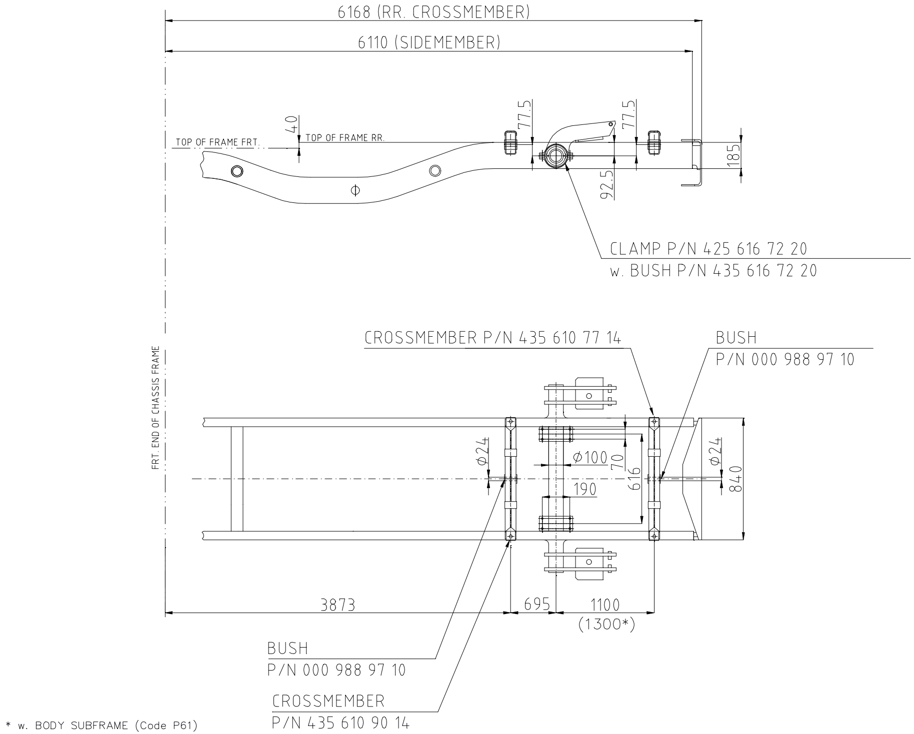


Figure 4.72 Fastening parts for third-party bodies U2150L/38 and U 2450L/38 with crewcab , BM 437.136 with code F 07 (code D65)

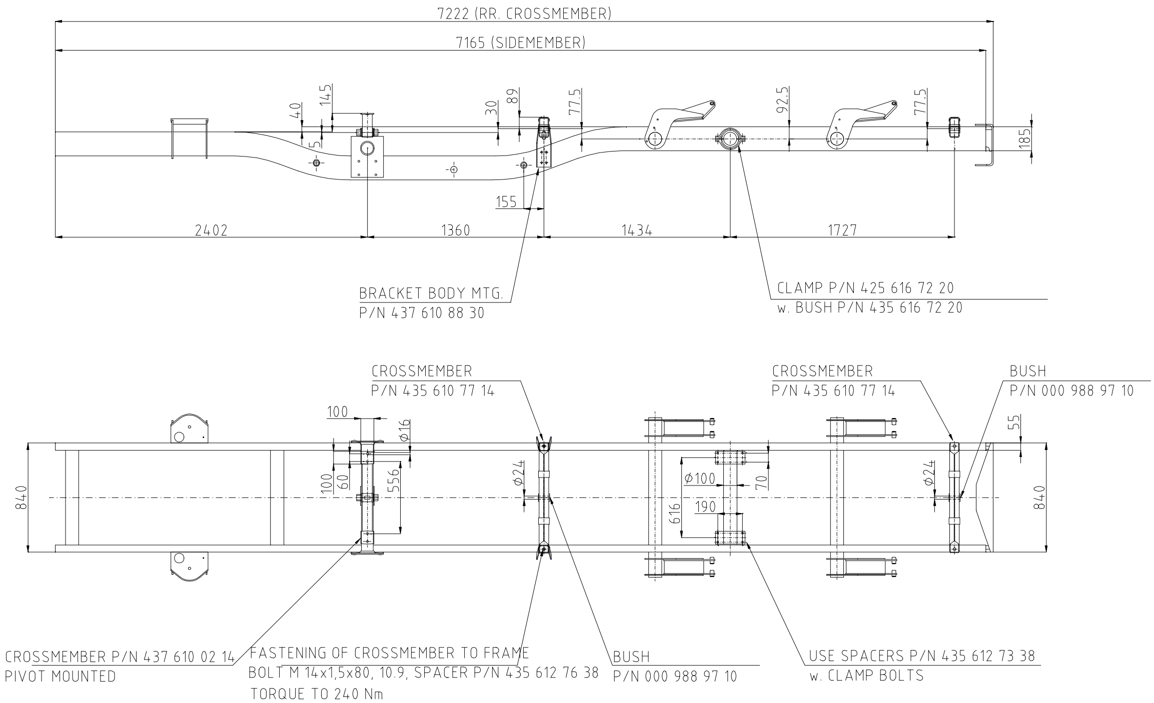


Figure 4.73 Fastening parts for third-party bodies U 2450L/ 6x6, BM 437.156 (code D65)

4.12.11 Implement examples for connecting pivot bearing and fixed bearing to the frame (code D65)

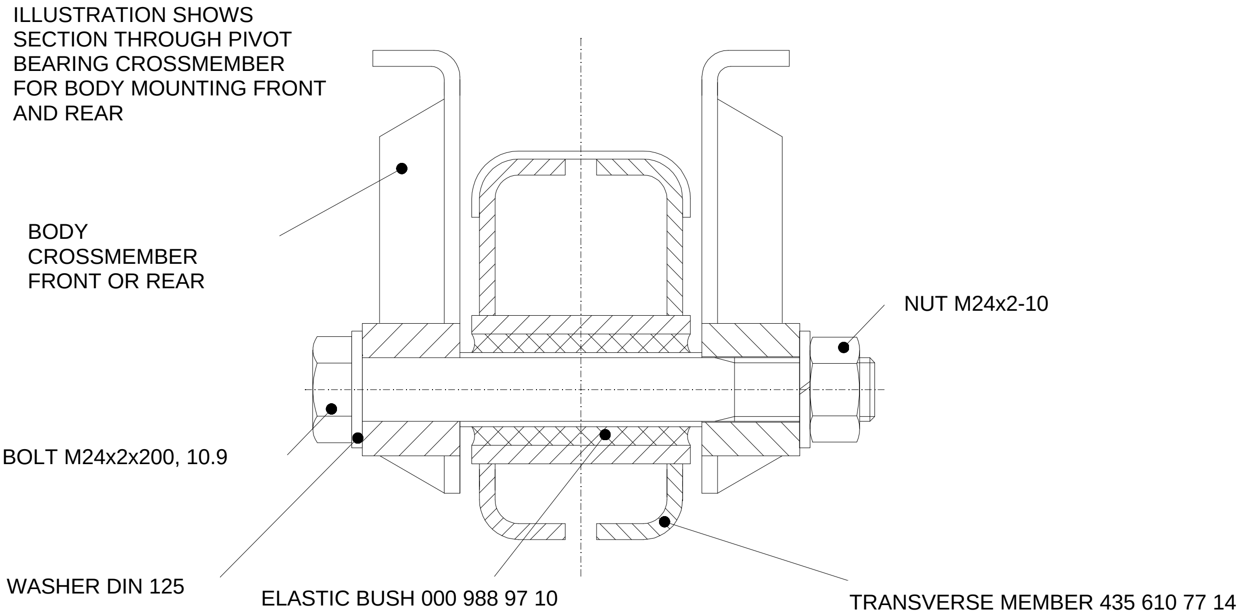


Figure 4.74 Transverse member center bearing (pivot bearing), longitudinal section e.g. in U2150L/38

Connection of the transverse member to the frame must,
in order to guarantee
bolt pre-tension force
carried out with an expander bushing.

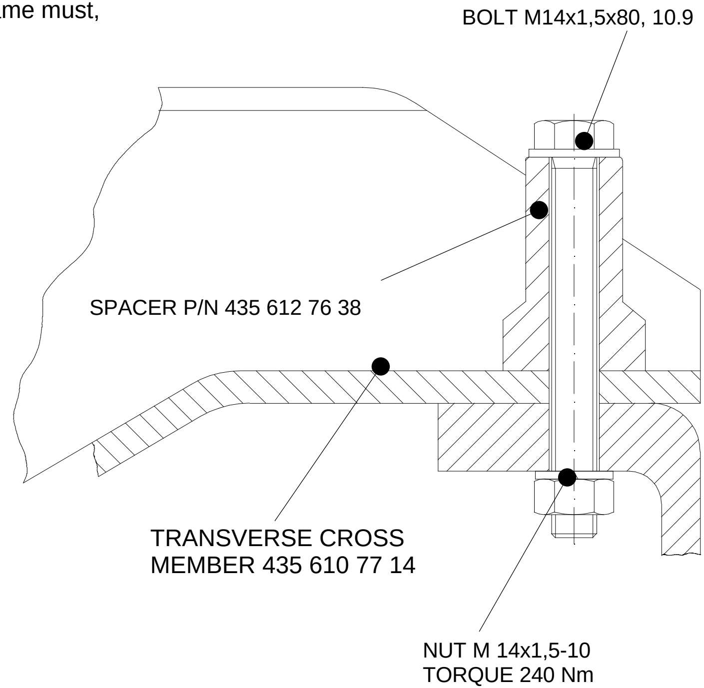
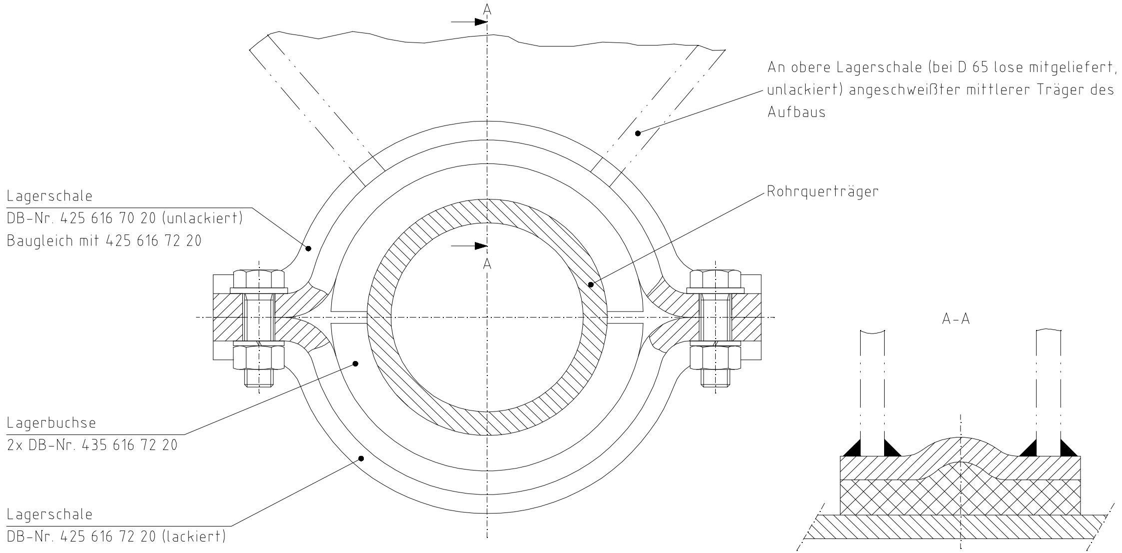


Figure 4.75 Connection of the cross member to the frame e.g. in U 2150L/38



Minimum distance 50 mm
for bending the frame
tubular transverse member at right-angles

Figure 4.76 Suspension on frame tubular transverse member (fixed bearing), e.g. in U 2150L/38

4.12.12 Floor assembly for special bodies code P61, particularly suitable for box bodies, etc.

A floor assembly (code P61) is available as a replacement part ex-works or for retrofitting purposes for fastening a body to UNIMOG chassis. The floor assembly enables bodies to be suspended without torsional flexion. It has been specially developed by DaimlerCrysler AG and ensures minimum tension in the body, even in the event of extreme torsional

flexion of the frame. The floor assembly enables the weight-saving design of the box body to be achieved. The off-road capability of the UNIMOG is not impaired by the body on the floor assembly if the body weight and form have been reviewed for off-road driving.
An illustration of the body assembly can be found in the Technical Manual, issue 3/95, page A57.

Vehicle designation	Model	Parts number	SA number	Comment	Length x width of the body [mm]
U 1450 L U 1650 L U 1650 L (214)	427.111 427.116 427.118	A 424 610 12 03	036.297/01	-------	3080 x 2050
U 1550 L U 1550 L (214)	437.111 437.116	A 437 610 01 03	035.586/16 w. code X18	185 pneus	3240 x 2240
U 1550 L/37 U 1550 L/37 (214)	437.120 437.125	A 435 610 77 03	035.586/08	-------	3690 x 2240
U 1550 L/37 Crewcab U 1550 L/37 (214) Crewcab	437.120/F07 437.125/F07	A 435 610 90 03	035.889/06	Crewcab (F07)	2607 x 2224*
U 2150 L/U 2450 L	437.118	A 435 610 76 03	036.055/01	-------	3240 x 2240
U 2450 L/38	437.136	A 435 610 93 03	036.055/02	-------	4100 x 2240
U 2450 L/38 Crewcab	437.136/F07	A 437 610 07 03	036.055/06	Crewcab (F07)	3200 x 2240
U 2450 L/6x6	437.156	A 437 610 10 03	036.055/07, 035.768/13	-------	4731 x 2426* * Floor assembly dimension

Figure 4.77 Table Allocation of the floor assembly

Notes regarding the rear underride guard and the lateral protection facilities:

The UNIMOG series are exempt from the obligation regarding the provision of an underride guard (Exception: U2400TG, BM 437.182) and do not require lateral protection facilities, see Chapter 6.7.5, 6.7.6 and Technical Manual, issue 3/95, page C62.

4.12.13 Bodies in U2450L/6x6, BM437.156

In the case of chassis U2450L/6x6, BM437.156 it is pre-specified that torsional vibration damper A006 323 41 00 be installed between the cab and the body (platform, crane carrying frame, box body, etc.) in accordance with layout drawing A437 000 03 52. The installation of the torsional vibration damper must be taken into consideration as early as in the body planning stage on the basis of the layout drawing. The drawings may be ordered by fax from PBU/TES.

4.12.14 Semitrailer tractor

The UNIMOG is only suitable for use as a semitrailer tractor to a limited degree. Only long wheelbase vehicle types, if any, are used for the design of such a vehicle. If clearances are to be adhered to according to ISO 1726, which describes the swan-neck contour of the semitrailer, considerable design modifications must be made to the vehicle.

Before designing a Unimog semitrailer tractor, the following must be noted with regard to the height of the coupling point:
The coupling point must be positioned as low as possible. The higher the coupling point, the greater the tractor trailer's tendency to buckle on braking.

Always inform PBU/TES at an early stage if you intend to design a Unimog semitrailer vehicle.

4.13 Rear-mounted implement

4.13.1 Rear mounting supports (code D50)

The rear mounting supports for the different Unimog series are depicted in the following.
The drawings contain all significant connection dimensions.

UNIMOG model	DaimlerCrysler AG parts number *right version*	 *left version*
BM 408	A 408 552 02 18	A 408 552 01 18
BM 418	A 418 552 00 18	A 418 552 03 18
BM 427	A 406 551 33 38	A 406 551 33 38
BM 437	A 425 552 05 18	A 425 552 05 18

Figure 4.78 Table Rear mounting supports

Mounting support for model 408 (LBU)

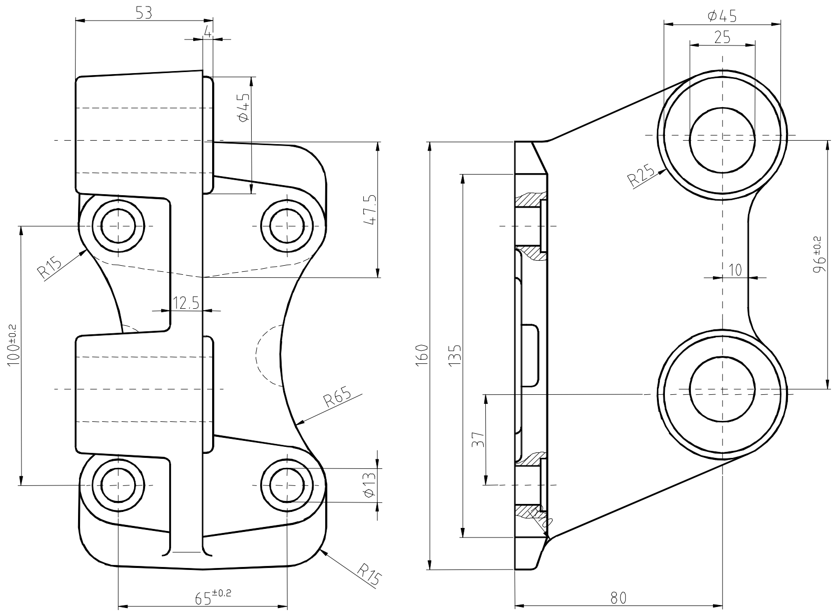


Figure 4.79 Rear mounting support

Note: Mounting support for model 408 (LBU)
Figure shows left version
P/N 408 552 0118

Mounting support for model 418 (MBU)

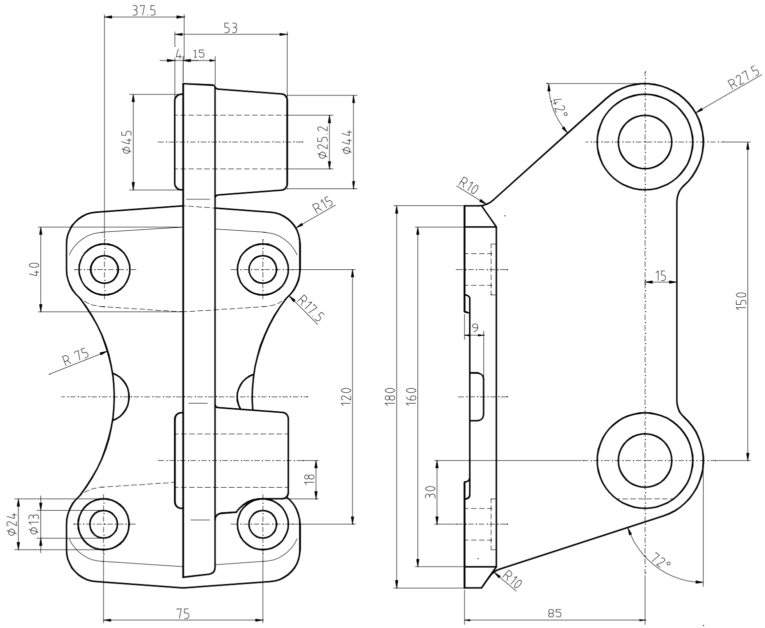


Figure 4.80 Rear mounting support for model 418

Note: Mounting support for model 418 (MBU)
Figure shows right version
P/N 418 552 00 18

Mounting support for model 427(SBU)

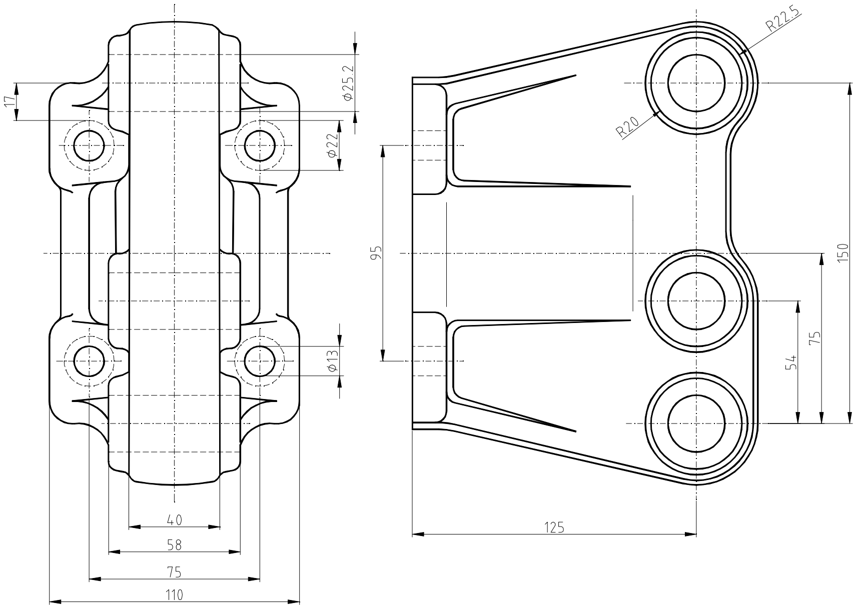


Figure 4.81 Rear mounting support for model 427 (LBU)

Note: Mounting support for model 427 (SBU)
Figure shows right and left version
P/N 406 551 33 38

Mounting support for model 437 (SBU)

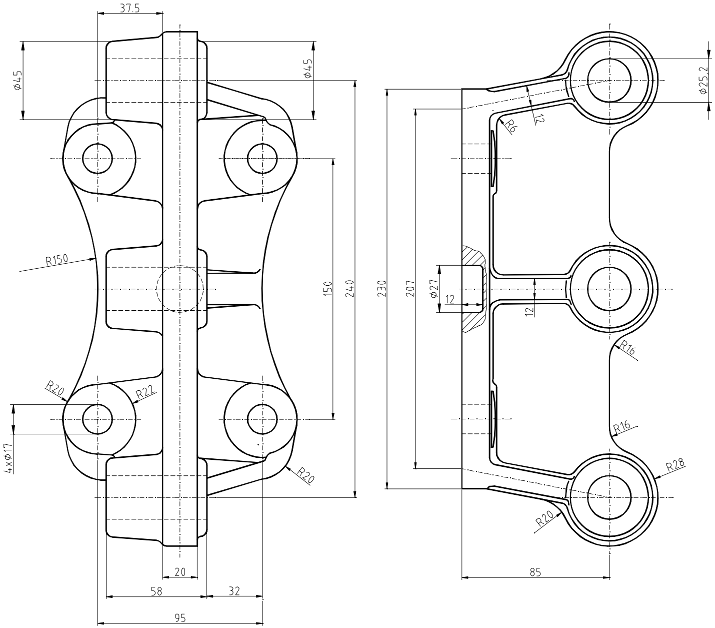


Figure 4.82 Rear mounting support for model 437

Note: Mounting support for model 437 (SBU)
Figure shows right and left version
P/N 425 552 05 18

4.13.2 Connection dimensions for rear mounting supports

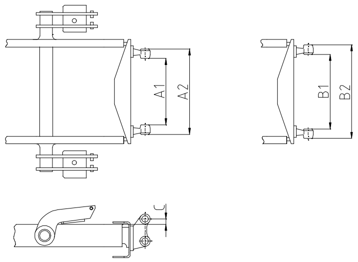


Figure 4.83 Layout of rear mounting supports

The implement dimensions may be changed via simple conversion of the rear mounting supports; this results in either dimensions A or B in the following Table:

- Only one installation position is available in BM408.
- In BM418, the left mounting support can be bolted on on the right and vice versa
- In BM427, the rear mounting supports can be moved laterally by 90mm in the hole pattern
- In BM437, the mounting supports are asymmetrically designed and can be rotated in the hole pattern

Model	Dimension A_1 [mm]	Dimension A_2 [mm]	Dimension B_1 [mm]	Dimension B_2 [mm]	Dimension C [mm]
408	527	633	-	-	8
418	527	633	617	723	30.5
427	527	643	617	733	-7.5
437	575	691	629	745	5

Figure 4.85 Table Rear mounting support implement dimensions

4.13.3 Permissible weights at the rear mounting supports (D50)

Mounted implements or ballast weights must be attached in such a way that both mounting supports are loaded to the same degree in the event of longitudinal and vertical acceleration.
In addition, the implement-side brackets must both be attached in a two-shear manner and without play to the mounting supports.
The implement center of gravity must not be more than 200 mm behind the bore hole level of the mounting supports.
In the vertical direction, the distance between the center of gravity and the lower bore holes must not exceed 500 mm.
Ballast weights must not be positioned above the mounting supports.
In the event of deviations, which are absolutely necessary as a consequence of the application, the Unimog development **department**
(PBU/TES) must be consulted.

Model	Implement weight in daN
408	700
418	1000
427	1200
437	1350

Figure 4.8.6 Table Permissible weights at the rear mounting supports (D50)

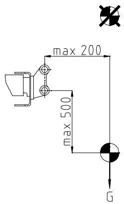


Figure 4.87 Permissible position of implement center of gravity in D 50 implement

4.13.4 3-point mounting

3-point mounting, depending on the model, is available from DaimlerCrysler AG:

Category 2 for LBU/ MBU (code Q40)
Category 2/ 3 for SBU (code Q45).

The 3-point mounting enables the attachment of standardized rear-mounted implements according to DIN 9674.

The vehicle-side review of implements designed for operation on the 3-point mounting is no longer carried out.
It is assumed that the implement manufacturer/supplier applies the recognized rules of technology and evaluates the strain which occurs during operation and that he can therefore assume responsibility for problem-free mounting, function, compliance with legal regulations, StVZO, StVO and the industrial safety and accident prevention regulations of the relevant employer's liability insurance associations.

4.13.5 Table of rear power lifters

Vehicle / type designation	Model	Rear power lifters					
Tractor and operating units short and long wheelbase		Lifting power in *N*	Cylinder ∅ in *mm*	Lifting power in *N*	Cylinder ∅ in *mm*	Double acting cylinder	Connection dimensions
U 90 Turbo	BM 408.101	24000	----	----	----	Yes	----
U 130	BM 418.102	36000	----	----	----	Yes	----
U 1400 / U 1450	BM 427.102 / BM 427.112	44000 [1.)]	80	50000 [2.)]	90	Yes	according to cat.II
U 1600 / U 1650	BM 427.105 / BM 427.115	50000	90	----	----	Yes	according to cat.II
U 1600 (214 / U 1650 (214)	BM 427.107 / BM 427.117	50000	90	----	----	Yes	according to cat.II
U 2100 / U 2150	BM 437.105 / BM 437.117	55000	100	----	----	Yes	according to cat.III
U 2400 / U 2450	BM 437.105 / BM 437.117	55000	100	----	----	Yes	according to cat.III

[1)] with code H30
[2)] with code H33

Figure 4.88 Table Rear power lifter lifting power

4.13.6 Rear excavator

If a rear excavator is to be attached, approved and tested types should be used. New adaptation is not planned, due to the required, comprehensive testing (see front loader Chap. 4.11.5).

4.14 General drawings available

Designation	DB number	Format	Paper drawing	CAD data set (dxf)	Valid for vehicle model
Vehicle with plat. U90	4080000000	A00	yes		408.100 (101)
Vehicle with plat. U90	RK999000C612	A3	yes	yes	408.100 (101)
Vehicle with plat. U100L	RK999000C673 Page 1	A4 long	yes		408.215 (216)
Vehicle U100L	RK999000C642	A3	yes	yes	408.215 (216)
Vehicle with plat. U130	4180000000	A00	yes		418.102
Vehicle U140L	RK999000C644	A3	yes		418.117
Vehicle U140L	RK999000C643	A3	yes	yes	418.217 (UVG300)
Vehicle U1400	4270000100	A00	yes		427.102
Vehicle with plat. U1400	4270000200	A00	yes		427.102
Vehicle with plat. U1400	4270002599			yes	427.102
Vehicle with plat. U1600	RK999000U569	A00	yes		427.105
Vehicle with plat. U1600	4270002799			yes	427.105
Vehicle with plat. U1450	RK999000S524	A00	yes		427.112
Vehicle with plat. U1450	4270002699			yes	427.112
Vehicle with plat. U1650/1650(214)	RK999000U331	A00	yes		427.112/117
Vehicle with plat. U1650	4270002899			yes	427.115
Vehicle U1650L with AC	4240002399	A4 long	yes		427.116
Vehicle U1650L Crewcab	4270000059	A4 long	yes		427.116 with F07

Vehicle with plat. U1550L	E348/78US/2	A00	yes		437.111
Vehicle U1550L	4370004799			yes	437.111
Axle torsional flexion U1550L	E579/77US	A3	yes		437.111
Vehicle U1550L/37	4350001899	A4 long	yes		437.120
Vehicle U1550L/37	4370004699			yes	437.120
Vehicle U1550L/37 Crewcab	4350001099	A4 long	yes		437.120
Vehicle with plat. U2100	E195/74US/1	A00	yes		437.105
Center body U2100	E507/74US	A00	yes		437.105
Vehicle U2150	E927/79	A00	yes		437.117
Vehicle with plat. U2150	E146/79US	A00	yes		437.117
Vehicle U2150L	4370002199	A4 long	yes	yes	437.118
Vehicle with plat. U2150L	E382/78US/1	A00	yes		437.118
Vehicle U2150L Crewcab	E382/78US/2	A00	yes		437.118 with F07

Designation	DB number	Format	Paper drawing	CAD data set (dxf)	Valid for vehicle model
Axle torsional flexion U2150L	E651/77US	A3	yes		437.118
Vehicle U2150L/38	4370000799	A4 long	yes		437.136
Vehicle U2150L/38	RK999000R788	A0	yes		437.136
Vehicle U2150L/38	4370004599			yes	437.136
Vehicle with plat. U2150L/38	4370001899	A4 long	yes	yes	437.136
Vehicle U2150L/38 Crewcab	4370001099	A4 long	yes		437.136 with F07
Vehicle U2150L/38 Crewcab	RK999000B024	A0	yes		437.136 with F07
Vehicle U2450L/6x6	4370001599 Page 2	A4 long	yes		437.156
Vehicle U2450L/6x6	4370004299 Page 1	A0	yes		437.156
Vehicle U2450L/6x6	Tender drawing	A3	yes	yes	437.156
Vehicle U2400TG	4370004399	A00	yes		437.182

Vehicle = Chassis drawing, with plat. = With platform, Crewcab = Crewcab, AC = Air conditioning system

Further general drawings and component drawings on request.

In the case of a justified requirement, paper drawings and CAD data sets may be requested by fax from PBU/TES **(Fax 07225-61-5512)**. Paper drawings are forwarded by post at short notice, CAD data sets are sent by e-mail in dxf format (state e-mail address.)

5. Implement drive

5.1 Drive options

Implement and body units can be

- mechanically driven (power take-off shaft or auxiliary power take-off)
- hydraulically driven/controlled
- connected to the vehicle electrical system (power supply, signal transfer)
- supplied with compressed air via the vehicle compressed air system, by the UNIMOG carrying vehicle

5.2 Mechanical implement drive

5.2.1 Instructions regarding the transmission ratio

Definition of transmission ratio in general*: $i = \frac{\text{(transmission)}\textbf{In}\text{put speed}}{\text{(transmission)}\textbf{out}\text{put speed}}$ here: $i = \frac{n_{\text{engine}}}{n_{\text{auxiliary power take-off}}}$

The speed of the power take-off shaft/of the auxiliary power take-off is calculated from the engine speed as follows:

$n_{\text{auxiliary power take-off}} = \frac{n_{\text{engine}}}{i}$ which means: $i>1$: reduction, $i<1$: speed increase

($>$: greater than)
($<$: less than)

* Input$\rightarrow$ output related to the direction of power flow

5.2.2 General instructions for mechanical drive

The following applies to all mechanical implement drives: in comparison with other power transfer systems, the mechanical transfer of power is the most effective.
The engine power for driving units can be drawn off via power take-off shafts at the front, rear and center of the vehicle.

Overview of available mechanical power take-offs for the UNIMOG:

Code	**Designation**	**Comment**	**Available for vehicle model**			
			408.	418st	427st	437st
N02	Special power take-off for transmission power take-off shaft 540 rpm to front	Power take-off shaft dependent on vehicle clutch; i.e. power flow interruption on shifting, on depression of the vehicle clutch, drive shaft and power take-off shaft drive is disengaged. Propshaft installation by implement manufacturer	-	-	all	all except for 156
N03	Special power take-off for transmission power take-off shaft 540 rpm to front and rear	Power take-off shaft dependent on vehicle clutch; i.e. power flow interruption on shifting, on depression of the vehicle clutch, drive shaft and power take-off shaft drive is disengaged. Propshaft installation by implement manufacturer	*	102 117	-	-
N06	Very high-speed engine power take-off shaft drive, i=0.745 to front and rear with flange power take-off	With twin clutch G45 only, i.e. power take-off shaft not dependent on vehicle clutch, the power take-off shaft can be engaged and disengaged whilst driving, Propshaft installation by implement manufacturer	-	-	all	all
N07	Special power take-off for engine power take-off shaft 540/1000 rpm to front and rear	With twin clutch G45 only, i.e. power take-off shaft not dependent on vehicle clutch, the power take-off shaft can be engaged and disengaged whilst driving	100 101	102 117	all	all except for 156
N11	Special power take-off for transmission power take-off shaft 540/1000 rpm to front and rear	Power take-off shaft dependent on vehicle clutch, i.e. power flow interruption on shifting, on depression of the vehicle clutch, the vehicle and power take-off shaft are disengaged	100 101	102 117	all	all except for 156

Code	Designation	Comment	Available for vehicle model			
			408.	418st	427st	437st
N16	High-speed power take-off, i=1.0, Profile DIN 5480, 30x2x14x9H	(connection to transmission input shaft) for e.g. directly driving a hydraulic pump Profile complying with DIN 5480, N30x2x9H, 14 teeth, Can only be used with vehicle stationary, or driving without shifting	-	-	all	all
N16	High-speed power take-off, i=0.737, i=0.588 with code G10 and selectable intermediate gears	(via single-stage transmission) Profile complying with DIN 5480, N30x2x9H, 14 teeth		102 117		
N17	Very high-speed power take-off with flange drive, i=0.71	for e.g. directly driving a fire fighting water pump Can only be used with vehicle stationary, or driving without shifting	-	-	all	all
N19	Very high-speed power take-off with flange drive, i=0.61	for e.g. directly driving a fire fighting water pump Can only be used with vehicle stationary, or driving without shifting	-	-	all	all
N20	Power take-off shaft train to front for N02/N07/N11 Splined shaft profile 1 3/8 inch		100 101	102 117	all	all
N22	Power take-off shaft train to front for N02/N07/N11 Splined shaft profile 1 ¾ inch		100 101	102 117	all	all
N32	Power take-off shaft train to rear for N02/N07/N11 Splined shaft profile 1 3/8 inch		100 101	102	102, 105, 107, 112, 115, 117	105 117

Code	Designation	Comment	Available for vehicle model			
			408.	418st	427st	437st
N37	Power take-off shaft train to rear for N02/N07/N11 Splined shaft profile 1 ¾ inch		100 101	102	102, 105, 107, 112, 115, 117	105 117
N71	High-speed auxiliary power take-off to rear with Flange power take-off, i=1.0	With twin-disc converter only code G31	-	-	107 117, 118	-
N72	Transfer box with auxiliary power take-off, i=0.85 Drive flange to front and rear	Speed dependent on the gear engaged in the 5-speed manual transmission, can only be engaged when the vehicle is stationary, max. output 30kW, >30kW an auxiliary oil cooler may be necessary	215 216	-	-	-
N76	High-speed auxiliary power take-off, i=1.0	Profile ANSI B92.2 M-1980 (SAE) 30°PA,21 teeth, 16/32 pitch	-	-	*	*
N76	High-speed auxiliary power take-off, i=0.737	Profile ANSI B92.2 M-1980 (SAE) 30°PA, 21 teeth, 16/32 pitch	-	102 117	-	-
N78	High-speed power take-off, i=0.737 with flange connection		-	102 117	-	-

*no longer available as standard, but can be retrofitted

Important notes:

- Power take-off shaft trains N20/N22/N32/N37 cannot be combined with high-speed engine power take-off shaft drive N06, which is engaged by twin clutch G45
- High-speed auxiliary power take-offs N16/N17/N19 must not be combined with hydrostatic drive shaft (G32, as the oil pump of the hydrostatic drive shaft occupies the installation space required for the high-speed auxiliary power take-off on the transmission.

- Engine and transmission power take-off shafts N02/N03/N06/N07/N11 are not to be combined with torque converters (torque converter clutches G30/31), as the converter occupies the installation space required for the power take-off shaft gear.
- On combining torque converter clutch G30 with high-speed auxiliary power take-off N16/N17/N19, it must be ensured that the high-speed auxiliary power take-off is also converter-dependent (see also Chap. 5.2.7)
- High-speed auxiliary power take-offs N16/N17/N19 must only be used whilst stationary or whilst driving without shifting, as the drag torque of the component connected to the auxiliary power take-off no longer enables the synchronization of the manual transmission, and shifting must not therefore take place (the synchronizer rings may be damaged on shifting).
- The current Unimog price list provides information regarding the availability and possible combination of the optional equipment.
- In the event of uncertainty regarding the suitability of an auxiliary power take-off for the planned usage, please consult Department PBU/TES.

5.2.3 Safety instructions regarding the mechanical implement drive

The implement manufacturer is responsible for the protection of the components connected to the power take-off shaft/the auxiliary power take-off against unintentional actuation or improper use (via suitable mechanical/electrical protective measures or warning notices) and, if required, for the provision of an intermediate engine speed blocking system (see Chapter 5.2.9.2).
Rotating parts, such as e.g. implement propshafts, must be covered or enclosed in accordance with the currently valid accident prevention regulations (see also 5.2.4.1)

5.2.4 Power take-off shaft drive

5.2.4.1 General

The power take-off shaft drive is available with a single clutch (code N02/03/11) or with a twin clutch (code N06/07). In the version with the single clutch ("transmission power take-off shaft"), the power take-off shaft can only be engaged and disengaged when the vehicle is stationary. Shifting is carried out pneumatically. At idle speed or on shifting whilst driving, the flow of power to the power take-off shaft is interrupted when the vehicle clutch is disengaged. In the case of the power take-off shaft drive with twin clutch ("engine power take-off shaft"), the power take-off shaft may be engaged and disengaged independently of the drive shaft. The flow of power to the power take-off shaft is not interrupted when the vehicle clutch is disengaged. In order to avoid start-up shocks and increased PTO clutch wear, the PTO clutch is only to be actuated at low engine speeds.

Depending on the version of the power take-off, various flange designs or splined shaft profiles are available.

Safety instructions for power take-off shaft operation:

- The permissible drive strain, taking the type of operation (shock coefficients, duration of use, ambient conditions) into consideration, must not be exceeded.
- The implement manufacturer is responsible for carrying out practical tests on the implement.
- On constant operation, the propshaft angle must not exceed 15° (short periods of time up to max. 30°).
- The propshafts are to be positioned so that irregular running is impossible in all operating positions.
- The sliding parts of the propshafts are to be selected such that easy movement is possible at max. torque transfer. In the case of high torques, telescopic type ball bearing traveler profiles should preferably be used.
- Guards shall be provided for rotating parts by the implement manufacturer, i.e. in the region of the propshaft connection on the vehicle.
- The direction of rotation in the vehicle/implement combination must be noted (risk of accident.).
- On operation of a power take-off shaft, it must be ensured that the rotating shaft is sufficiently protected.
- In the case of operations in the area of rotating drive shafts and rotating component parts, only wear tightly-fitting clothing.
- On stationary operation, the vehicle must be secured against rolling away (parking brake, wheel chocks). See also Chapter 3 "Damage prevention, Safety instructions and Accident prevention" and Chapter 8.2 "Safety instructions".
- The power take-off shaft must not be operated without the guards prescribed.
- Only connect and disconnect implements when the engine is at a standstill and the power take-off shaft is disengaged.
- Prior to all operations on implements which are driven by power take-off shafts, the engine must be switched off and no work must be carried out until the implement has come to a standstill.
- Only connect and disconnect the propshaft to the power take-off shaft and never by pulling the propshaft tubes apart.

Power take-off shaft guard

The power take-off shaft must not be operated without the power take-off shaft guard. The standard power take-off shaft guard must not be removed. Operation without power take-off shaft guard is impermissible.
According to the accident prevention regulations, rotating shafts must be equipped with safeguards (see also operating instructions).
The guards for rotating parts shall be provided by the implement manufacturer, i.e. in the area of the propshaft connection on the vehicle. Propshafts which are located in areas in which personnel pass or work must be encased or covered. Following the removal of the power take-off shaft, the protective cap must be placed on the end of the power take-off shaft.
See i.e. Chapter 8.1 "Safety instructions".

5.2.4.2 Direction of rotation and speeds of the power take-off shaft drive

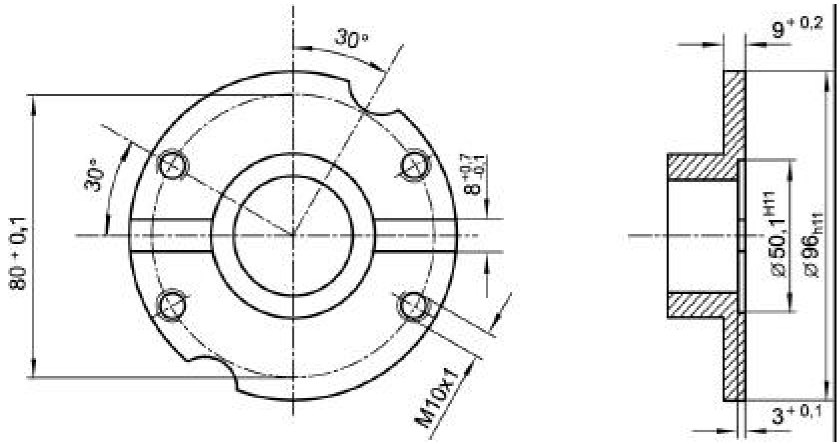
Vehicle model	Code	Standard speed [rpm]	Gear ratio (see 5.21)	Direction of rotation (in direction of travel)	n_{engine} at PTO standard speed [rpm]	$n_{power\ take\text{-}off\ shaft}$ at engine rated speed [rpm]
408	N07/N11	540	5.33	right	2880	713
$n_{rated/engine}$=3800 rpm		1000	2.92	right	2924	1301
418	N07/N11	540	4.0	right	2164	599
$n_{rated/engine}$=2400 rpm		1000	2.2	right	2196	1093
427/437	N07/N11	540	3.85	right	2080	623 (675)
$n_{rated/engine}$=2400 rpm (2600 rpm with 177 kW engine)		1000	2.19	right	2190	1096 (1187)

Figure 5.1 Table: Power take-off shaft drive

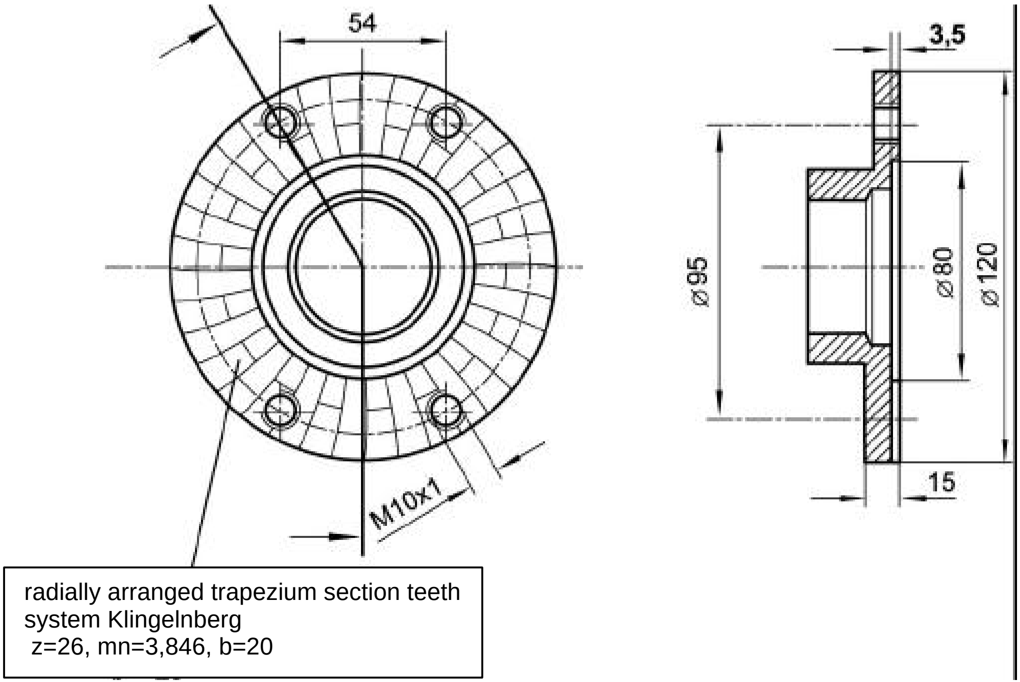
5.2.4.3 Direction of rotation and speed of the very high-speed engine power take-off shaft drive

Vehicle model	Code	Transmission ratio	Direction of rotation (in direction of travel)	n power take-off shaft at rated engine speed [rpm]	
				2400	2600
427/437	N06	0.745	left	3220	3490

5.2.4.4 Flange design N03/N07/N11 on BM 408/418, MB No. 406 264 27 44



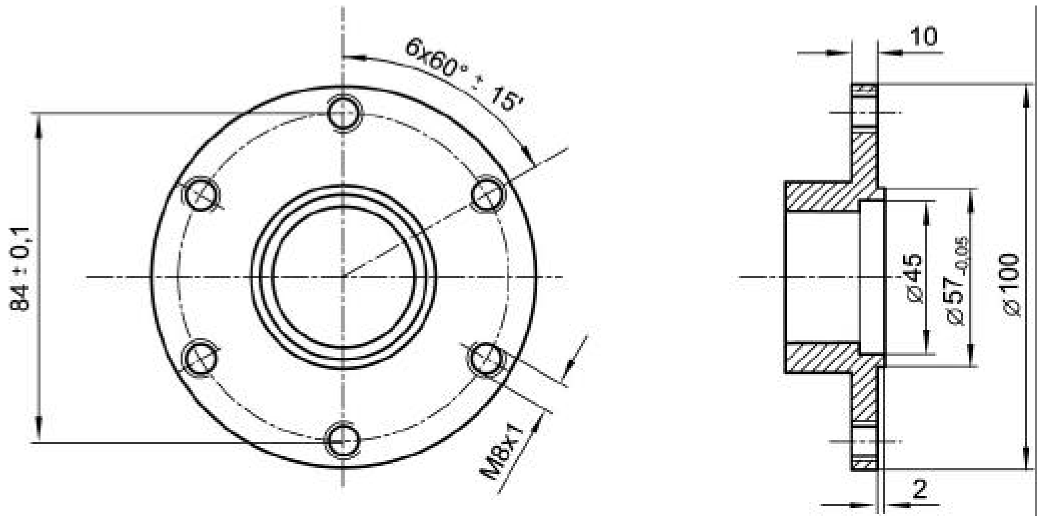
5.2.4.5 Flange design N07/N11 on BM 427 old version and current/437, MB No. 443 262 00 45



Note:
From October 1996, the flange drive of power take-off shaft N07/N11 will be discontinued on BM 427 (from vehicle 427102-187029), and replaced by a "stub" with an involute profile DIN5480, W45x2x30x21x8f, onto which the power take-off shaft is directly connected.

Instruction:
In the event of the direct implement-side connection of propshafts to the power take-off shaft gear, the involute connections must be sealed with rubber gaiters to protect against soiling and the action of water
(as in the case of vehicle-side propshafts N20/22/32/37).
On BM 437, the flange with the spur profile (see figure) remains in the use.

5.2.4.6 Flange design N06 on BM 427/437, MB No. 425 262 15 45



5.2.4.7 Power take-off shaft profile

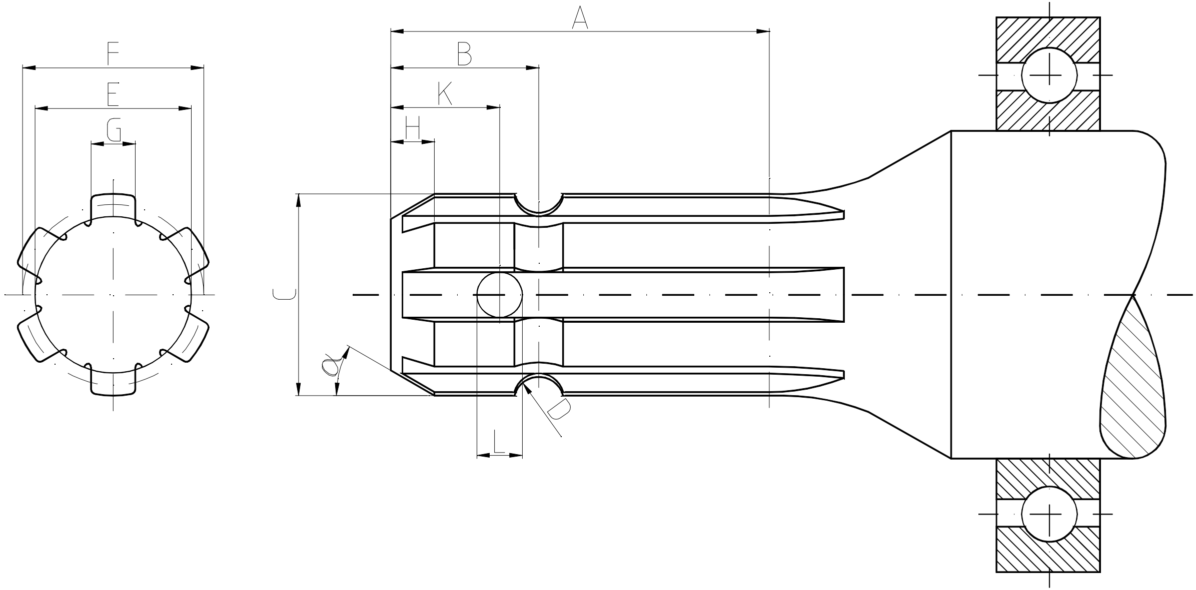


Figure 5.2 Power take-off shaft profile dimensions

Power take-off shaft profile	Dimension A	Dimension B	Dimension C	Dimension d	Dimension E	Dimension F	Dimension G	Dimension H	Dimension K	Dimension L	a	standardized according to
1 3/8" splined shaft	74	38	34.79 +/-0.06	R 6.7 +/-0.25	28.91 +/-0.05	29.5	8.69	7	-	-	30°	DIN 9611/ISO 500 (6 splines)
1 3/4" splined shaft	77	38	44.32	R 8.3	36 +0.25	37.2 +0.2	10.95 +0.05	8.7	25	9.9	30°	SAE J499a (6 splines)

all dimensions in mm
A = useable area (at least)

Figure 5.3 Power take-off shaft dimensions

5.2.5 Auxiliary power take-off

5.2.5.1 General

All auxiliary power take-offs can only be (pneumatically) engaged and disengaged when the vehicle is stationary. The auxiliary power take-offs can be used to drive hydraulic pumps (e.g. on crane or excavator operation) and fire brigade pumps when the vehicle is stationary. The drive can (with code N16) be flanged directly onto the transmission or (with code N17/N19) be connected via a propshaft . The flow of power to the transmission input shaft and therefore to the auxiliary power take-off is interrupted when the clutch is depressed. If the auxiliary power take-off is to be used during driving, driving may only be carried out in the previously selected gear. Shifting during driving is not possible, as the drag torque of the driven implement impedes synchronization in the transmission (Exceptions: Codes N71 in G31 and N72 on BM408.216: Shifting is possible if the vehicle clutch is disengaged but the flow of power is also interrupted in this case).

Designation code: SN = High-speed auxiliary power take-off
SSN= Very high-speed auxiliary power take-off

5.2.5.2 N16 with flange power take-off

On BM418, it is possible to equip auxiliary power take-off N16 (mating profile DIN 5480, N 30x2x14x9H) with flange power take-off (code N78). This threaded flange (part number 418 264 06 44, 6-hole M8, pitch circle ∅ 84mm) fits as regards installation i.e. on BM427/437, but can only be used with up to max. 50kW power consumption or approx. 200Nm drive torque.
The induction of radial force, which e.g. results from propshaft bending angles, is not permissible. General approval for the flange power take-off on BM 427/437 cannot therefore be issued.
Insofar as it is absolutely necessary, as a consequence of the application, to drive a propshaft via N16, a corresponding intermediate bearing must be flanged on in order to cope with the (radial and axial) propshaft forces.

5.2.5.3 Direction of rotation and speeds of auxiliary power take-offs N16/N17/N19/N71

Code	Designation	Transmission ratio	Model	Direction of rotation (in direction of travel)	Speed at rated engine speed [rpm]	
					2400	2600
N16	SN = High-speed auxiliary power take-off	i = 0.737 i = 0.588 at G10 (selectable)	418	right	3260 4080	-
N16	SN = High-speed auxiliary power take-off	i = 1.0	427/437	left	2400	2600
N17	SSN = Very high-speed auxiliary power take-off	i = 0.71	427/437	right	3380	3660
N19	SSN = Very high-speed auxiliary power take-off	i = 0.61	427/437	right	3930	4260
N71	Auxiliary power take-off with TwinDisc converter	i = 1.0	427/437	left	2400	2600

Figure 5.2 Table of auxiliary power take-offs

Attention (applies only to BM427/437):

In the event of chassis distortion, auxiliary power take-off N16, N17, N19 follows the distortion of the transmission and not, as would be expected, that of the frame. This is because of the 3-point mounting of the transmission in the frame, which is positioned transverse to the vehicle longitudinal axis. The relative movements between the transmission and vehicle frame therefore result from the rotation of the transmission around the vehicle transverse axis which runs through the right transmission mounting, which corresponds to the distortion angle of the frame. If parts of flanged pumps are to project above the tubular transverse member of the vehicle frame, a vertical space of 50mm must be taken into consideration in design. The actual relative movements are dependent on the type, geometry and weight of the body and on the conditions of use, and may only be determined exactly via distortion and driving trials.

5.2.5.4 Direction of rotation and speeds in auxiliary power take-off N72 (U100L Turbo)

Auxiliary power take-off N72 is located on the vehicle's transfer box. The transfer box is driven via a propshaft by the 5-speed manual transmission, so the speed of the auxiliary power take-off is dependent on which gear is engaged in the manual transmission. If the vehicle clutch is disengaged, the flow of power is interrupted. Driving and shifting when the auxiliary power take-off is engaged on is possible. The auxiliary power take-off itself can only be engaged and disengaged when the vehicle is stationary.

Vehicle model	Code	Gear (Speed)	Transmission ratio Manual transmission	Transmission ratio Transfer case	Direction of rotation (in direction of travel)	$n_{\text{power take-off}}$ [rpm] at rated engine speed
408.216 $n_{\text{rated/engine}}$=3800 rpm	N72	R	*		*	*
		1	5.053			885
		2	2.601			1720
		3	1.521	0.85	left	2940
		4	1.000			4470
		5	0.784			5700

*The auxiliary power take-off must not be used when the manual transmission is in reverse gear.

Note:
Auxiliary power take-off N72 can be used in all three (road/off-road/idle speed) of the transfer box's settings.
For all three settings, the speeds in the Table on Page 177 apply.

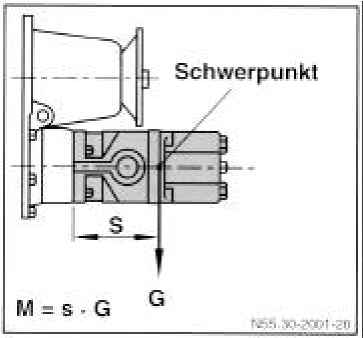
Safety instructions: **Depending on the component which is added-on, corresponding warnings regarding the high speeds of the auxiliary power take-off in 3rd, 4th and 5th gear must be displayed in the cab.**

5.2.5.5 Hydraulic pumps for auxiliary power take-off N16 on BM427/437

The implement manufacturer is responsible for selecting and coordinating the components.
The following hydraulic pumps can be driven via N16 (4 hole flange SAE C, 4xM12, pitch circle diameter 162mm, center diameter 127mm):

- Volvo pump type F1 with Volvo adapter No.603705750, VOAC Hydraulics, 45356 Essen, T.02131-5130
- Weser pump type WP340, Weser, 27751 Delmenhorst, T.04221-25181

Mass torque M

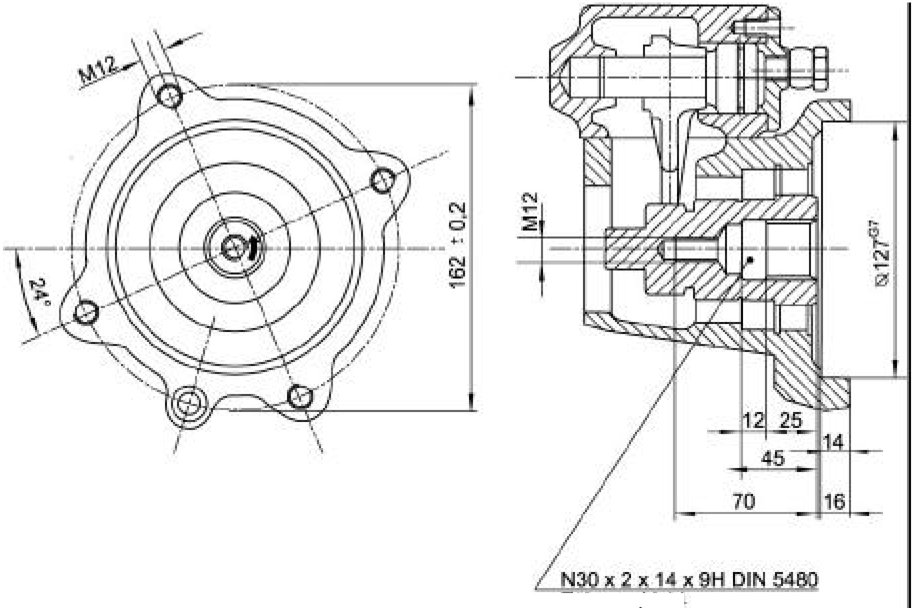


In the case of direct attachment of the hydraulic pump, the static load of the flanging surface must not exceed
M_{max} = 40 Nm as a result of the pump

Attention:
If this mass torque is exceeded, damage to the auxiliary power take-off or transmission may occur.

M= mass torque [Nm]
G= pump weight including fittings
S= distance of the pump's center of gravity from the pump flanging surface

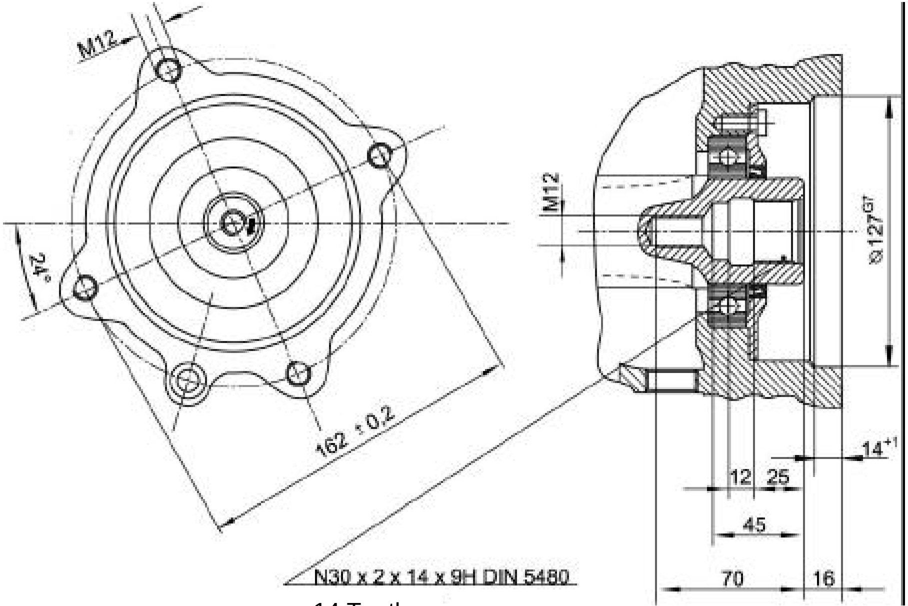
5.2.5.6 Connection flange/profile of auxiliary power take-off N16 on BM 427/437, MB No. 425 264 04 06 (driving pinion)



14 Teeth

Note:
Anticlockwise rotation
In code N76, the connection profile has the part number 425 264 05 06 (profile ANSI B92.2 M-1980 (SAE) 30°PA,21 teeth, 16/32 pitch)

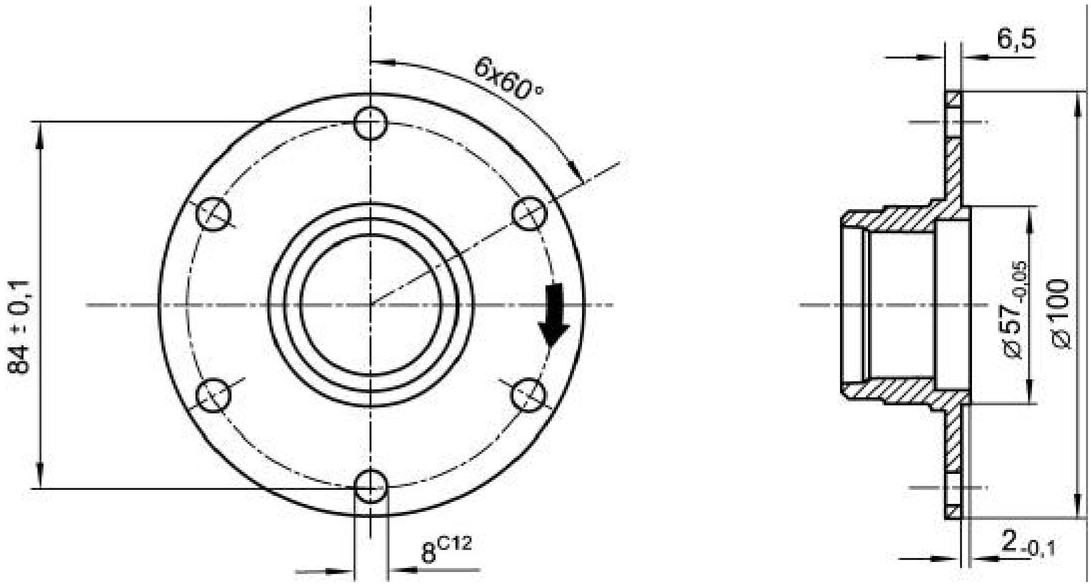
5.2.5.7 Connection flange/profile of auxiliary power take-off N16 on BM 418, MB No. 417 264 00 32 (driving pinion)



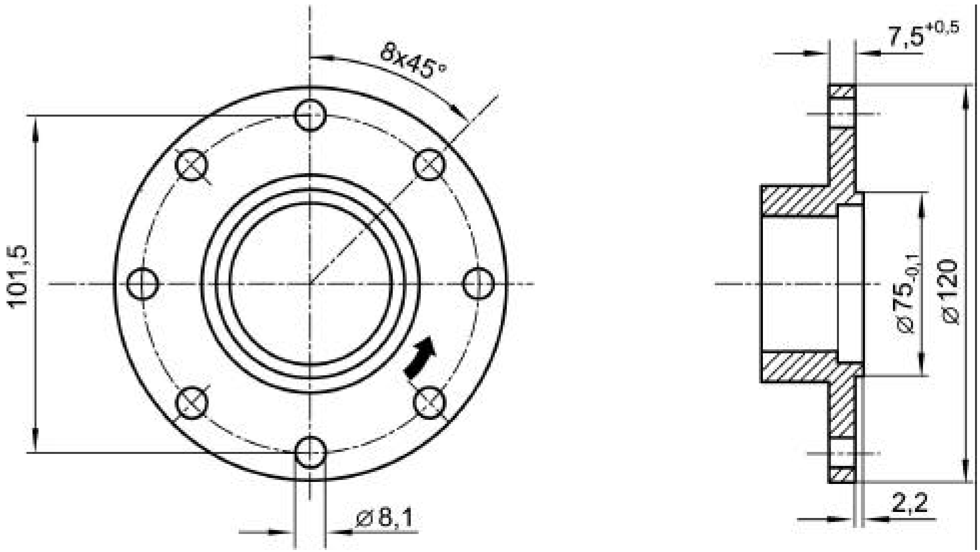
14 Teeth

Note:
Clockwise rotation

5.2.5.8 Flange design of auxiliary power take-offs N17/N19 on BM 427/437, MB No. 385 264 02 45

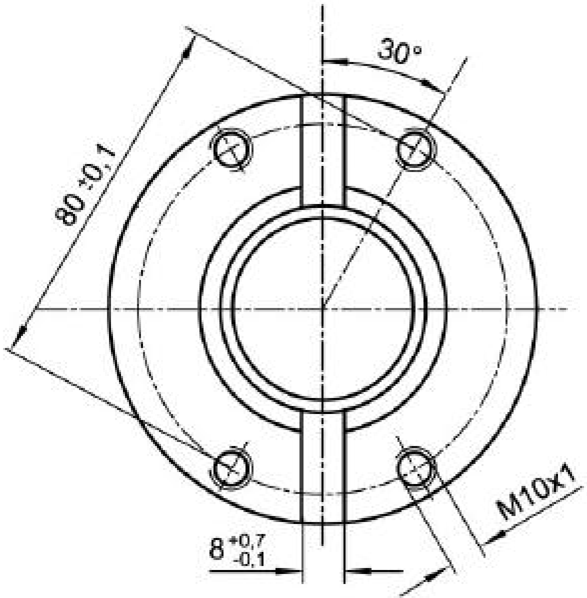


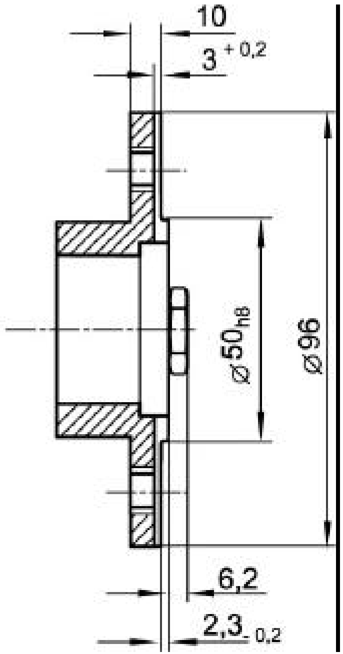
5.2.5.9 Flange design of auxiliary power take-off N71 on BM 427



Note:
Flange SAE J1496 type A 120x8x10 for propshaft GWB 587/15-120mm

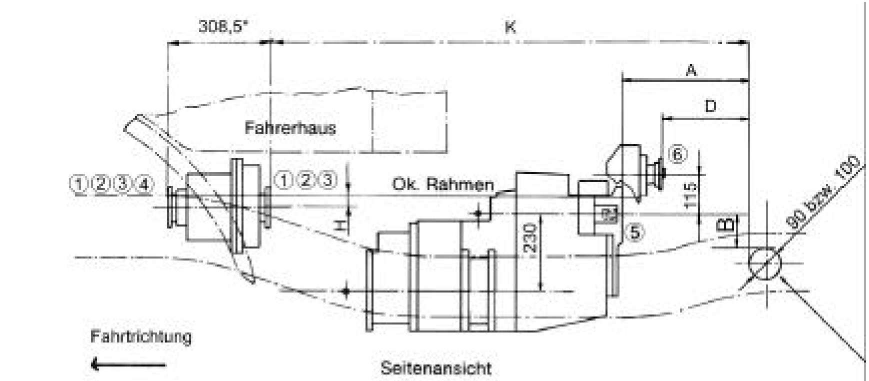
5.2.5.10 Flange design of auxiliary power take-off N72, MB No. 425 262 11 45



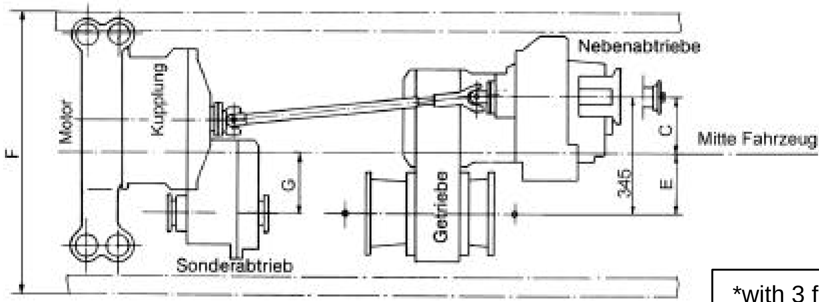


5.2.6 Positional diagram of power take-offs

5.2.6.1 N06/N07/N11/N16/N17/N19 on BM 427/437



1	LIFE PTO
2	TRANSMISSION PTO
3	HIGH SPEED LIFE PTO
4	PTO DRIVE FRT.
5	HIGH SPEED PTO
6	VERY HIGH SPEED PTO



Ansicht von oben

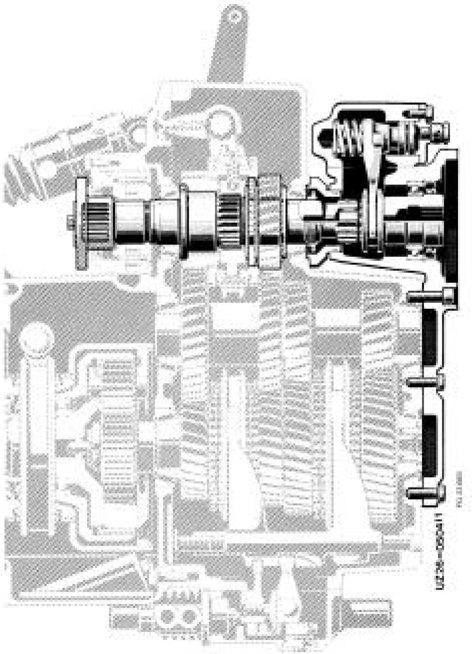
*with 3 flange to flange 284,4 mm
stub to stub 420,6 mm

UNIMOG type/sales designation	**Mod-el (BM)**	**Dimension A [mm]**	**Dimension B [mm]**	**Dimension C [mm]**	**Dimension D [mm]**	**Dimension E [mm]**	**Dimension F [mm]**	**Dimension G [mm]**	**Dimension H [mm]**	**Dimension K [mm]**
Tractor and operating unit short and long wheelbase										
U 1400	427.102	366.4	98.0	207	249.4	138	746/760*	180	20	1341**
U 1450	427.112	366.4	95.5	207	249.4	138	760	180	20	1341**
U 1600	427.105	366.4	98.0	207	249.4	138	760	180	20	1341**
U 1650	427.115	366.4	95.5	207	249.4	138	760	180	20	1341**
U 1600 (214)	427.107	366.4	98.0	207	249.4	138	760	180	20	1341**
U 1650 (214)	427.117	366.4	95.5	207	249.4	138	760	180	20	1341**
U 2100	437.105	439.4	47.5	166	322.4	179	840	180	37.5	1934.3
U 2150	437.117	439.4	47.5	166	322.4	179	840	180	37.5	1934.3
U 2400	437.105	439.4	47.5	166	322.4	179	840	180	37.5	1934.3
U 2450	437.117	439.4	47.5	166	322.4	179	840/856*	180	37.5	1934.3
UNIMOG chassis										
U 1450 L	427.111	366.4	95.5	207	249.4	138	760	180	20	1341**
U 1550 L	437.111	444.4	62.5	166	327.4	179	840	180	17.5/37.5*	1939.4
U 1550 L/37	437.120	444.4	52.5	166	327.4	179	840	180	37.5	1939.4
U 1550 L (214)	437.116	444.4	62.5	166	327.4	179	840	180	17.5/37.5*	1939.4
U 1550 L/37 (214)	437.125	444.4	52.5	166	327.4	179	840	180	37.5	1939.4
U 1650 L	427.116	366.4	95.5	207	249.4	138	760	180	20	1341**
U 1650 L (214)	427.118	366.4	95.5	207	249.4	138	760	180	20	1341**
U 2150 L	437.118	439.4	47.5	166	322.4	179	840/856*	180	37.5	1934.3
U 2150 L/38	437.136	439.4	49.5	166	322.4	179	840/856*	180	37.5	1934.3
U 2450 L	437.118	439.4	47.5	166	322.4	179	840/856*	180	37.5	1934.3
U 2450 L/38	437.136	439.4	49.5	166	322.4	179	840/856*	180	37.5	1934.3
U 2450 L/6x6	437.156	439.4	39.0	166	322.4	179	840	--	--	--

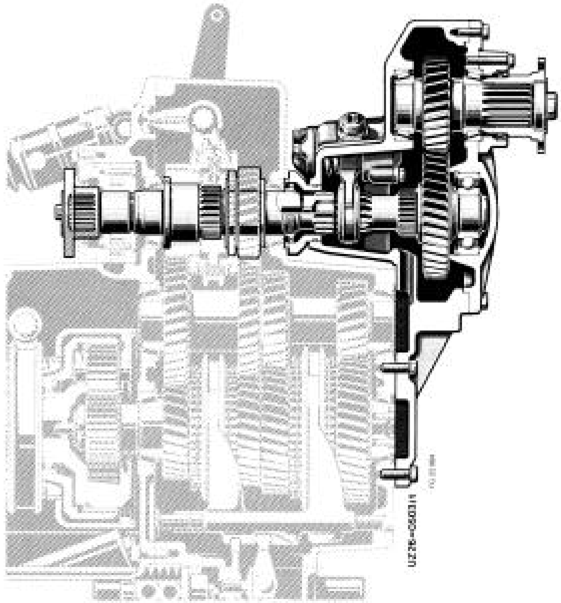
*with code X19 **PTO transmission stub tip in N07/11, in N06 flange power take-off K=1397mm

Figure 5.6 Table of power take-off coordinates

N16 on BM 427/437



N17/N19 on BM 427/437



5.2.6.2 N07/N11/N16 on BM 408/418

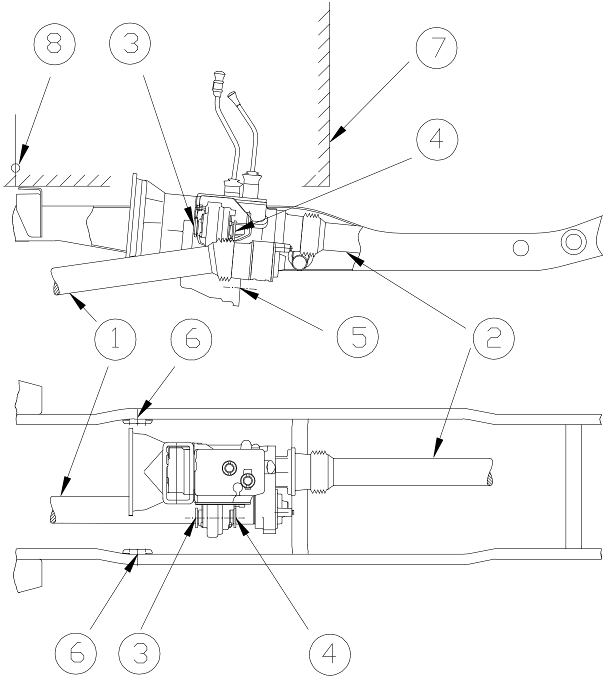


Figure 5.7 Positional diagram of power take-offs in Model 418

LEGEND:

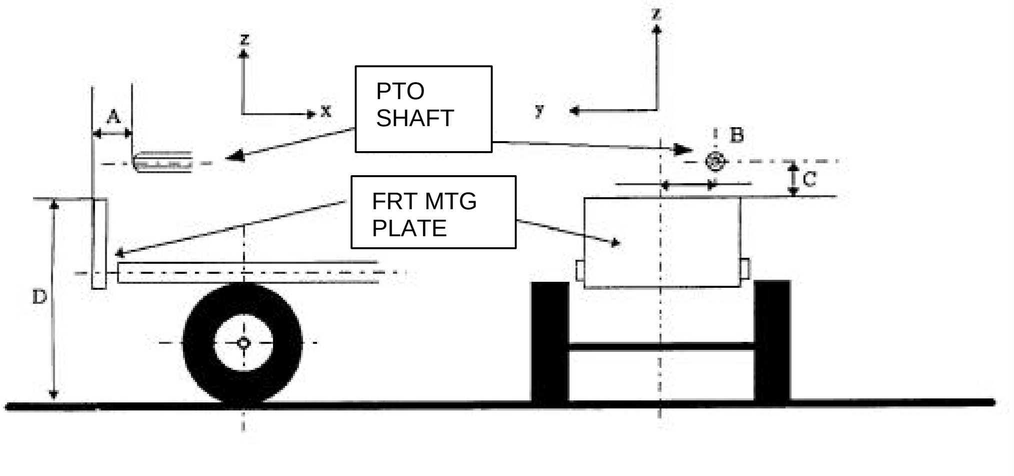
1 THRUST TUBE; FRT. AXLE
2 THRUST TUBE; REAR AXLE
3 PTO DRIVE; FRT.
4 PTO DRIVE; REAR
5 HIGH SPEED PTO N16
6 TRANSMISSION MOUNTING
(must not be used for mounting implements)
7 REAR FACE OF CAB
8 "0"- LINE OF CAB

Model		408.101		418		
Code		N07/N11		N07/N11		N16
Item on illustration 5.7		3	4	3	4	5
Coordinates [mm]	x	1593	1800	1594	1802	2057
	y	-171	-171	-161	-161	-115
	z	22	4	-19	-38	-204

Figure 5.8 Table of power take-off coordinates on BM 408/418

5.2.6.3 N20/N22 on BM 408/418/427/437

Mounting position of front power take-off shaft in relation to the front mounting plate (FAP)

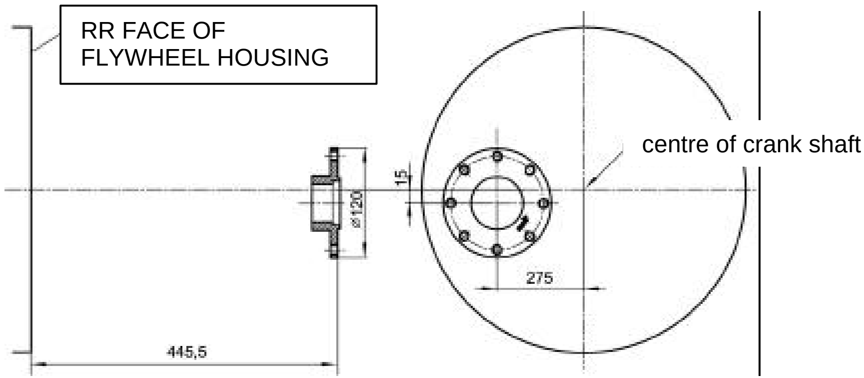


Size of FAP	Vehicle model	Dimensions [mm]				
		A nominal	B nominal	C nominal	D nominal	D actual (vehicle unladen)
1	408	35	195	38	-	805
3	418	65	198	149	900+/-60	880
	427	72	156	100	900+/-60	875
	437*	60	160	162	900+/-60	920
5	437**	80	160	42.5	980+/-60	1040

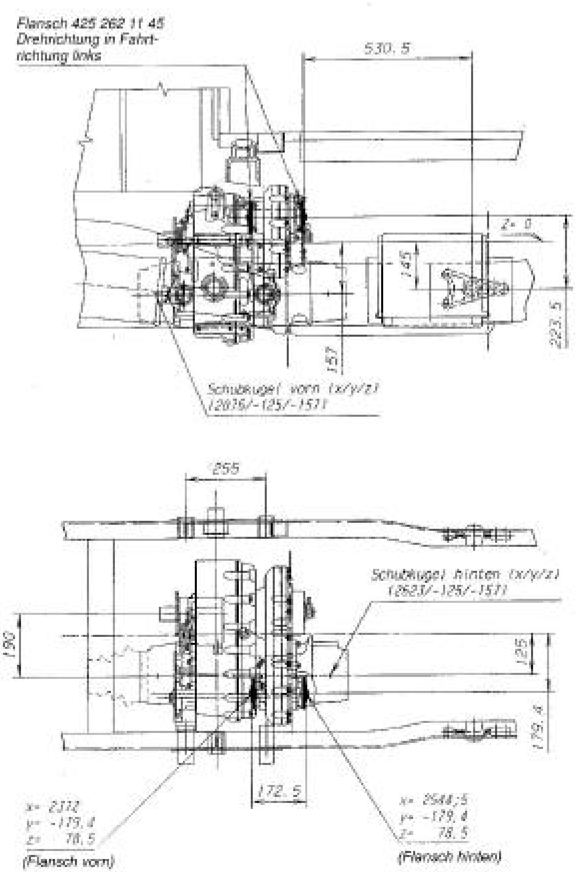
* Values for U1550L (only 165 frame profile, not with X19): A=76, B=165, C=86.5, D_{actual}=855, with 185 frame profile: C=162, D_{is}=770

**FAP size 5 not in U1550L, in U1550L37 D_{actual}=890

5.2.6.4 Positional diagram of auxiliary power take-off N71 on BM 427/437



5.2.6.5 Positional diagram of auxiliary power take-off N72 on BM 408.216, U100L Turbo



5.2.7 Maximum available output at the power take-off shaft / at the auxiliary power take-offs

The maximal available output can be determined approximately as follows:

1. Determination of the engine speed at which the output is to be taken off (e.g. at power take-off shaft standard speed 1000 rpm, ratio of power take-off shaft gear on BM427/437 i=2.19, resulting in engine speed 2190 rpm)
2. Determination of the engine output at this speed from the engine output diagram (Technical Manual)
3. Reduction in engine output due to the driven auxiliary components (fan, hydraulic pumps, steering pump, alternator, coolant compressor)
4. Consideration of the degree of efficacy of the drive train (approx. 85 to 95%), multiplication of the reduced engine output by this factor

5.2.8 Maximum useable output

5.2.8.1 Power take-off shaft

The permissible power take-off shaft outputs are predominantly dependent on the conditions of use, such as duration of use, ambient temperature and total implement load.

The full output of the engine can therefore only be used by the power take-off shaft (code N02/03/06/07/11/22/37) under certain conditions. On use of the 1 3/8 inch power take-off shaft stub (code N20/32), the power uptake of the driven implement must not exceed 50kW in any of the models.
In the case of high continuous power take-off shaft output, a power take-off shaft transmission fluid cooler (code G51/52, external cooling module with electric fan) is necessary.
The values in the following Table of possible power take-off shaft outputs are to be regarded as reference values. Measurement of the power take-off shaft transmission fluid temperature under conditions of actual use may possibly be necessary in order to determine any special measures such as fluid coolers or output limitations.

Engine output		Special measures	Comment (related to use with full engine output, only possible with 1 3/4 inch stub)
up to 100 kW	BM408/418	none	Synthetic fluid recommended at speed 540 rpm max. output 50kW
	BM427/437	none	Synthetic fluid recommended
up to 120 kW		Synthetic fluid, if necessary PTO transmission fluid cooler	Measure PTO transmission fluid temperature in use at fluid temperature over 130°C PTO transmission fluid cooler necessary
up to 155 kW		Synthetic fluid + PTO transmission fluid cooler	Use without PTO transmission fluid cooler only permissible for short-term operation (monitor fluid temperature)
over 155 kW		Synthetic fluid + PTO transmission fluid cooler	No continuous output, intermittent use e.g. in winter service rota

5.2.8.2 Auxiliary power take-off

A maximum 115kW may be used by the auxiliary power take-off (code N16/17/19/76), i.e. in the case of engine output up to 120kW, the full engine output may be used. For the use of continuous output in excess of 50kW at the auxiliary power take-off (code N16/17/19/76), a transmission fluid cooler (code G50) is necessary.

In combining auxiliary power take-off N16/17/19 and torque converter clutch G30, speed and torque conversion also takes place for the auxiliary power take-off. The speed at the auxiliary power take-off is therefore lower than in the case of straight drive. The maximum power take-off can be determined from graph 5.9. Power take-off must only be carried out in the gray shaded area, in order to keep the slip in the converter as low as possible, i.e. maximum 10% difference in speed between the engine and auxiliary power take-off N16. If the auxiliary power take-off is used during driving, the total drive shaft and auxiliary power take-off output must lie within the grey shaded area.

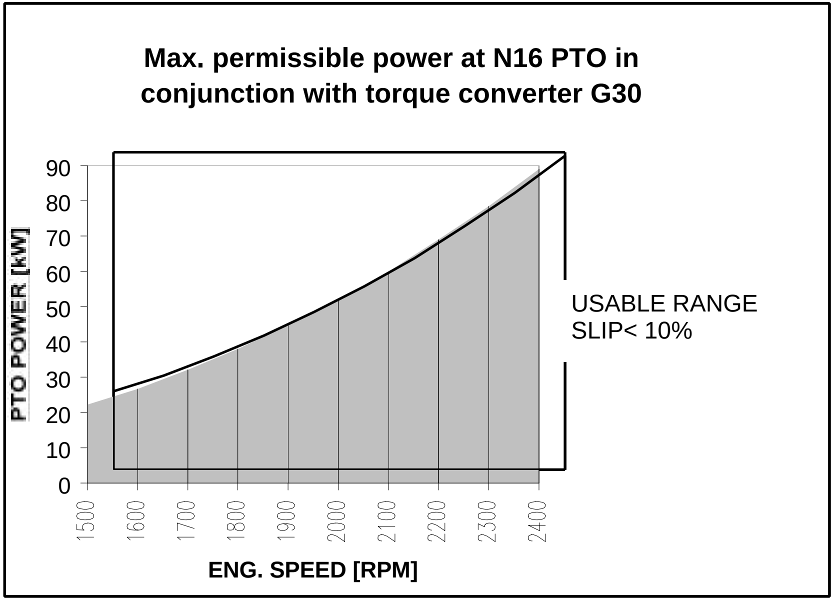


Figure 5.9 Power take-off graph

Auxiliary power take-off N71 of twin disc converter G31 involves a straight-through drive, speed/torque conversion is only carried out for the drive shaft. The maximum usable torque *in the case of continuous load* on the flange is 150Nm, i.e. a maximum 40kW/2600 rpm can be taken off. *In the short-term* a maximum 370Nm are permitted, i.e. 100kW/2600 rpm.
In the U100L/U100LTurbo, the auxiliary power take-off (code N72) may be loaded with **up to 30kW**. If higher output is taken off, the fluid in transfer box UVG300 must be replaced with a approved, high-quality synthetic fluid (e.g. CASTROL Syntrans) and the temperature of the fluid must be measured. If the temperature limit value of 130°C is exceeded, a fluid cooler may be connected to the short-circuit line which is accessible on the outside of the transmission. Please consult PBU/TES with regard to this.

If high output is continuously taken off at the power take-off shaft, the temperature limit values of the engine must be noted, see Chapter 5.2.9.3.

5.2.9 Information regarding the vehicle engine which is relevant to the implement drive

5.2.9.1 Engine speed control

Note: does not apply to U90/U90Turbo or U100L/U100LTurbo, see Chap. 5.2.9.4

The diesel engines OM364LA, OM366A and OM366LA are equipped as standard in all Unimog versions with the BOSCH-RSV variable speed governor at the injection pump.

Notes regarding variable speed control:

Variable speed control means that the engine speed is proportional to the adjusting lever setting (accelerator pedal/throttle hand lever) in all engine load conditions, i.e. that the injection pump governor independently governs the injection volume from zero up to the maximum injection volume, in order to maintain the specified speed. In doing so, the speed of the engine can, with a pre-specified lever setting, be "forced" by, at most, the so-called p-degree up to full load
under load. The p-degree of the RSV governor is almost constant over the entire speed range and is approx. 10 to 15%.

Definition of the p-(proportional-)degree: $\text{p-degree} = \dfrac{\text{zero load speed}^{*} - \text{full load speed}^{*}}{\text{rated speed}} \times 100\%$

*at a certain accelerator pedal position

Example: $n_{\text{rated}}=2400$ rpm, $n^{*}_{\text{zero load}}=1800$ rpm, $n^{*}_{\text{full load}}=1560$ rpm

*e.g. at accelerator pedal position 40%

$\Rightarrow$ p-degree = 10%

All UNIMOGs are equipped as standard with a throttle hand lever, which is mechanically connected to the accelerator pedal. The engine attempts to maintain the speed which is set via the throttle hand lever. The hand throttle setting may be overridden by the accelerator pedal.

5.2.9.2 Intermediate engine speed stop

The engines OM366A/LA in models 427/437 can be equipped with an intermediate engine speed stop device (code M12), or this may be retrofitted. The Intermediate engine speed blocking device is a pneumatic cylinder which is installed on the injection pump governor, which *is pressurized*, and which prevents the maximum engine speed setting from being exceeded via a mechanical stop. In this manner, for example, pumps connected to the auxiliary power take-off can be protected against being driven at too high a speed. All circuitry, the compressed air supply (line to the cylinder) and the engine speed setting are to be carried out by the implement manufacturer.

In the case of engines OM364LA in model 418 and OM602D29 in model 408 (only U90, not Turbo), the intermediate engine speed blocking device is provided by a pneumatic cylinder installed in the governing linkage, which is *vented* in order to limit engine speed.

5.2.9.3 Temperature limit values

Sufficient cooling air throughput must be guaranteed.

- Keep the radiator air inlet free
- Do not affix warning signs, badges or other trim parts in the area in front of the radiator.

In models 418/427/437 (engine series 300), the **continuous** coolant temperature at the engine outlet (=water cooler inlet-upper-) must not exceed 95°C (especially important in the event of power take-off at the power take-off shaft when the vehicle is stationary, i.e. no air flow due to motion), the continuous engine oil temperature (in the oil pan) must not exceed 120°C.

In model 408 (engine series 600), the continuous coolant temperature at the engine outlet (=upper water cooler inlet) must not exceed 105°, the limit value for the engine oil is 135°C.
In the U90Turbo/U100LTurbo, the injection volume is automatically reduced from 110°C coolant temperature by the electronic engine control unit in order to protect the engine against overheating ("anti-boiling protection").

In the event of overheating, relieve the load on the engine and allow to continue running at medium speed until it has cooled to a normal temperature level.

5.2.9.4 Engine in the U90/U90Turbo and U100L/U100LTurbo

The engine OM602D29 (Euro1, no longer available) in the U90 is also equipped with the BOSCH-RSV governor, Chap. 5.2.9.1 (Notes regarding variable speed control) applies accordingly. The same applies to the U100L when equipped with code M13 (RSV governor).

The engine OM602D29 (Euro1, no longer available) in the U100L is equipped as standard with an injection pump with the BOSCH-RSF governor. Due to the lack of engine speed control, implements may not be driven, or may only be driven to a limited degree. The same applies to the U90 when equipped with code M03 (RSF governor).

The engine OM602DE29LA in the U90Turbo/U100LTurbo is equipped with an electronic engine governor. The function of the variable speed control is contained as standard in the electronic s system and is always active. The notes listed in Chap. 5.2.9.1 regarding the variable speed control system of the mechanical RSV governor apply accordingly to the electronic engine speed control system.

5.2.10 Propshafts for driving implements

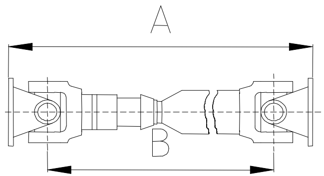
The propshafts must be positioned such that uneven running is impossible in all implement operating positions. The sliding parts of the propshafts must be selected such that i.e. **easy movement is possible at maximum torque transfer**. Telescopic type ball bearing traveler profiles should preferably be used in the case of high torques. The **direction of rotation** in the vehicle/implement combination must be **complied with**.

Attention: *Danger of accident.*

The implement manufacturer shall provide safeguards for rotating parts, i.e. in the area of the propshaft connection on the vehicle. Propshafts which are located in areas in which personnel passes or works must be encased or covered (accident prevention regulations **UVV**)

On installing propshafts note:

- The installation guidelines of the propshaft manufacturer.
- If necessary, use several propshafts with intermediate bearings.
- The mating surfaces must be completely plane.
- The bending angles must be identical at both joints ($ß_1=ß_2$). These must not be greater than 15° and not less than 1°.
- Balancing plates must not be removed.
- On installation ensure that the marks on the halves of the propshaft correspond.
- Balance the propshaft prior to installation.



A OVERALL LENGTH (Fl to Fl)
B PERMISSIBLE LENGTH BETW: JOINT CTRS.

Bild 5.10 DRIVE SHAFT

The correct layout of the propshaft train prevents the development of noise and vibrations. If possible, use original Mercedes-Benz parts.

5.2.10.1 Location of propshaft in three dimensions

The propshaft has a three-dimensional location when bending occurs in two planes, i.e. the drive shaft and power take-off shaft intersect in a displaced manner. A common plane, as is found in the case of W or Z-bending, does not exist. In order to compensate the occurring fluctuations in speed, the inner forks of the joint must be offset. This angle is designated with μ. See also Figure 5.11.

The following applies:

β_1 = three-dimensional angle of shaft 1 β_2 = three-dimensional angle of shaft 2 β_S = three-dimensional working angle

$$\boxed{\tan^2 = \tan^2 b_1 + \tan^2 b_2}$$ three-dimensional working angle

The horizontal and vertical working angles of the two propshafts reveal the angle of offset μ.

$$\boxed{\tan^2 \mu_1 = \frac{\tan_{\beta h1}}{\tan_{\beta v1}}} \qquad \boxed{\tan^2 \mu_2 = \frac{\tan_{\beta h2}}{\tan_{\beta v2}}}$$

$$\boxed{\mu = \mu_1 + \mu_2}$$

β_S = three-dimensional working angle β_v = working angle (vertical) β_h = working angle (horizontal) μ = angle of offset

An infinite number of possible positions may be created by the combination of the vertical and horizontal working angle. In order to better determine the angle of offset, the propshaft manufacturer should be involved in an advisory capacity.

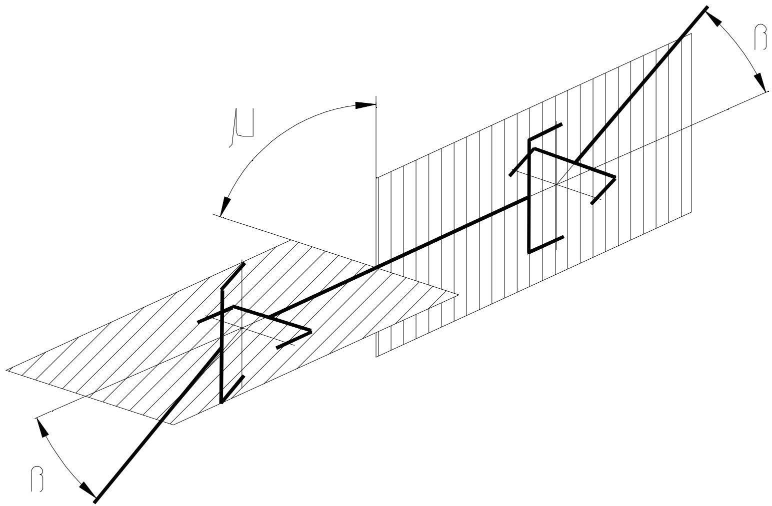


Figure 5.11 Three-dimensional propshaft location

5.2.10.2 Forces in the propshaft system

As a result of the working angle in the propshaft train, forces are introduced. Further additional forces are created if the propshaft is laterally displaced under the concomitant effect of forces and torques. The type, magnitude and direction of the additional forces are dependent on the relevant operating status and the type of propshaft position.

5.2.10.3 Working angle

In continuous operation, the propshaft angle must not exceed 15°. In the short-term, a working angle of a maximum 30° is permissible, but not if high outputs are to be transferred.
Working angle of greater than 15° and a flange angle error ($ß_1 \neq ß_2$) lead to critical vibrations on the drive train. These impair the service life of the components and may lead to damage.

Types of bending

- Bending in one plane:
  W or Z-bending

- Bending in two planes (three-dimensional bending):
  In the case of three-dimensional bending, the drive shaft and power take-off shaft intersect at an offset (combined W and Z-bending).

In order to compensate fluctuations in speed, the inner forks of the joint must be offset.

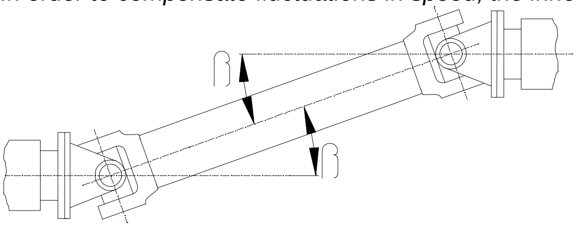


Figure 5.12 Z-position of the propshaft

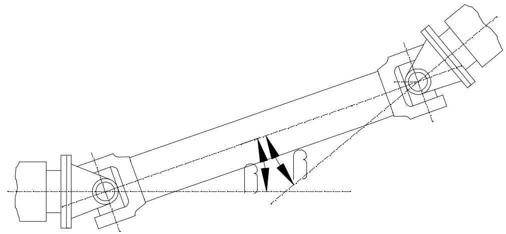


Figure 5.13 W-position of the propshaft

5.2.10.4 Assembly of the propshaft

Optimization of synchronization
All vehicle-side propshafts are statically and dynamically balanced in order to avoid vibrations. They are identified accordingly.

Each propshaft train comprises several joints, i.e. each propshaft train is subject to synchronization optimization (compensation of the rotational movement between drive and power take-off joints).
This synchronization optimization is coordinated exactly to the relevant installation position and overall length of the shaft train in the vehicle.

Prespecified joint offsetting is therefore taken into consideration as early as during welding, in order to compensate irregularity via slight differences in the working angles of the joints.

Important instruction:
On installation of a propshaft or a propshaft train, the joints must therefore be installed so that the marks on the joint parts are opposite one another.

Instruction:
Depending on the type of version, one of the two marks is located beneath the rubber sleeve.

Noise and vibrations:
Noise and vibrations may occur:

- If the speed of an implement is too high or too low.
- Due to vibrations originating from the working unit.
- If the load is too high or too low.
- Due to worn-out joints or bearing mountings.
- Due to propshafts which are incorrectly assembled following repair as a result of the marks' not being noted or the absence of the marks.

5.3 Hydraulic drive

5.3.1 General instructions regarding the use of the vehicle hydraulic system

Implements, which are to be properly operated in conjunction with the vehicle hydraulic system, are to be reviewed as regards:

- The maximum volume of fluid which can be taken from the vehicle system.
- The necessary flow cross-sections (nominal line diameters, etc.) corresponding to the maximum flow rate
- The available system pressure (primary pressure relief).
- The necessary fluid quality
- The permissible degree of fluid heating (see Chapter 5.3.4).
- The compatibility of the port connections
- Actuation speeds
- The actuation speed of the implements must be designed, by accordingly designing the size of the actuating cylinder and/or the installation of flow control valves (chokes) in such a way that the implements cannot move suddenly when actuated (risk of accident, implements and vehicle strain)
- Do not connect operating implements which are mounted at the front and rear to the same valve cell.
- In order to rule out operating errors, all implements which operate in a floating position must be connected in a single-acting manner.
- *"Raise"* connection hose to connection *"raise"*, see Chapter 5.3.2.
- *"Lower"* connection hose on *"separate return".*
- Only load the hydraulic system when the engine is at operating temperature.
- Prior to initial operation, note fluid level and permissible volume which may be consumed. See operating instructions.
- Note safety instructions. See Chapter 8.2.

5.3.2 Interfaces/ports

The hydraulic connection of implements can be carried out at the standardized front and rear ports. For implements which require a constant fluid supply during operation, such as e.g. load side-connected control units or hydraulic motors, retaining latches are available for the control lever.
Each double acting cylinder may only be connected to one cell, so that its actuation is analogous with the movements of the operating unit (raise: *pull* hydraulic actuating lever, lower: *push* hydraulic actuating lever).

The ports are identified with symbols as regards function and allocation to the relevant control unit (see vehicle operating instructions). From chassis number 408.101-186567 and 427.102-186662, this identification is carried out via numbers. For the position of the ports on the vehicle, see vehicle operating instructions and Chap. 5.3.2.1 to 5.3.2.4
By connecting the lower line of the front power lifter at the separate return, this becomes single acting, and the implement cannot be unintentionally pushed into the ground with this allocation.

Explanation of the port symbols:

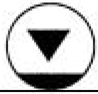
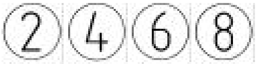
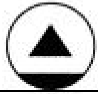
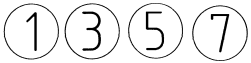
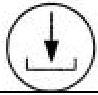
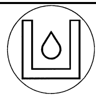
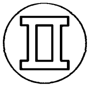
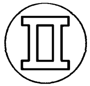
Old	New	Function
		Lower
		Raise
		Separate return
		Circuit II

Figure 5.14 Hydraulic port symbols on the vehicle

5.3.2.1 Coupling sizes

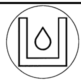
All hydraulic ports on the vehicle side are designed as *coupling sockets* (female).
The pressure line couplings in circuit 1 have the nominal diameter BG3 and correspond to ISO 7241-1:1987 (E).
The couplings of circuit 2 and the separate return have the nominal diameter BG4.
Corresponding connectors can be obtained e.g. from **Voswinkel, D-58540 Meinerzhagen.**

5.3.2.2 Front ports

A maximum of 10 ports are available for operating front-mounted implements:

8 BG3 connectors *	circuit 1, cell 1 to 4
1 BG4 connector	circuit 2
1 BG4 connector	separate return

* one connector for both supply and return

Table of port allocations				
Circuit	**Cell**	**Port No./symbol**	**Symbol color**	**Operating lever actuation (by driver in LHD)**
I	1	①	red	pull
		②	red	push
	2	③	green	pull
		④	green	push
	3	⑤	yellow	pull
		⑥	yellow	push
	4	⑦	blue	pull
		⑧	blue	push
II	1		white	(switch II)
	1		black	(return line)

Circuit I Port arrangement on the vehicle seen from left to right in direction of travel in ascending sequence

Circuit II Pressure line left, return line right

on BM408/418, position below the bumper, on BM427/437 position above the bumper

5.3.2.3 Center port

only circuit II in the area to the right behind the cab

5.3.2.4 Rear connection, position related to end transverse member (SQT)

Vehicle model	Hydraulic circuit	Position on the vehicle
408	I	above SQT as in 5.3.2.2
	II	with standard SQT (on right beneath SQT): II left, SRL right with SQT for implement (Q36): SRL above, II below
418	I	above SQT as in 5.3.22
	II	II left, SRL on right in the standard SQT with SQT for implement (Q36): as on BM408
427	I+II	above SQT (seen in direction of travel): left side: II; 4; 3; 1; 2 / right side: 7; 8; 5; 6; SRL
437	I+II	above SQT (seen in direction of travel): left side: II; 4; 3 / right side: 2; 1; SRL or optionally left side: II; 8; 7 / right side: 3; 5; SRL

5.3.3 Hydraulic pumps/drive outputs

Hydraulic pumps

The hydraulic pumps (gear pumps) are driven by the engine crankshaft via a V-belt. The specified pump outputs refer to rated engine speed without taking the mechanical-hydraulic degree of efficacy into consideration. Depending on speed and pressure, the volumetric degree of efficacy is between 0.85 at low speeds and 0.99 at high speeds.

As regards the function of the hydraulic system and the control valves, see operating instructions or "Driver's information" brochure (Source: UNIMOG Sales/Service Department, PBU/VS, Tel. 07225-61-2297, Fax 07225-61-5095).

5.3.3.1 Single circuit hydraulic system

For the single circuit hydraulic system, an internally toothed wheel pump with $16 cm^3$ displacement volume is used (BM 408: 001 553 03 01, BM 418: 001 553 05 01, BM 427/437: 001 553 18 01). The resulting pump outputs are between 45 and 55 l/min (see Table 5.2.1).

5.3.3.2 Twin circuit hydraulic system

In the twin circuit hydraulic system, a tandem pump (two coaxially mounted internally toothed wheel pumps with 16 and $6.3 cm^3$ displacement volume, BM 408: 001 553 06 01, BM 418: 001 553 08 01, BM 427/437: 001 553 08 01) supplies two separate hydraulic circuits with different pump outputs (see Table 5.21). Due to the twin circuit hydraulic system, two consumers which are not dependent on one another may be operated simultaneously. Due to volume switchover, the volume of fluid can be switched from circuit I to circuit II and vice-versa.

5.3.3.3 Hydraulic output / standard values

The installed hydraulic output is generally calculated according to the following formula:

$$P = \frac{Q \times p}{600} \times \eta_{ove}$$

whereby:
- P= output[kW]
- p= pressure[bar]
- Q= pump volume[l/min]
- η_{total}= total degree of efficacy[-] (dependent on pressure, pump volume/speed, temperature, leaks, etc.)

Note:
Due to the possible range of the degree of efficacy, only the output is calculated from the hydraulic standard values Q_{max} (at rated engine speed) and p_{rated} (rated pressure) in order to estimate the required output. The standard output is thus:

$$P_E = \frac{Q_{max} \times p_{rated}}{600} \qquad \text{with } \eta_{total} = 1$$

The engine output to be applied for driving purposes is therefore always greater, and the hydraulic output provided is always less, than the standard output.

5.3.4 Hydraulic control unit

Mechanically actuated 4/4 directional control valves with neutral setting, two pressure settings and floating setting are used. Circuit I can be equipped with up to four double acting valve cells with the relevant switch settings for the functions:

- Raise
- Lower
- Neutral
- Floating setting
  and with up to eight ports at the front and rear.

If equipped with a multi-cell valve block, the subsequent operation of several implements is possible. Only hydraulic valves which are connected together in a series circuit are installed. In the series circuit, the full pump current always reaches the actuated valve. If a second load side-connected valve is actuated at the same time, this remains without pressure. The concomitant control of two independently operating implements is therefore not possible.

5.3.5 Fluid heating

In the case of continuous consumers, **the implement manufacturer must ensure** that the maximum temperature cannot be exceeded under the expected conditions of usage. The guideline value is 100 °C (80°C in the case of rape oil), but is dependent on the type of oil which is used and the operating duration of the oil. Further details should be obtained from the oil manufacturer.
In order to avoid impermissible oil temperatures, an auxiliary oil cooling system may have to be installed (e.g. code G51). A lesser degree of oil heating can, i.e. be achieved via a larger volume of oil (larger reservoir). Basically, a check should be carried out to see whether unnecessarily high loss of output may be avoided via the coordination of all hydraulic components with regard to the relevant use or operating point.

5.3.6 Types of fluid

Only mineral oils approved by Daimler-Benz AG may be used in the hydraulic system. The Gaggenau plant provides approvals for vegetable oils.

Vegetable oil for the hydraulic system
Vegetable oil is biologically degradable and is suitable for use in ground water preservation areas (water risk class WGK 0). These oils may be mixed with mineral oils.

After mixing, it is no longer biologically degradable.

Use of vegetable oil in UNIMOG vehicles
As regards filling up new vehicles ex-works, two types of biologically degradable oil are available as optional extras (code H95 rape oil, Fuchs Plantolhyd 40 N, code H97 carboxylic acid ester, Panolin HLP 46 synthetic), plant approval is available for both of these oils.

The approval of other types of oil is in preparation.

Use of vegetable oils in old and new implements
As the service life increases, vegetable oils have an aggressive effect on seals and hoses. The implement or body manufacturer must clarify whether the hydraulic components are suitable for the use of vegetable oils with his suppliers. Department PBU/TES must be informed if any old implements or oil types are prohibited.
The following companies can supply components which are suitable for use with vegetable oil:

Components:

AEROQUIP GmbH, Dr.Recke-Str.1, 76532 Baden-Baden, Fax 07221-682-277
BUCHHOLZ Hydraulik GmbH, Wasserwerkweg, 24147 Klausdorf-Schwentine,
Fax 0431-7900740
VOSWINKEL GmbH, Neugrünenthal, 58540 Meinerzhagen, Fax 02354-705-145

Seal manufacturers:

FREUDENBERG Dichtungstechnik, 69465 Weinheim, Fax 06201-88-4489
PARKER Prädifa, Arnold-Jäger-road, 74321 Bietigheim-Bissingen,
Fax 07142-351293

Instructions:
On replacement of the oil, the implement should be drained and flushed through once with vegetable oil. This flushing oil must not be disposed of
in the same manner as unmixed vegetable oil.
It is possible to mix vegetable oils with mineral oils, but this is not recommended.
Synthetic esters are sensitive to water.

Disposal
Vegetable oil must **not** be disposed of into the sewer or directly into the ground.
Slight loss due to leakage alone does not pollute the ground.

Comparative factors between mineral oil – vegetable oil

Fuel Viscosity index	**Mineral oil** SAE 10 W	**Rape oil** (HTG)	**Synthetic ester** (HE) Oleic acid / carboxylic acid [1.)]
Application	- moderate - more heavy - continuous	- lighter	- moderate - more heavy - continuous
Temperature behavior	-20 °C over +100 °C	-10 °C +70 °C	-30 °C / -40 °C over +100 °C
Properties	• Good aging stability • Good lubricative capacity	Decreased aging stability at temperatures over 70 ^{0}C • Very good lubricative capacity	• High service life and aging stability (especially carboxylic acid oils) • Very good lubricative capacity, i.e. at high temperatures
Seal compatibility	• Very good	• Less good/not guaranteed	• Less good/not guaranteed
Miscibility	• Can be mixed with vegetable oil	• Can be mixed with mineral oil	• Can be mixed with mineral oil
Service life/maintenance	• Oil change interval • Hours of operation • 2400 h	• Oil change interval Hours of operation 1200 h at least once per year	• Oil change interval Hours of operation 2400 h (oleic acid basis) 3600 h (carboxylic acid basis)
Environmental compatibility	• Water risk class • (WGK 3)	• Water risk class (WGK 0) environmentally-compatible	• On request
Price factor	• 1	• 2 to 3	• 4 to 6 Oleic acid ester / 8 Carboxylic acid ester
Service life factor	• 1	• 0.5	• 1 / 1.5
Disposal	• Hazardous waste • Special waste oil container A1	• Hazardous waste Separately stored and collected as specified in the German Waste Disposal Law	• Hazardous waste Separately stored and collected as specified in the German Waste Disposal Law
Recycling or waste code	• 541 12	• 121 02	• 541 06

Table 5.15 "Comparison of mineral oil - vegetable oil"

5.3.7 Shut-off valve/neutral position

When driving on public roads, the actuating levers must be locked to prevent unintentional actuation.

To do this, switch actuating lever to neutral position and push the locking lever into "Lock" position.

When transporting front and rear-mounted implements on the hydraulic power lifter on public roads, the hydraulic line must be sealed via the shut-off, so that the implement does not lower. In the case of *terramatic* this is not necessary, as the transportation position of the implement readjusts itself independently.
"Terramatic" electronic lifting gear regulation system
For certain types of BM427/437 (for availability, see current price list), a hydraulic control system developed by Daimler-Benz AG, the electronic lifting gear regulation system *terramatic*, is available. The *terramatic* is available in two variants:

Variante	elektrische Bedienbarkeit	Lagesensor hinten	Fernbedienung hinten	Anschluß für Tastregelung	Drucksensor für Zylinderdruck-regelung	Lagesensor für ALL-Regelung	Umschaltventil Front/Heck für terramatic	Lagesensor Tastfühler Anschluß vorn	Fernbedienung vorn	Heckkraftheber doppeltwirkend
2 (Code H38)	X	X	X	X	X	X	-----	----	----	----
3 (Code H39)	X	X	X	X	X	X	X	X	X	X

Figure 5.16 Table: "terramatic variants"

Difference between variant 2 and 3 of *"terramatic"*

Merkmal	Variante 2	Variante 3	Nutzen
Automatische Senksperrung; Hubbegrenzung	X	X	Höhere Sicherheit im Geräteeinsatz
terramatic -Bedienpult und elektrische Fernbedienung am Heck	X	X	Höherer Bedienungskomfort
Lageregelung	X	X	Automatisches Wiedereinstellen der Arbeitsstellung nach Hubvorgängen
Außenanschluß für Tastregelung	X	X	Bessere Tiefenführung
Zylinderdruckregelung	X	X	Übernahme von Gerätegewicht auf den UNIMOG
Zylinderdruckregelung oder Tastregelung	X	X	Ausgleich von Bodenunebenheiten ohne Stützräder
Zylinderdruckregelung am Heck	X	X	Geregeltes Tragen von Geräten mit Restlast (z. B. Mähwerk)
ALL-Regelung (automatisch lastabhängige Lageregelung)	X	X	Exakte Höhenführung von Spritzbalken und Düngerstreuer unabhängig vom Belastungszustand
Umschaltung auf doppeltwirkendes Steuerventil	-----	X	Heckkraftheber auch doppelt wirkend
Elektrische Fernbedienung	-----	X	Fernbedienung an Front- und Heckkraftheber beidseitig
Für Frontkraftheber: Lageregelung Zylinderdruckregelung	-----	X	Regelung des Frontkrafthebers

Figure 5.17 Table: "Comparison of terramatic variants 2 and 3"

5.3.9 Technical data

UNIMOG TYPE	MODEL NUMBER	terramatic 1.) Variant 2	terramatic 1.) Variant 3	OP. PRESSURE in bar	TOT. SYSTEM CAPACITY (l)	USABLE VOLUME (l)	OPT. AVAILABL. NUMBER OF HYDR. SOCKETS: NUMBER OF CONTROL VALVES (STACK-UP) a.)	PUMP DELIVERY [l/min]	CIRC. 1 FRONT	CIRC. 1 REAR	SEPARATE RETURN FRON	SEPARATE RETURN REAR	CIRC. 2 vorne	CIRC. 2 hinten	CIRC. 2 mittig b.)	CIRCUIT 1 in l/min	CIRCUIT 2 in l/min	CIRCUIT 1 und 2 Summenschaltung in l/min
TRACTORS AND IMPLEMENT CARRIERS SHORT AND LONG WB																		
U 90 Turbo	BM 408.101	----	----	200	36	26	2 oder 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 130	BM 418.102	----	----	200	36	26	2 oder 4	51	bis 8	bis 8	1	1	1	1	1	20	51	71
U 1400	BM 427.102	X	X	200+15	31	26	bis 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 1450	BM 427.112	---	---	200+15	31	26	bis 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 1600	BM 427.105	X	X	200+15	31	26	bis 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 1650	BM 427.115	---	---	200+15	31	26	bis 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 1600 (214)	BM 427.107	X	X	200+15	44	40	bis 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 1650 (214)	BM 427.117	---	---	200+15	44	40	bis 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 2100	BM 437.105	X	X	200+15	44	40	bis 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 2150	BM 437.117	---	---	200+15	44	40	bis 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 2400	BM 437.105	X	X	200+15	44	40	bis 4	51	bis 8	bis 8	1	1	1	1	1	20	51	71
U 2450	BM 437.117	---	---	200+15	44	40	bis 4	51	bis 8	bis 8	1	1	1	1	1	20	51	71
CHASSIS/CAB L- Variante																		
U 100 L Turbo	BM 408.216	----	----	----	----	----	----	---	----	----	----	----	----	----	----	----	----	----
U 140 L	BM 418.117	----	----	----	----	----	----	---	----	----	----	----	----	----	----	----	----	----
U 1450 L	BM 427.111	---	---	200+15	31	26	bis 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 1550 L / U 1550 L/37	BM 437.111 / BM 437.120	---	---	200+15	31	26	bis 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 1550 L (214) / U 1550 L/37 (214)	BM 437.116 / BM 437.125	---	---	200+15	44	40	bis 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 1650 L / U 1650 L (214)	BM 427.116 / BM 427.118	---	---	200+15	44	40	bis 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 2150 L / U 2150 L/38	BM 437.118 / BM 437.136	---	---	200+15	44	40	bis 4	47	bis 8	bis 8	1	1	1	1	1	18	47	65
U 2450 L / U 2450 L/38	BM 437.118 / BM 437.136	---	---	200+15	44	40	bis 4	51	bis 8	bis 8	1	1	1	1	1	20	51	71
TRACTION HEADS																		
U 130 T	BM 418.000	----	----	200	36	26	2 oder 4	51	bis 8	----	1	----	1	----	----	20	51	71
U 1400 T	BM 427.000	----	----	200+15	31	26	bis 4	47	bis 8	----	1	----	1	1	----	18	47	65
U 2100 T	BM 437.002	----	----	200+15	44	40	bis 4	47	bis 8	----	1	----	1	1	----	18	47	65

a.) Double acting valves with "float" setting   1.) Available option (SA)
b.) Standard requirement for snow clearing vehicles (hdry. Socket rear of cab at r.h.s)
For tech. Data on frt. Power lift see chap. 4.2.1.6.1/ rr. Power lift see chap. 4.2.3.6

Figure 5.18 Table: "Hydraulic system"

5.4 Power supply and signal transfer

5.4.1 General instructions for electric drives

See also Chapter 3.10 "Prevention of damage" to the "electrical system".

Adjustment of the headlamps

Following the completion of the vehicle, the headlamp setting must be checked for road traffic safety reasons (MERCEDES-BENZ service station).
Use headlamp adjustment unit.
Note basic headlamp setting (see rating plate).

In order to adjust the headlamps, see operating instructions.

Lighting/outline lamps

If a lighting facility may be covered by more than 50 % when implements are operated on the stationary vehicle, the vehicle must be secured accordingly. Any instruction for the vehicle operator must be easily seen.
Vehicles whose overall length exceeds 6m must be equipped with side marker lamps in accordance with Directive 91/663/EEC.

See also "UNIMOG Technical Manual", "General" Chapter.

According to § 51b StVZO and EC Directive 76/756/EEC, vehicles with a width >2100 mm must be equipped with outline lamps. Vehicles with a width of 1800 to 2100 mm may be equipped with outline lamps.
If the lamps or license plates are covered by implements or implements, these must be repeated or moved. In the case of fixed implements, e.g. cranes, the vehicle's lighting or license plates may be moved.
In the case of swap bodies, the lighting or the license plate (incl. lighting) must be repeated on the implement.

5.4.2 Electric cables

Cable cross-sections

On determining cable cross-sections, the decrease in voltage in the conductors must be taken into consideration. If the decrease in voltage is too great, this may lead to the conductor's becoming heated and, under certain circumstances, to a cable fire. Conductor cross-sections of less than 1 mm^2 are to be avoided due to the low stability of the conductor. The positive and negative cables must have the same cross-section. Specialist literature provides information regarding the cross-sections of electric conductors which are to be used or which are suitable. No more than 3A should be carried per mm^2 cable cross-section.
The necessary cross-section must be calculated by the manufacturer of the implement and must be tested under concrete practical conditions.

On extending electric cables, note the following:

- Only use FLK-R cables with the same cross-section and same basic and identification color as the standard cables (FLK-R= standard for low voltage cables with thin-walled insulation for use in road traffic).
- The cables must be sheathed with an insulated hose (with a corrugated hose in the case of vehicles carrying hazardous loads (GGVS)) (GGVS = German Law on the Road Transport of Hazardous Loads).
- Only attach original MERCEDES-BENZ connectors to the ends of cables.
- Electric cables may only be connected via junction boxes.
- Do not change standard connections, i.e. ground connections.
- On changing the length of cables or on installing further cables, water-proofed connectors must be used.
- If the installation position of electric or electronic components is changed, the length of the electric cable must be adapted. Slight excess in the cable length may be compensated for via corresponding routing. Excess length must not be routed in rings or loops.
- On routing cables from one side of the frame to the other, an already existing bore hole must be selected. An additional hole may only be drilled if there is no other possibility of passing the cable through the frame. The bore hole must be provided with edge protection, so that the cables are protected against damage.

See also Chapter 3.11.3 "Connection and cable routing".

5.4.3 Current consumption - auxiliary consumers

If auxiliary electrically driven components are installed, batteries or alternators with higher outputs may be necessary. Retrofitting of larger batteries by the implement or body manufacturer is possible.
If, despite these measures, the output of the vehicle electrical system is insufficient, a vehicle-independent power supply must be installed.

If electrical consumers are subsequently installed by the implement or body manufacturer, the following must be noted:

- On special request, an auxiliary alternator (code M38) may be retrofitted on BM 418/427/437 .
- Do not connect further consumers to occupied fuses.
- Do not connect additional cables to existing cables (e.g. with insulation displacement connectors) .
- Provide consumers with sufficient protection via additional fuses.
- In vehicles with a 24 Volt system, the power for 12 Volt implements must only be supplied via a voltage transformer . **Supplying power from only one battery is not permissible.**
- A continuous current socket, from which max. 8A may be taken, is located in the instrument panel; the voltage corresponds to that of the vehicle electrical system.
- On BM427/437, a **12V** continuous current socket (MB No. 004 545 64 26), fused with 25A, is available as optional equipment (code E37) . The socket is located on the right under the instrument panel (left hand drive vehicle) and is supplied via a voltage transformer in the case of 24V vehicles.
  On the 3-pin socket, terminal 30 and terminal 31 are occupied. The accompanying connector is available as a replacement part under part number 022 545 90 28.

5.4.4 Trailer socket

All vehicles are equipped with a trailer socket as standard. 24 Volt vehicles are equipped with a 15-pin socket complying with ISO 12098, 12 Volt vehicles are equipped with a 13-pin socket complying with ISO 11446.

The 15-pin socket has the following pin-outs

Contact No.	Function
1	Turn signal lamp, left
2	Turn signal lamp, right
3	Rear fog lamp
4	Ground
5	Left rear lamp, left outline lamp and license plate lamp [1)]
6	Right rear lamp, right outline lamp and license plate lamp [1)]
7	Brake lamps
8	Reversing lamp
9	24 V
10	Not occupied
11	Not occupied
12	Not occupied
13	Not occupied
14	Not occupied
15	Not occupied

[1)] The license plate lamp must be connected such that no lamp is connected to this device with both contacts 5 and 6.

The 13-pin socket has the following pin-outs

Contact No.	Function/current circuit
1	Turn signal lamp, left
2	Rear fog lamp
3	Ground
4	Right turn signal lamp
5	Right rear lamp, outline lamp, side lamp and license plate lamp [1)]
6	Brake lamps
7	Left rear lamp, outline lamp, side lamp and license plate lamp [1)]
8	Reversing lamp
9	Not occupied
10	Not occupied
11	Not occupied
12	Not occupied
13	Not occupied
[1)] The license plate lamp must be connected such that no lamp is connected to this device with both contacts 5 and 7.	

5.4.5 Front socket (code E45)

The 7-pin front socket complies with ISO1724:

Contact No.	**Function/current circuit**
1	Left turn signal lamp
2	Not occupied
3	Ground
4	Right turn signal lamp
5	Right rear lamp and side lamp and license plate lamp
6	Not occupied
7	Left rear lamp and side lamp and license plate lamp

5.4.6 Connector for trailer sockets

The following trailer connectors are available as original replacement parts in the agencies and dealerships:

Part number	Designation
025 545 14 28	7-pin connector 12V
004 545 21 28	7-pin connector 24V
601 540 11 81	Set of parts 13-pin connector 12V
650 540 28 81	Set of parts 15-pin connector 24V
002 540 11 81	Adapter 15-pin connector on two 7-pin sockets

5.4.7 Direct connection

The power can also be taken off directly from an electric back-up point, especially in the case of higher electric outputs. **The connected cables must be separately fused**. On BM 427/437, the back-up point (continuous positive terminal 30) is located on the left under the instrument panel, on BM408/418 in the right footwell of the cab.
Furthermore,

- D+ signal (alternator)
- terminal 15 (+ when ignition is switched on)
- terminal 58 (parking light)

are also available for drawing control current - on BM427/437 on the left under the instrument panel and on BM408/418 also with a terminal 31 connection (ground) on the right behind the glove compartment.

Ground connections may be made on the chassis frame at the engine ground cable connection (front half of vehicle) or at the ground back-up point in the left longitudinal member approx. 250mm before the end transverse member (rear half of vehicle).

5.4.8 External starting socket

The external starting socket is intended for jump starting or for current transfer. If the capacity of the battery is no longer sufficient to start the engine, it is possible to start the engine via an external current source, 12 Volt or 24 Volt direct current depending on the vehicle electrical system voltage.

Attention:
Do not start vehicle without battery. On starting with external current, the following sequence must be followed:

	Current consuming motor vehicle	**Current providing motor vehicle**
1	Switch battery main switch and ignition switch off	Switch battery main switch and ignition switch off
2	Connect external current cable	Connect external current cable
3		Switch main battery current switch on Switch ignition switch on Start engine Engine speed: medium speed
4	Switch main battery current switch on Switch ignition switch on Start engine Engine speed: medium speed	
5		Switch engine off Switch ignition switch off
6	Disconnect external current cable	Disconnect external current cable

Figure 5.19 Table: "External jump starting"

Note instructions in Chapter 3.10.

5.4.9 Speed signal (C3) and distance signal (C4)

Changing or disconnecting the distance signal (tachometer/tachograph input signal, signal from the speed sensor in the transmission) is prohibited. Any manipulation leads to the expiry of the warranty and all rights to goodwill in the event of malfunctions.
If equipped with a tachograph (Kienzle 1318) a speed signal (C3-signal, terminal B7) and distance signal (C4-signal, terminal B8) are available at the tachographs.
The speed signal is a pulse-gap modulated signal with a pulse of t=2ms·8000/k (k=travel impulses per km), amplitude 8V, I_{max}=1mA.
The distance signal provides 4 impulses per metre of travel, amplitude 8V, I_{max}=1mA.

5.4.10 Voltage transformer

In vehicles with a 24 Volt system, current for 12 Volt implements must only be taken off via a voltage reduction unit or series resistor in connection with charge compensation.
If two batteries are connected in series, the 12 Volt voltage take-off must not be carried out by the consumers' being connected to only one battery.

5.4.11 Electromagnetic compatibility

See also Chapter 3.12. In each vehicle which is equipped with electronics components, electromagnetic compatibility is a criterion which basically has to be taken into consideration if further electronics components are installed.
For this reason, no components which generate powerful electromagnetic fields, such as, for example electromagnetically pilot operated hydraulic valves, may be installed in the immediate vicinity of electronics components.
In non-assessable cases, the electromagnetic compatibility of subsequently installed components in comparison with the vehicle components is to be verified via an EMC test.

5.4.12 External engine starting and shutdown facility

Various implement and attachment implements may require that the vehicle engine be started and stopped from the implement. If the installation of such a facility is planned, please consult GBU/TEN beforehand, as certain safety functions (such as e.g. the starter lock, starting the engine only if the clutch is depressed) may not simply be bypassed.

5.4.13 Technical data

See also Chapter 3.10 "Prevention of damage" to the "electrical system".

				ELECTRICAL SYSTEM													
				24 Volt-System (BM418: Code E04)							***12 Volt-System (BM427/437: Code E02)***						
				ALTERNATOR							*ALTERNATOR*						
			DRIVE RATIO	OUTPUT	TAGE NOM	ENT OU	ROT. SPEED	STARTER MOTOR OUTPUT	BATTERY CAP	TRAILER SOCKET	OUTPUT	TAGE NOM	ENT OU	ROT. SPEED	STARTER MOTOR OUTPUT	TTERY C	TRAILER SOCKET
UNIMOG TYPE	MODEL NUMBER	OLTAG	nENG / nALTERNATOR	in *W*	in *V*	in *A*	min^{-1}	in *kW*	in *Ah*	No. Of PINS	in *W*	in *V*	in *A*	min^{-1}	in *kW*	in *Ah*	No. Of PINS
TRACTORS AND IMPLEMENT CARRIERS SHORT AND LONG WHEELBASE																	
U 90 Turbo	BM 408.101	12 V	0.40	-	-	-		-	-	-	1260	14	45/90	1800/6000	2,2	120	13
U 130	BM 418.102	12 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	120	13
U 1400	BM 427.102 / BM 427.11	24 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13
U 1600	BM 427.105 / BM 427.11	24 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13
U 1600 (214)	BM 427.107 / BM 427.11	24 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13
U 2100	BM 437.105 / BM 437.11	24 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13
U 2400	BM 437.105 / BM 437.11	24 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13
CHASSIS L-VERSION																	
U 100 L Turbo	BM 408.216	12 V	0.40	-	-	-		-	-	-	1260	14	45/90	1800/6000	2,2	120	13
U 140 L	BM 418.117	12 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	120	13
U 1450 L	BM 427.111	24 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13
U 1550 L	BM 437.111 / BM 437.12	24 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13
U 1550 L (214)	BM 437.116 / BM 437.12	24 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13
U 1650 L	BM 427.116 / BM 427.11	24 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13
U 2150 L	BM 437.118 / BM 437.13	24 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13
U 2450 L	BM 437.118 / BM 437.13	24 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13
U 2450 L 6x6	BM 437.156	24 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	-	-	-	-	-	-	-
TRACTION HEADS																	
U 130 T	BM 418.000	12 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13
U 1400 T	BM 427.000	24 V	0.45	1540	28	10/55	1500/6000	4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13
U 2100 T	BM 437.002	24 V	0.45	1540	28	10/55		4	2x66 (je12V)	15	1260	14	29/90	1500/6000	3	154	13

5.5 Pneumatic auxiliary consumers

5.5.1 General instructions for pneumatic auxiliary consumers

The compressed air system consumers (delivery range differs with individual vehicle types) are sub-divided into

- Main consumers (service brake assistance, parking brake, trailer brake system, etc.)
- Auxiliary consumers (all-wheel drive differential lock switch, power take-off shaft coupling actuation, transmission cross-connection etc.)

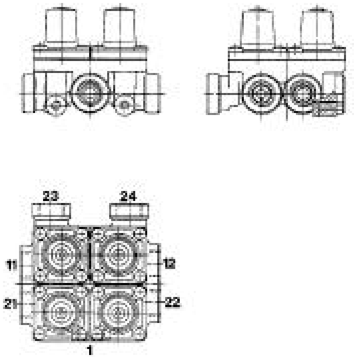
5.5.2 Pneumatic auxiliary consumers

On the installation of pneumatic auxiliary consumers, the following must be noted:

- In the case of auxiliary consumers with a high or constant air consumption, it must be verified whether the standard air compressor meets the necessary output . For data, see Chapter 5.5.4. If the standard air compressor is not sufficient, an air compressor with a higher output can be installed in the factory (code M31). The installation of an auxiliary air compressor must be clarified beforehand with Department PBU/TEN. An auxiliary air compressor may only be driven by the engine via a V-belt. Additional compressed air reservoirs may be installed to store the air supply. The reservoirs must be tested according to the EC Directive on "Simple pressure vessels" (87/404/EEC). Operating instructions must be provided.

  Caution:
  The pneumatic compressed air system used in the UNIMOG is a high pressure system with a maximum operating pressure of more than 18 bar.
  The compressed air circuits are protected against one another by four pressure-relief valves with limited backflow within the four-circuit safety valve.
  Auxiliary consumers may only be connected to the four-circuit safety valve *port 24* (pressure 7.5 bar).
  If required, a T-piece can be installed in the pressure line screwed in to port 24.

5.5.3 Four-circuit safety valve



Port	Designation
1	Pressure line from air compressor
21	Brake circuit 1 supply pressure
22	Brake circuit 2 supply pressure
23	Trailer
24	Auxiliary consumers

5.5.4 Technical data

Vehicle / type designation	Model	Supply pressure *[bar]*	Operating pressure *[bar]*	Air compressor description	**Output** Air compressor *a.)* *[l/min]*	Air compressor *c)* with code (M31) *[l/min]*	Backpressure *[bar]*	At engine speed *[rpm]*	Air dryer with integrated pressure regulator	Compressed air reservoir content (standard) *[l]*	Compressed air port
Tractor and operating unit short and long wheelbase											
U 90 Turbo	BM 408.101	18.3	7.5	*b.)*	110	----	18	3000	**X**	20 (2 x 10)	*d.)*
U 130	BM 418.102	18.3	7.5	*c.)*	220	----	18	2400	**X**	20 (2 x 10)	*d.)*
U 1400 / U 1450	BM 427.102 / BM 427.112	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	*d.)*
U 1600 / U 1650	BM 427.105 / BM 427.115	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	*d.)*
U 1600 (214) / U 1650 (214)	BM 427.107 / BM 427.117	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	*d.)*
U 2100 / U 2150	BM 437.105 / BM 437.117	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	*d.)*
U 2400 / U 2450	BM 437.105 / BM 437.117	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	*d.)*
UNIMOG chassis L variant											
U 100 L Turbo	BM 408.216	18.3	7.5	*b.)*	110	----	18	3000	**X**	20 (2 x 10)	*d.)*
U 140 L	BM 418.117	18.3	7.5	*c.)*	220	----	18	2400	**X**	20 (2 x 10)	*d.)*
U 1450 L	BM 427.111	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	*d.)*

					Output						
Vehicle / type designation	Model	Supply pressure *[bar]*	Operating pressure *[bar]*	Air compressor description	Air compressor *a.)* *[l/min]*	Air compressor *c)* with code (M31) *[l/min]*	Backpressure *[bar]*	At engine speed *[rpm]*	Air dryer with integrated pressure governor	Compressed air reservoir content (standard) *[l]*	Compressed air
U 1550 L / U 1550 L/37	BM 437.111 / BM 437.120	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	*d.)*
U 1550 L (214) / U 1550 L/37 (214)	BM 437.116 / BM 437.125	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	*d.)*
U 1650 L / U 1650 L (214)	BM 427.116 / BM 427.118	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	*d.)*
U 2150 L / U 2150 L/38	BM 437.118 / BM 437.136	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	*d.)*
U 2450 L / U 2450 L/38	BM 437.118 / BM 437.136	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	*d.)*
U 2450 L/6x6	BM 437.156	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	d.)
UNIMOG driving units											
U 130 T	BM 418.000	18.3	7.5	*c.)*	220	----	18	2400	**X**	20 (2 x 10)	*d.)*
U 1400 T	BM 427.000	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	*d.)*
U 2100 T	BM 437.002	18.3	7.5	*b.)*	150	220	18	2400	**X**	20 (2 x 10)	*d.)*

a.) Standard equipment. Alternatively: Air compressor with higher output (code M31).
b.) Air-cooled, driven via V-belt by engine
c.) Water-cooled, driven via V-belt by engine
d.) Tyre-inflating valve on the test port of the supply reservoir, Attention: 18 bar, **danger of tyre bursting.** ,
Auxiliary consumers, connection 24, four-circuit safety valve (7.5 bar)

6. Modifications to the chassis frame

6.1 Chassis frame materials

If the wheelbase is modified and the frame extended, the quality and dimensions of the extension material must be equivalent to the standard chassis frame.

Vehicle	Model	Material
LBU	408	E380TM ww. E460TM
MBU	418	E380TM ww. E460TM
SBU	427/437	St 52-3

6.2 Drilling on the frame

The chassis frame may be drilled In special cases. The spacing dimension "a" must not be less than 25 % of the frame height H. The drillings must be spaced at intervals of not less than 50 mm. The maximum drilling diameter must be 15 mm (see Figure 6.1). After drilling, deburr and ream all drillings.

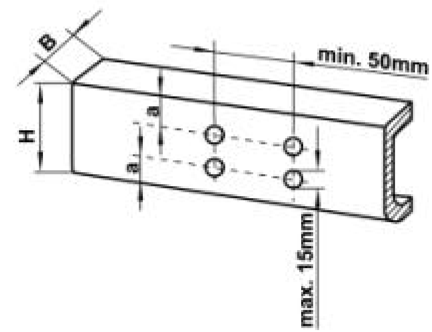


Figure 6.1 Distance between holes

Drilling must not be carried out:

- On the upper and lower flange of the chassis frame (see Figure 6.2). Exception only following consultation with Department PBU/TES.
- In areas where the frame longitudinal member profile has been modified, such as e.g. where the frame has been bent at right angles and tapered, tubular crosshead connections, reinforcements and frame flanges.
- At load induction points (e.g. immediately at the spring mountings).
- Factory-made drillings in the upper and lower flange of the chassis frame must not be opened out.

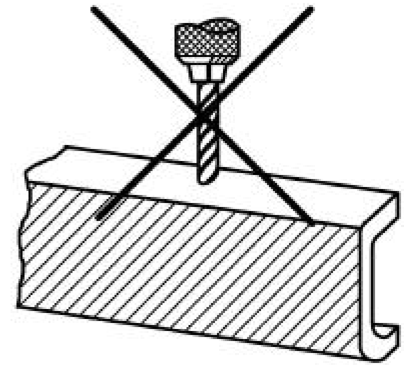


Figure 6.2 Do not drill the flanges

6.3 Threaded connections

Standard bolts may only be replaced by bolts with

- the same diameter,
- the same property classs,
- the same thread pitch.

Note prescribed tightening torque.

6.4 Frame modifications

Prior to a planned modification, Department PBU/TES must be consulted, the expected load values and axle loads calculated, and a check carried out on the basis of the permissible minimum and maximum values. The end transverse member must not be removed, even if the operation of a trailer is not planned. After the modification has been carried out, the function of the trailer connections (compressed air, electrical and hydraulic connections) must be checked. See also Chapter 6.4.2 "Welding on the frame”.

6.4.1 Frame extensions

In order to ensure that the bending and twisting strength of the rear frame overhang is sufficient, the distance between the last transverse member and the end transverse member must be kept as small as possible. The permissible trailer nose load must be reduced in accordance with the extension. Use the same materials and profile form (see Chapter 6.2).

Cutting the frame is not permissible in the area of:

- Load points
- Axle guide, axle suspension
- Transmission mounting
- Profile modifications (where the frame has been bent at right angles and tapered).

Frame profile supply sources

Frame and reinforcement profiles suitable for use in frame modifications may be obtained from

Company: **Stephan Witte**
Sales - Development
Contact person: Mr. Lötters
Telephone: 02371/ 211- 285, Fax 02371 / 211 - 212
Stefanstr. 2
58638 Iserlohn.

6.4.2 Welding on the frame

Welding operations on the frame may only be carried out by specialist personnel with welding qualifications complying with EN 287.

Prior to the commencement of a welding operation, the frame must be in its normal position and free of pre-tension due to external forces. This means that all mounted implements must be lowered to the ground and that the hydraulic system actuating lever is in floating position. Additional weights and bodies must be removed. The corresponding sites must always be exposed before welding is commenced.

Further cautionary measures:

- Disconnect battery.
- Cover springs or remove if necessary.
- Cover or remove plastic lines and electric cables.

See also Chapter 3 "Damage prevention, safety regulations and accident prevention" and Chapter 6.4.3 "Design instructions for extending the frame".

The joint must be checked at regular intervals following welding.

On completion, the welding site must be thoroughly cleaned and protected against corrosion. Particular reference is made to the fact that all swarf must be removed.

Welding must not be carried out on the upper and lower flange of the chassis frame (except in the event of wheelbase modifications and frame extensions).

Connect the ground terminal of the welding unit directly to the part of the vehicle which is to be welded.

- Only use well-dried out electrodes with lime-based coating, electrode diameter 3.25, 4.00 or 5.00 mm
  (DIN 1913 E 5154 B10, ISO 2560 E 51.5 B 12026)

- Electrodes must only be welded with direct current via the positive terminal.
- Inert gas shielded arc welding is preferable to manual arc welding, welding wire SG 3 DIN 8559.
- In order to avoid notching effects due to fusion penetration, grind seams with direction of grinding in direction of torsion and, if necessary, reinforce with corner irons. Seams are not permitted in bending radii (radius $\leq$ 15 mm). The distance between seams and the outer edge should be at least 15 mm.

6.4.3 Design instructions for extending the frame

In principle, there are two possible methods of welding.
Welding can be carried out

a.) with reinforcement plates (web plates) and upper or lower flange reinforcement, or

b.) directly without reinforcement plates.

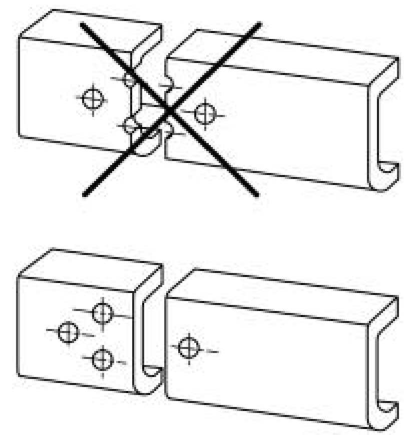


Figure 6.3 Cutting point a

Cutting the longitudinal member with a cutting torch is not permissible. This must be carried out with a cutting tool.

a.)
The longitudinal member may be cut as shown in Figure 6. 3.
Drillings must not be cut. In order to reinforce the seam site and relieve load on the seam, a reinforcement must be welded in in accordance with Figure 6.7. Upper and lower flange reinforcement profiles are welded on according to DIN 18 800 Part 1 "Welding the flange plate ends on". For source of profile supplies, see Chapter 6.4.1.

b.)

In the case of **direct welding**, the cut must be diagonal.

The cut must correspond to the above illustration (Figure 6. 4) , whereby the cutting angle must be between 30° and 45° measured to the vertical. It must be ensured that any drillings on the frame are not cut. Vertical cuts are **not** permitted in the case of direct welding.

6.4.3.1 Seam preparation

It is recommended that a double-V seam (joint form) be used on the upper and lower flange. The use of a V-seam is sufficient in the area of the web.

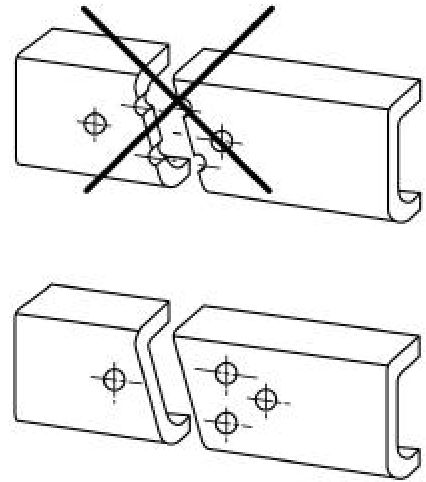


Figure 6.4 Cutting point b

A lack of seam preparation is often the cause of serious defects in and the failure of welded constructions.
The protective paint must be completely removed from the area of the weld. On creation of the seam form, it must be ensured that no furrows are caused in the frame (e.g. due to slipping on creation of the joint). On later use, these become notches and thereby reduce the service life of the chassis.

If carefully created, butt seams may be equivalent to the basic material. These seams enable force to flow in a largely uninterrupted manner.

6.4.3.2 Regulations for seam preparation

DIN 8551 Part 1 and 4 (seam preparation, joint forms on steel, gas welding, manual arc welding, inert gas shielded arc welding and submerged arc welding) contains guidelines for the design of joint forms depending on the welding procedure.
The seam form and dimensions are contained in DIN 8551 Part 1.
In the case of root seams, it must be ensured that even root penetration is carried out. The root seam must be of high quality and must not reveal any fusion defects. Subsequently, the seam must be ground internally, if necessary.
Depending on the form of the seam, the seam must be filled in with filling material.

6.4.3.3 Welding sequence

First, the upper and lower flange is to be welded from the outside and then from the inside, whereby the flange opposite the last welded flange is welded first. Finally, the web is welded. See welding sequence diagram (Figure 6.5).

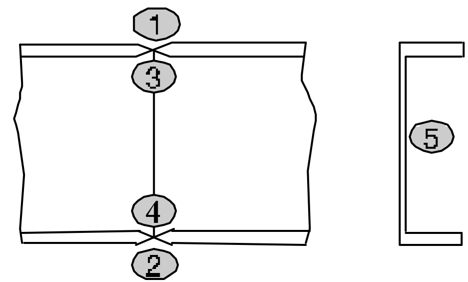


Figure 6.5 Welding sequence diagram

6.4.3.4 Subsequent seam treatment

The final run and root layers must be ground plane with the plate, whereby the chatter marks must run in the direction of torsion (i.e. parallel to the longitudinal axis). The surface roughness of the grinding should not exceed surface roughness Rz 6.3.
After welding, sufficient anti-corrosion protection must be applied.

6.4.3.5 Examples of welding

The following shows graphical examples of web plates and frame inserts. The variant which is to be used must be decided in individual cases. The end section of web reinforcement plates must always be designed in accordance with Figure 6.6. It must be ensured that the welding seams project over the ends of the web plate edges, in order to reduce the rigidity leap in the transitional area between the longitudinal member ⇔ web plate.
In the case of a frame extension with a straight separation point, the reinforcement inserts are to be designed in accordance with Figure 6.7. On insertion, first the upper, and then the lower, flange should be welded along their whole length in one operation.

Figure 6.6 Web reinforcement

Figure 6.6 a Outside

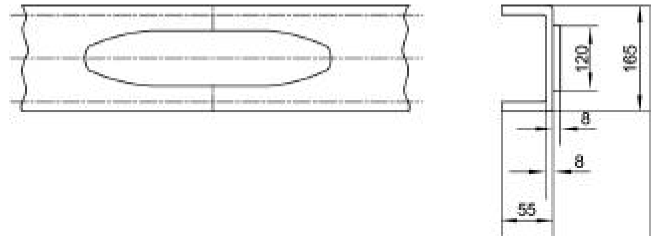
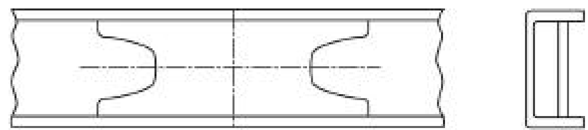


Figure 6.6 b Inside



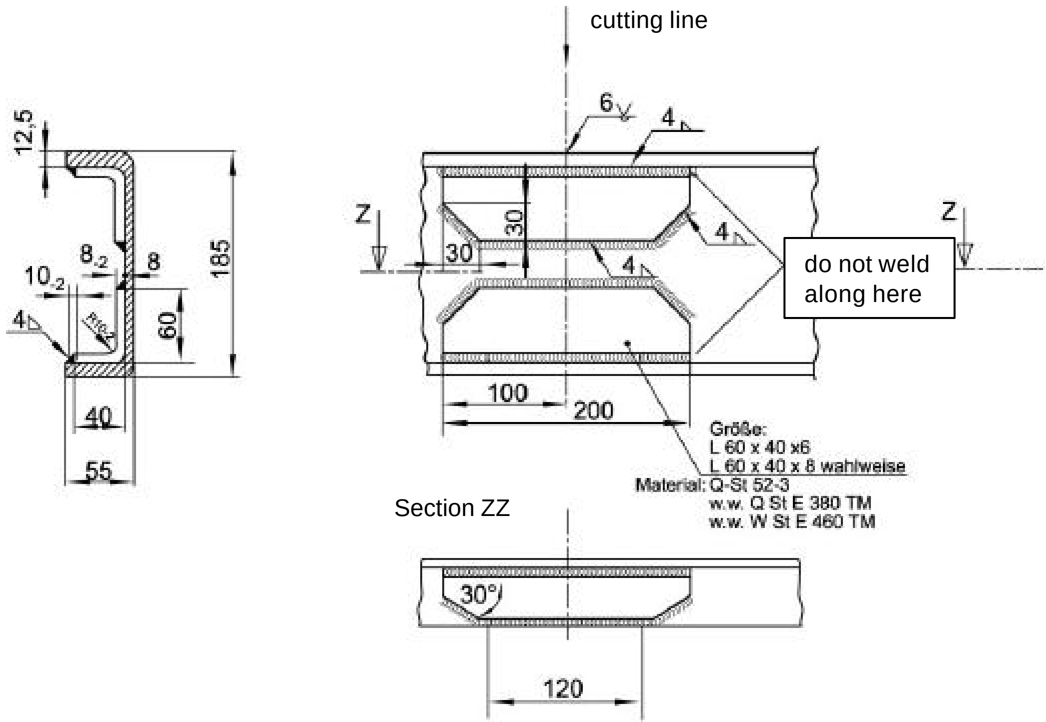


Figure 6.7 Frame insert

6.5 Shortening the frame

On shortening the end of the frame, the end transverse member must be moved to the remaining end of the frame. The connection of the end transverse member with the chassis frame must be carried out as in the original.

6.6 Wheelbase modifications

Wheelbase modifications are only permissible in special cases. Consultation with Department PBU/TES is required in every case.
In the event of wheelbase modifications, chassis components which are already used in another standard wheelbase must be used. Practice has shown that the creation of other wheelbases is work and cost-intensive, as new torque tubes (with torque balls) and new propshafts have to be manufactured.

Attention:
Note modified values for chassis weight, axle loads, brake force distribution and turning circle.
ABE (general type approval) expires if the wheelbase is modified.
No statements are made by DaimlerChrysler, UNIMOG Division regarding the handling, braking and steering behavior of vehicles in which the wheelbase has been modified.

6.7 Mounted implements and auxiliary components

6.7.1 Mounting on the vehicle

- Use set, shank or flange head bolts (property class 10.9, pitch 1.5 mm), self-locking nuts or flange head nuts (see Figure 6.8). Avoid using washers if possible (settling symptoms).
- Use existing drillings.
- Select the number of bolts according to the load.
  If necessary, remove paint down to the primer, in order to minimize settling symptoms.
- Use sufficiently strong washers for clamping sleeves and deformable sleeves in

St50 phosphatized. (See Figure 6.9)

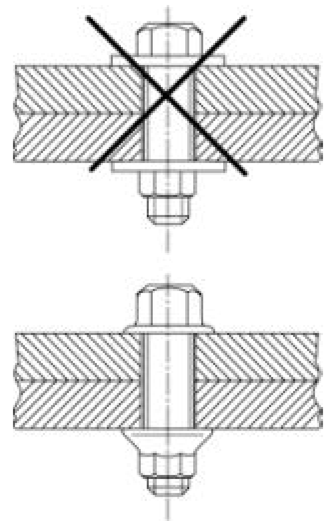


Figure 6.8 Section through bolted joint

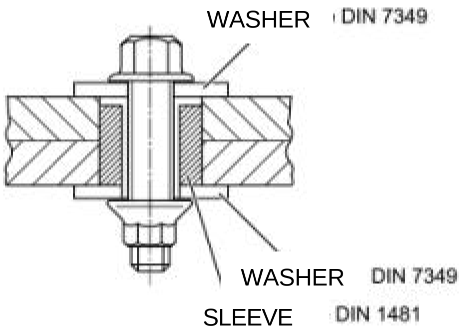


Figure 6.9a Sleeve to take lateral load

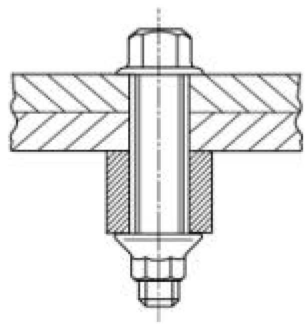


Figure 6.9b Spacer to maintain clamping force

6.7.2 Wheel chocks

Take note of regulations (§ 41 StVZO) and directives.

Mounting:

- Without play in suitable bracket.
- Secured against loss.
- Easily accessible.
- Removable without risk of injury.

6.7.3 Wings and wheel wells

The distance from the tyre to the wing or wheel well must be sufficient, even if snow and tyre chains are mounted and in the event of full spring deflection (i.e. in the event of distortion).
Re-install the wing brackets at the standard drillings in the chassis frame.

6.7.4 Spare wheel

Mounting:

- Take note of regulations.
- Easily accessible, easy to use.
- Doubly secured against loss.
- In the event of deviations from the standard mounting, the approval of PBU/TES is necessary.

6.7.5 Rear underride guard

Rear underride guard in accordance with 70/221/EEC including 97/19/EC.

Motor vehicles and trailers with a maximum permissible speed of more than 25 kph must, in accordance with **§ 32 (b) StVZO**, be equipped with an **underride guard** at the rear of the vehicle if the distance between the rear end of the vehicle and the last axle exceeds 1.0 m and if, at the same time, significant parts of the body have a clearance of more than 0.7 m above the surface of the road.

The UNIMOG series are exempt from the obligation regarding the provision of an underride guard (not U 2400 TG, however)
via

EC certificates

e1-70/221-0485 (for model 408... / 418...) e13 -70/221-1557 (for model 427... / 437...).

The UNIMOG U 2400 TG is available as standard with an underride guard.

6.7.6 Side guards in accordance with 89/297/EEC

§ 32 (c) StVZO states that trucks, tractors and trailers with a maximum permissible speed of more than 25 kph and more than 3.5 t permissible gross vehicle weight must be equipped with side guards.

Motor vehicles which, due to the design characteristics of their chassis, can be equated with trucks or tractors are also affected. Such vehicles include e.g. self-propelled machines (e.g. crane vehicles) and possibly special motor vehicles (such as e.g. mobile homes)

The predominant exceptions from these regulations are vehicles with a short wheelbase (semitrailer tractors) and agricultural or forestry tractors and vehicles designed for special purposes (e.g. UNIMOG as carrier vehicle for attaching and mounting implements), in which sideguards cannot be fitted owing to the purpose for which the vehicle is to be used. This also includes tipper vehicles which tip to three sides.
In principle, the UNIMOG series do not require any side guards.
Exemption has been granted with the EC certificate:

e1-89/297-00011

The model U 2400 TG is not listed in the exemption, but is covered via the tipper exemption (tipping on three sides). If necessary, side guards must be installed in other cases.

6.8 End transverse member

An end transverse member must always be fitted, even if the operation of a trailer is not planned.
If a trailer hitch is retrofitted, any reinforcements that may be requir3ed must be taken into consideration.
The trailer hitch must be fitted in accordance with Chap. 4.2.3.3.

7. Cab

7.1 Tilting the cab

The tilting ability of the cab must not be impaired as a result of an implement or body on a UNIMOG chassis. Lines or control cables, which are guided from the implement or body into the interior of the cab or which are firmly routed there, must have disconnection points or, like the vehicle wiring harness, must be guided via the cab pivoting point. The connector for an electric cable which must be disconnected prior to tilting must be easily accessible. The connectors must be adequately protected against dirt and water, in order to ensure that they function even when driving off-road or through water (permissible mud depth up to 1.2m). Control cables and the accompanying controls may also be passed through the rear sliding window into the interior of the cab. See also section 7.4. This option is only suitable for implements or bodies which are very rarely operated with the UNIMOG.

Before tilting the cab, note operating instructions. For further instructions see Chap.3.4

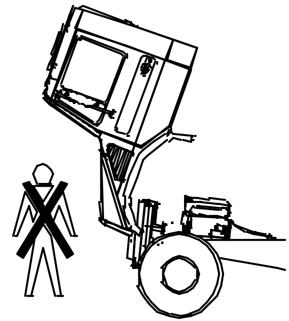


Figure 7.1 Cab tilted

The presence of personnel in the area in front of the cab is **prohibited** whilst the cab is raised. See illustration 7.1. In order to avoid damage to the cab, ensure that sufficient space is available in front of the vehicle. A front-mounted implement must, depending on its design and size, be removed prior to tilting. In certain cases it is sufficient if, in the case of model 408/418, the bonnet and, in the case of model 427/437, the plug-in flap and the bonnet are removed before tilting. As a result of this, the implement may, if necessary, remain on the vehicle. In the case of bodies which project above the cab, free movement corresponding to the tilting curve of the rear edge of the cab axis must be guaranteed.

Any roof loads must be removed before the cab is tilted.

Corresponding instructions must be enclosed in the implement operating instructions.

The design of an implement or body must ensure that the cab is able to tilt unimpaired. In the case of a body which is already present, free movement on tilting must be checked under practical conditions. On raising the cab, it must be ensured that the vehicle is standing on an even surface. Even slight unevenness leads to unilateral spring deflection, thereby increasing the amount of space which is required. The body must only be located within the shaded area in illustration 7.2.
Caution, different tilting curves in the case of low and high axis cabs (see Figure 7.2).
When transferring implements, note cab equipment.

Clearance behind the cab

If the cab is built over, a space of at least 400 mm must be available between the upper edge of the roof and the body (cab movement in the event of distortion of the vehicle occurs contrary to that of the central body, see also Chap.7.7)

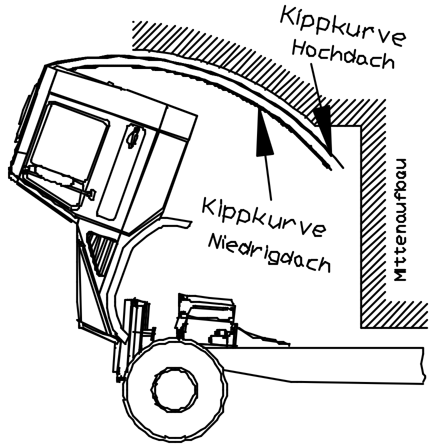


Figure 7.2 Tilting curve

Sufficient clearance between the cab and the body must be maintained even in case of maximum chassis frame torsion (axle articulation). Distance "A", from the rear wall of the cab to the front face of the body, must not be less than 70 mm.

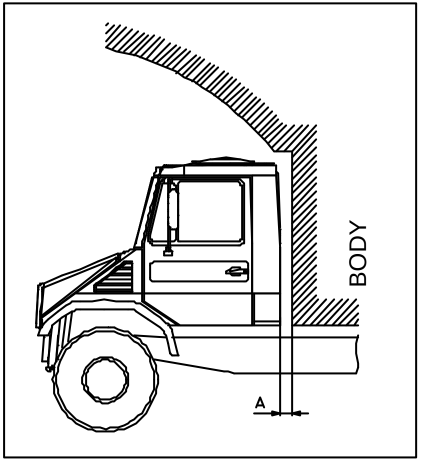


Figure 7.3 Built over cab

7.2 Drilling on the rear wall

The standard ducts in the floor of the cab (jack panel) should be used to route cables into the cab. An accessible disconnection point must be provided for tilting the cab. If cables are to be passed through the rear wall of the cab, holes may be drilled at the shaded points (Figure 7.4/7.5) in the rear wall. It must be ensured that the function of reinforcement plates or braces is not impaired. A disconnection point is also required for tilting the cab if cables are passed through the rear wall. **Maximum drilling diameter 30 mm.** If larger dimension ducts or holes are required elsewhere, PBU/TES must be consulted in advance.

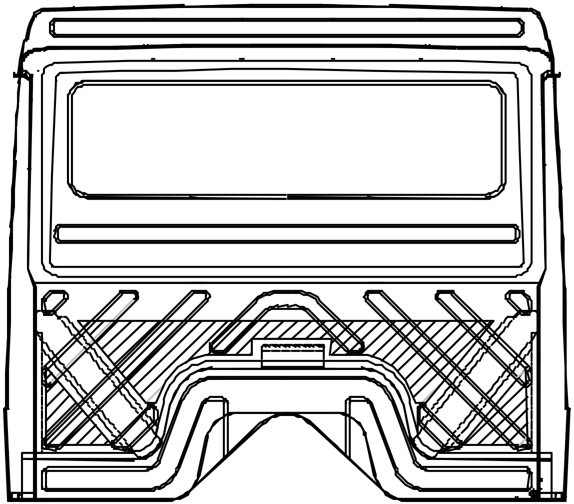


Figure 7.4 BM 408/418 rear wall

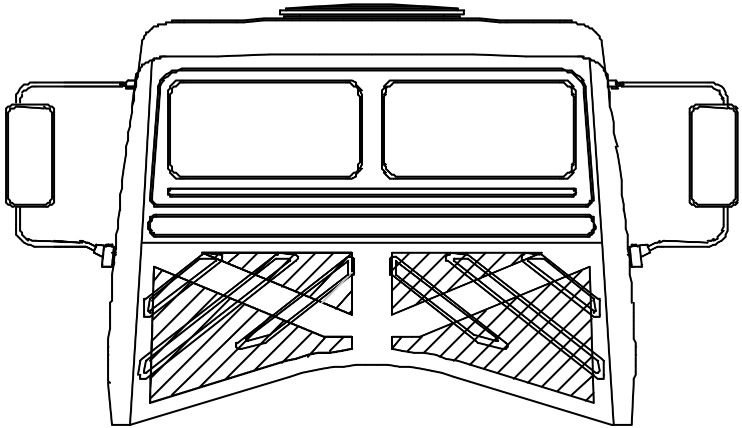


Figure 7.5 BM 427/437 rear wall

Permissible area for drillings in the rear wall of the cab

7.3 Mountings on the cab

7.3.1 Roof brackets

In order to avoid damage to the cab as a result of a roof load, a maximum load of 30 daN per A or B-pillar is permissible, i.e. maximum overall axle load 120daN. Where forces are passed into the cab, a **large-surface support** must be ensured. Passing forces through a single point is not permitted. As regards driving, the roof bracket must be fastened such that it cannot independently come loose due to shock incurred on off-road use. Correct mounting is the responsibility of the operator. In addition, the valid laws and standards of the relevant countries must be complied with.

The driving speed must be adjusted to the relevant road, road traffic and off-road conditions, whereby the influence of the roof bracket must be taken into consideration on braking, cornering, driving on a slippery road surface or unfirm surface, in an oblique position, on inclines or on descents etc.

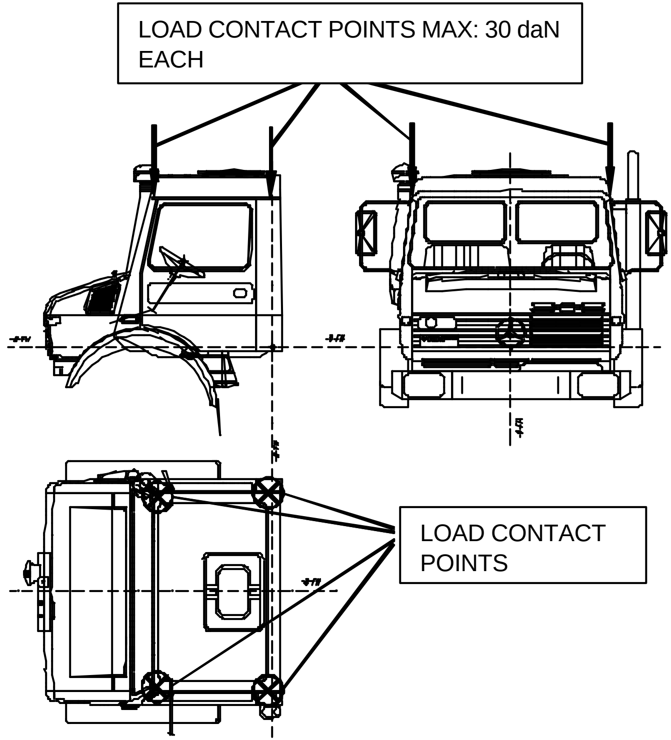


Figure 7.6 Load areas on the roof

The implement or body manufacturer is responsible for:

- the function and fastening of the roof bracket which he has mounted,
- all modifications and components fitted which are not, or not completely covered by the documents which he has submitted,
- for a strong and proper design and clearance of the implement or body with regard to all vehicle components (also in the event of distortion).

7.3.2 Mounting an antenna on the B-pillar

Bracket 425 860 30 14 is available as a replacement part for mounting an antenna on the left or right B-pillar.

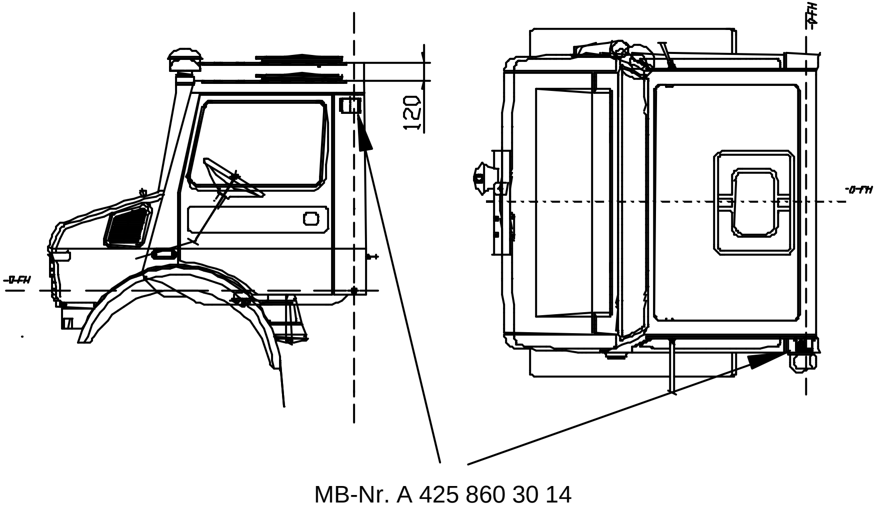


Figure 7.7 Example of mounting an antenna

National laws and regulations must be taken into consideration. Special caution is required on passing through level crossings. If the antenna comes into contact with overhead power lines, the lives of the vehicle passengers are placed in danger.

7.4 Proposed solution for window duct

In order to route cables or control cables from the implement or body into the interior of the cab, the sliding window may be modified (optional equipment code S48/49). To this end, an installation plate which corresponds to the geometry of the sliding window must be manufactured (shown as shaded). As regards locking, the standard window lock - only drawn schematically in this case - should be used; this may be obtained from Cleff (Tel. 0202-64799-0). The installation plate may be made of wood, plastic, steel or alloy. The recess "Y" may be individually designed as required. Dimension "A" must not be more than 1/3 of dimension "B", as installation in the window guide may no longer be possible. Dimension "A" is oriented to the form of recess "Y" and the material which is used.

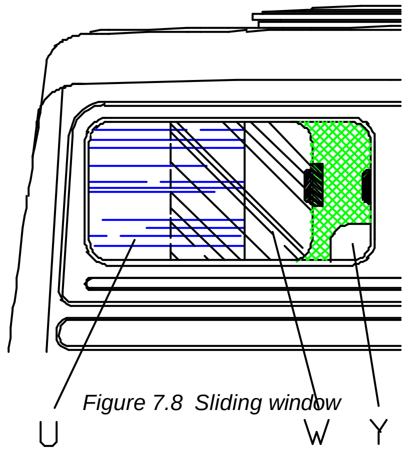
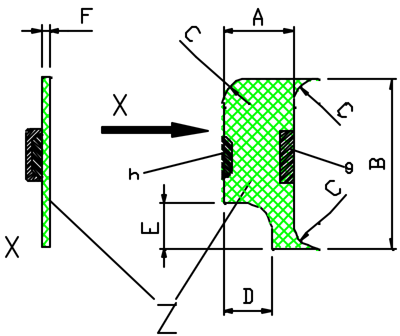


Figure 7.8 Sliding window



If materials which are easy to bend are used, installation is simplified.
The radius "C" is a consequence of the geometry of the sliding window.
The thickness "F" of the fitting corresponds to the thickness of the window glass.

Figure 7.9 Dimensions of the fitting

Figures 7.10 and 7.11a show its exact position in profile.

Explanations: U Fixed window

W Sliding window

Z Fitting

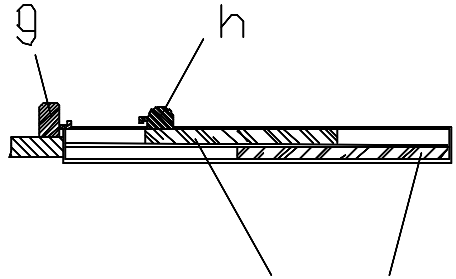
g Original lock part

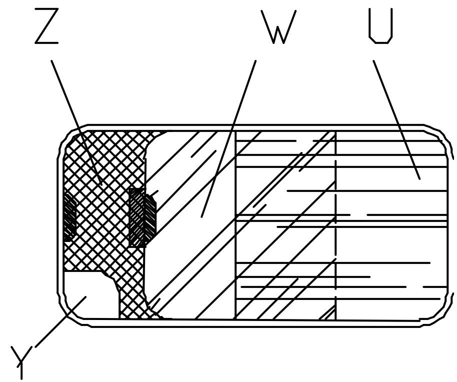
h Original lock part

Y Cut-out

R Rear wall of cab

Figure 7.10 Position without fitting (top view)





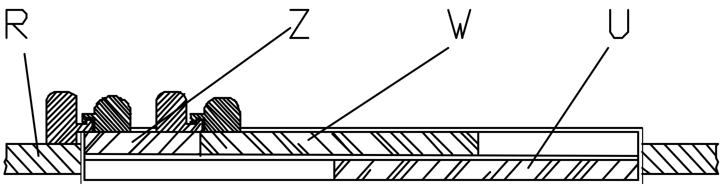


Figure 7.11a Position with fitting (top view)

Figure 7.11b Position with fitting (rear view)

7.5 Connections (electrical)

- Connectors must be designed so that they are continuously able to endure the strain of being used under road and off-road conditions. The following, in particular, are to be noted:
- Good accessibility
- Good anti-corrosion resistance with regard to de-icing salts (snow clearance)
- Not sensitive to mud and stone impact
- Shocks incurred in off-road use must not cause disconnection of the connector
- Connectors which are not routed via junction boxes must be enclosed, equipped with cable strain relief devices and, if necessary, be fixed to the vehicle with cable ties

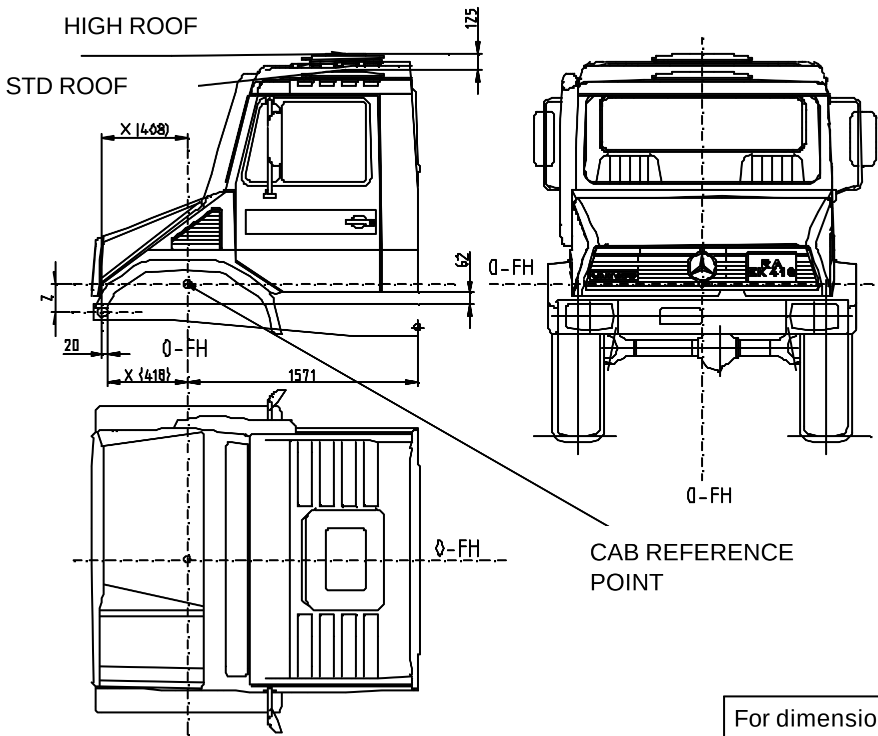
See also Chapter 5.4 "Power supply and signal transfer" and ff.

7.6 Cab reference point

Drawings of the cabs are shown in the following. The position of the cab reference point is marked in these drawings. All dimension data on the cab refer to this point. On BM408/418, the coordinates of the cab reference point refer to the chassis reference point, on BM427/437 they refer to the front edge of the frame (x direction) or to the upper edge of the front frame profile (z direction). See also Chapter 4.6 and ff (chassis coordinate systems).
Apart from the relevant wing versions, the design of the cabs in models 427 and 437 and 408 and 418 are identical.
A variant with a high roof is available for both cab types.
In the case of bodies which project above the cab, the high roof must be taken into consideration, as the minimum space between the upper edge of the roof and the lower edge of the superstructure must be at least 400 mm.

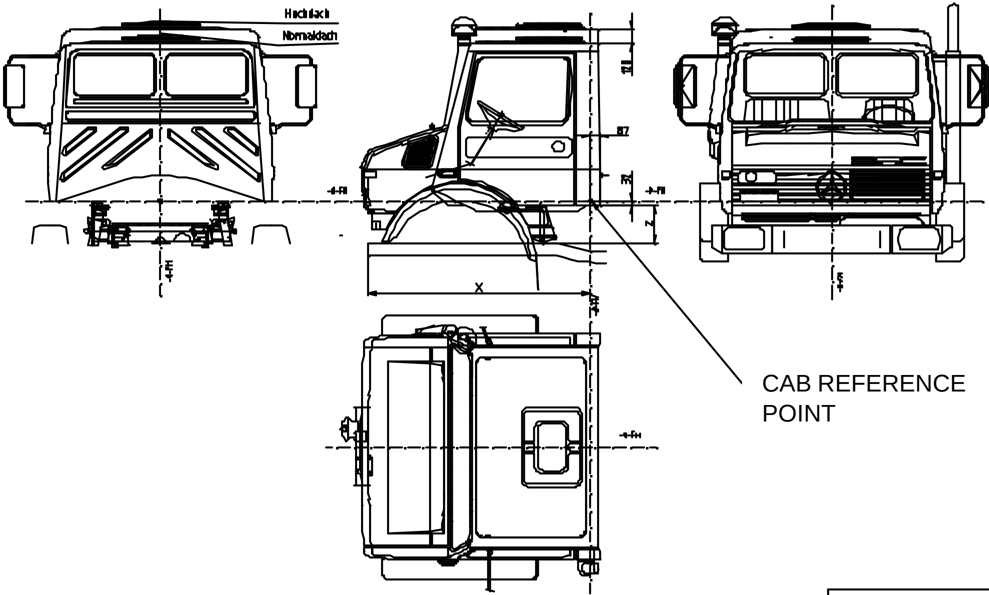
Cab with high roof		
Model	408/418	427/437
Dimension of the raised	125 mm	120 mm

Figure 7.12 Table: Cab with high roof



For dimensions x and z
see Figure 7.16
y=0

Figure 7.13 Cab BM 408/418

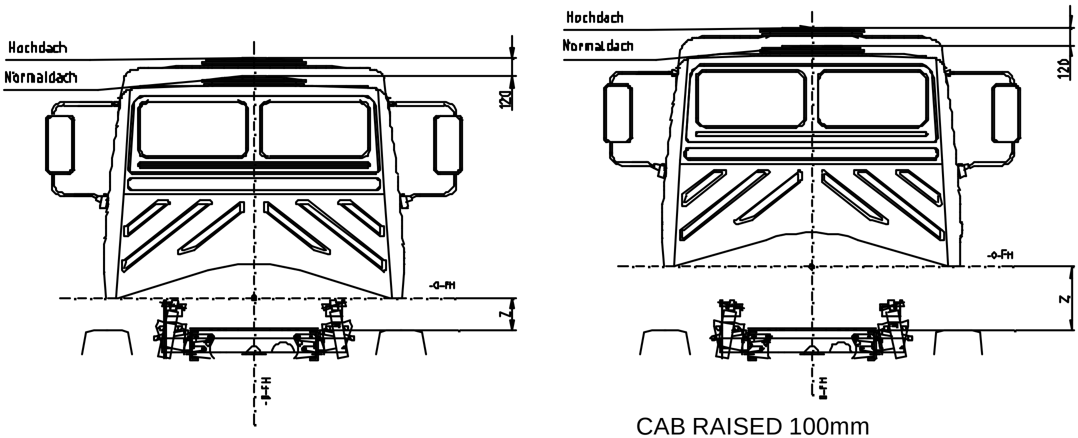


For dimensions x and z
see Figure 7.16
Dimension y=0

Figure 7.14 Cab BM 427/ 437

Raised cab

In the raised cab (all SBUs above 155kW engine output - larger cooling system), the cab reference point is 100 mm higher.



For dimension z see Figure 7.16

Figure 7.15   Cab raised BM 437

Position of the cab reference point

UNIMOG model/ sales designation	Model (BM)	Dimension X [mm]	Dimension Z [mm]
UNIMOG chassis L variant			
U 100 L Turbo	408.216	650	220
U 140 L	418.117	650	222
U 1450 L	427.111	2160	175
U 1550 L	437.111	2140	177
U 1550 L with code X19	437.111	2165	157.5
U 1550 L/37	437.120	2165	157.5
U 1550 L (214)	437.116	2140	277
U 1550 L (214) with code X19	437.116	2165	257.5
U 1550 L/37 (214)	437.125	2165	257.5
U 1650 L	427.116	2160	175
U 1650 L (214)	427.118	2160	275
U 2150 L	437.118	2165	257.5
U 2150 L/38	437.136	2165	257.5
U 2450 L	437.118	2165	257.5
U 2450 L/38	437.118	2165	257.5

Figure 7.16a) Table: Position of the cab reference point

UNIMOG type/ sales designation	Model (BM)	Dimension X [mm]	Dimension Z [mm]
Tractor and operating units short and long wheelbase			
U 90 turbo	408.101	650	220
U 130	418.102	650	222
U 1400	427.102	2160	175
U 1450	427.112	2160	175
U 1600	427.105	2160	175
U 1650	427.115	2160	175
U 1600 (214)	427.107	2160	275
U 1650 (214)	427.117	2160	275
U 2100	437.105	2165	257.5
U 2150	437.117	2165	257.5
U.2400	437.105	2165	257.5
U 2450	437.117	2165	257.5
UNIMOG driving units			
U 1400 T	427.000	2160	175
U 2100 T	437.002	2165	257.5

Figure 7.16b) Table: Position of the cab reference point

7.7 Relative movement of cab/body in the event of distortion

In order not to limit the distortion of the vehicle frame, components such as the engine, transmission, cab and platform are all connected to the frame via three-point mountings.

In vehicles with a short wheelbase, the body must be mounted onto the chassis via simple three-point mounting and in vehicles with a long wheelbase, via distortion-capable 4-point mounting, known as 2x3-point mounting. Distortion causes relative movements between the cab and body (see Figure 7.17). In particular, reverse motion must be taken into consideration in the case of cables and linkages which are routed between the cab and the body, and fixed body components which are located next to the cab (e.g. auxiliary headlamps).

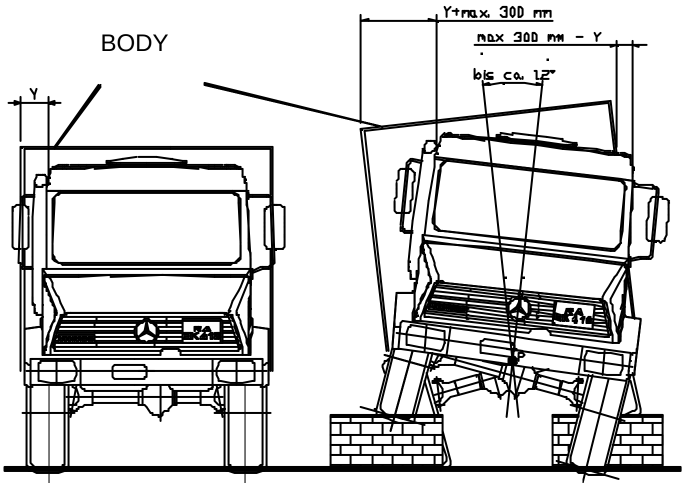


Figure 7.17 Relative movement of cab and body on distortion with instantaneous center of rotation P

In this case, the cab and body may rotate by up to 12° relative to one another. The instantaneous center of rotation P of this rotation is an (imaginary) axis in the vehicle longitudinal direction which runs approximately on the level of the center of the longitudinal member profile. The ensuing relative travel is proportional to the height of the cab or to the height of the body.

8. Appendix

8.1 General safety and accident prevention regulations

Basic regulations:
Prior to each initial period of vehicle operation,
check for road traffic and operating safety.

- In addition to the instructions in this directive, take note of the generally applicable safety and accident prevention regulations.
- In the case of bodies and implements, note manufacturer's specifications.
- On use of public roads, take note of the relevant regulations.
- Before commencing operations, familiarize yourself with all devices and their actuating controls and function. It is too late to do this during operation.
- Only start the engine from the driver's position. The engine must not be started by short-circuiting the electric connections on the starter
- Before starting off, check the area in the vicinity of the vehicle (children). Make sure that visibility is adequate. Do not allow then leave the engine running in enclosed spaces. **- Danger of poisoning**
- The driver should wear tightly fitting clothes. Avoid loose clothing. Wear sturdy footwear.
- Caution is required when handling fuel, increased risk of fire. Never fill with fuel in the vicinity of naked flames or sparks. Do not smoke when filling with fuel.
- Before filling with fuel, switch engine off and remove ignition key. Do not fill with fuel in enclosed spaces. Immediately remove spilt fuel.
- In order to avoid the risk of fire, keep the engine clean. Caution when handling brake fluid and battery acid (toxic and corrosive). Only work in good light and visibility.

Transportation of personnel

- Passengers may only be transported if a proper passenger seat is provided.
- In all other cases, the transportation of personnel is not permissible.

Driving

- The driving speed must always be adjusted to suit the ambient conditions and the load. Avoid sudden cornering when driving uphill, downhill and across inclines. Switch the differential lock off on cornering. Never declutch and shift on ascents.

- Connect trailers and implements in accordance with the regulations. Handling, steering and braking are influenced by implements, trailers and ballast weights. For this reason, ensure that steering and braking capability is sufficient.
- Take note of permissible axle loads and gross vehicle weights.

- On cornering with trailed or semi-mounted implements , take the wide projection and the centrifugal mass of the implement into consideration.

Maintenance

- Fluids which escape under high pressure (fuel, hydraulic fluid) may penetrate the skin and cause severe injuries. In the event of an injury, seek a physician immediately, as severe infections may otherwise occur.
- Dispose of fluids, fuels and filters in the proper manner.
- Fitting tyres demands adequate knowledge and the proper fitting tools.
- In operations on the electrical system, always disconnect the ground cable from the battery.
- Replacement parts must meet the technical standards specified by the manufacturer. This is guaranteed e.g. by original parts

Engine

- Do not allow the engine to run in enclosed spaces - ***Danger of poisoning*** -
- Always operate the starter from the driver's seat, never short-circuit the starter.
- When shutting the engine off, always switch the ignition off.
- Do not shut engine off at high speeds.

Engine maintenance

- Do not carry maintenance out when the engine is running.
- In operations on the engine, always disconnect the battery (negative terminal).
- Only fill with fuel when the engine is shut-off. - ***Smoking prohibited*** -
- Take note of the specified grade of oil and fuel, and only store these in approved containers.
- Caution when draining hot oil. -***Risk of burning*** -
- Dispose of drained oil in the proper manner.
- Caution when removing the radiator cover. Coolant is under pressure. - ***Risk of scalding*** -
- Loosen cooling water compensation tank cap to stop and relieve pressure, then remove the cap completely.
- Caution in the event of excessive cooling water temperature - only continue operation when the causes of overheating have been discovered and rectified.
- The engine must be shut-off before the coolant is drained.
- Ensure that the cooling system contains regulation coolant.
- Refit safety equipment after maintenance operations.
- Only remove or fit V-belt when engine is shut off.

Start-assist facilities (pilot starter/flame starting system)

- Smoking and naked flames in the vicinity are prohibited when filling the tank.
- The start-assist fluid is flammable and explosive and should not be exposed to temperatures above 50° C.
- On pushing, take note of the regulation shift lever positions and permissible speed.
- If a flame starting system is installed, always start the engine only after the flame starter operating lamp (glow plug) has gone out.

Electrical system

- In operations on the electrical system, always disconnect battery (negative terminal).
- Make sure that the battery is correctly connected - positive terminal first and then the negative terminal.
- Caution, battery gases are highly explosive.
- Avoid the formation of sparks and naked flames in the vicinity of the battery.
- When topping battery up, remove cover so that the build-up of highly explosive gases is avoided.
- **Caution.**when handling battery acids - corrosive.
- Only use original fuses. The electrical system may be damaged if too highly rated fuses are used. ***Risk of fire***
- Only operate the starter for a limited time, as the coil otherwise becomes too hot. Allow starter to cool down.

Cab, controls

- Never adjust driver's seat whilst driving - risk of accident.
- Before commencing driving and operations, adjust mirrors so that road surface and working area to the rear of the vehicle can be seen completely.
- Do not carry out any welding, drilling, sawing or grinding operations on the cab or safety frame. Following damage, have parts replaced.
- Check brake function before driving off.
- Before ascending a hill, engage a lower gear.
- If the engine is stationary or the hydraulic power steering system fails, considerably more force must be used for steering. - Risk of accident -
- In the event of all steering and brake malfunctions, stop vehicle immediately. Have malfunctions rectified immediately.
- On replacement of cab ventilation filters, ensure that waste disposal is carried out in the proper manner.

Air conditioning system

- Avoid all contact with liquid coolant.
- If coolant is sprayed into eyes, rinse out with clear water, seek a physician immediately.

- Only allow maintenance and repair operations to be carried out by specialist personnel.
- Welding must not be carried out on the components of the coolant circuit or in their immediate vicinity.
  Danger of poisoning
- Maximum ambient temperature for coolant approx. 80° C.

Power take-off shaft

- Never operate power take-off shaft without the guard.
- Only attach and disconnect implements when engine is stationary and power take-off shaft is disengaged.
- In the case of propshafts, take note of the prescribed insertion lengths.
- Before engaging the power take-off shaft, make sure that nobody is in the area of the implement.
- Before engaging the power take-off shaft, ensure that the selected vehicle power take-off shaft speed corresponds to the permissible speed of the implement.
- In operations with the power take-off shaft, nobody must be present in the area of the rotating power take-off shaft or propshaft.
- After disengaging the power take-off shaft, the attached implement may - due to its centrifugal force - continue running. • Do not approach the implement during this time; operations may only be carried out on the implement when it is stationary
  !
- After disconnecting the power take-off shaft, place the protective cap on the power take-off shaft stub.
- Only clean, lubricate or adjust the power take-off shaft-driven implement or the propshaft when
  - the power take-off shaft is disengaged
  - the engine is shut down
  - the ignition key has been removed
- Never engage power take-off shaft when engine is shut down.
- Always disengage power take-off shaft when it is not required.

Implements / trailers

- Before attaching implements to the three-point mounting, move the operating lever into the position in which unintentional raising or lowering is impossible.
- Secure trailers and implements against rolling away.
- There is a risk of injury when coupling implements to the vehicle.

- There is a risk of injury in the area of the three-point mounting from crushing and shearing points.
- On actuation of the external controls for the three-point implement, do not move not between vehicle and implement.
- Only operate vehicle if all guards have been fitted and are in position on implements and trailers.
- When driving on roads with a raised implement, the operating lever must be blocked against lowering.
- Before leaving the vehicle, lower implements to the ground - ***Remove ignition key***.
- Nobody must be present between the vehicle and implement or trailer without the vehicle being secured against rolling away via the parking brake and wheel chocks.
- On cornering with trailed or semi-mounted implements, take the wide projection and the centrifugal mass of the implement into consideration.
- Secure trailer against rolling away with wheel chocks at the rear wheels. The unbraked trailer front axle must still be able to rotate.
- When the tractor unit is reversing, nobody must be between the tractor unit and trailer.
- Attach the trailer in the proper manner. Check the function of the trailer brake system.
  Note manufacturer's specifications.
- Only attach implements and trailers to the intended devices.
- Secure towbar.
- When coupling the trailer, the greatest caution and care are required.
- Note danger of tipping in the case of an uneven load, especially on coupling and when uncoupled.
  Loaded single-axle trailers must not be transported on the drawbar jack castor wheel.
- Note maximum permissible nose load of the trailer coupling.

Platforms

- On tipping, especially to the rear, the vehicle must be positioned on a sufficiently load-bearing, horizontal surface. **- Caution** in the case of bulk material which does not slide easily.
- Conscientiously lock/release tilting bearing.
- Before tipping, ensure that nobody is within the danger zone.
- Driving with a tipped platform is prohibited.
- Caution is required when opening the platform gates.

- After opening the platform gates, position the platform gate locks in the "closed" position again, so that the open platform wall locks do not project into the operating area. - ***Danger of injury*** -
- In operations on the raised load area, support this in accordance with the operating instructions and secure the vehicle against rolling away.
  - Parking brake
  - Wheel chocks

Front loader

- When using a front loader. No persons must be in the operating area.
  - Never walk under a raised load.
- Danger of tipping when front loader is raised.
- In operations on slopes: Caution when raising the implement - ***Danger of tipping***-
- When driving on roads, bring the front loader into the prescribed position. On completion of the front loader operation, secure the hydraulic lever, position transportation restraints and fork cover on the loading shovel Before leaving the vehicle, lower front loading shovel completely.
- Lower front loader and other implements so that they are stable.
- If protective devices and operating tools are subject to wear, they must be checked regularly and replaced if necessary.
- On transportation - engage restraining devices
- On use of front loaders:
  Only apply the specified volume of ballast to the load area or the 3-point mounting.
- Due to the displacement of the center of gravity when the raised shovel is full, special caution is required when maneuvering. Adjust driving speed.
- No loads may be carried on the shovel on transportation.
- In the event of maintenance operations on the front loader:
  - Lower front loader
  - Switch engine off
  - Remove ignition key
- Only operate front loader from driver's seat.
- Check the working area for concealed holes, stones or other uneven areas prior to the operation.

Hydraulic system

- The hydraulic system is subject to high pressure.
- A possible jet of fluid, which may hardly be visible, from a leak may cause severe injuries (fluid may penetrate the skin)
- When searching for leaks, use suitable aids due to the danger of injury.
- Before operations on the hydraulic system, the engine must be shut-off and the vehicle secured against rolling away.
  - Parking brake
  - Wheel chock
- When connecting hydraulic cylinders and hydraulic motors, ensure that hydraulic hoses are connected as specified.
- Confusion of ports causes reversed function (e.g. raise/ lower) ***Risk of accident.***
- Regularly check hydraulic hoses and replace in the event of damage and aging. The hoses must comply with the technical standards of the implement manufacturer.

Brakes, brake fluid

- Check the function of the brakes each time before driving.
- The brake systems must be regularly subjected to a thorough test.
- Adjustment and repair operations on the brake system may only be carried out by specialist workshops or recognized brake services.
- Regularly check the level of the brake fluid. Only use specified brake fluid and replace as prescribed.
- Caution on handling brake fluid ***Toxic and corrosive.***
- Do not spill brake fluid.
- Dispose of brake fluid in the proper manner.

Additional weight

- On attaching rear-mounted implements, always ensure that the front axle load is sufficient, the steering capacity must remain intact.
- Note removal of load on the rear axle due to front-mounted implements or front weights, ensure that braking capacity is sufficient.

- Always attach weights in the regulation manner at the intended fastening points.
- On selecting the front and rear weights, make sure that the permissible axle loads and the permissible gross vehicle weight including the mounted implement are not exceeded.
- In the event of ballasting, note necessary tyre pressure.

Threaded connections, wheels and tyres

- In operations on the wheels and tyres, it must be ensured that the vehicle has been safely shut down and secured against rolling away.
  - Parking brake
  - Wheel chock
- In operations under the jacked up vehicle, no personnel may be on the vehicle.
- After each wheel replacement:
  - Tighten front and rear wheel fastening bolts and nuts according to manufacturer's specifications.
- Repair operations on the tyres may only be carried out by specialist personnel using suitable tools.
- If the air pressure in the tyres is too high, there is a –***risk of explosion-.***
- Regularly check tyre pressure.

Crop protection implements

- Take note of the recommendations of the pesticide manufacturer.
  - Protective clothing
  - Warning instructions
  - Dosing regulations
  - Application regulations
  - Cleaning regulations
- **Attention**
  Note crop protection law instructions.

- Do not open pressurized hoses.
- Only prescribed hoses which are able to cope with the chemical, mechanical and thermal strain may be used as replacement hoses. Specified hose clamps must be used on installation
  (For regulations regarding the identification and integration of hoses, see "Guidelines for liquid sprays").
- Repair operations in the spray container may only be carried out:
  - after thorough cleaning
  - wearing a respiratory protection device
- A second person must monitor the operations from the outside of the container for safety reasons.

Miscellaneous

- **Caution**
  If the vehicle is equipped with radar sensors, do not expose the eyes to the radiation area of the radar sensor. - Microwaves -
- Auxiliary heaters must never be operated in enclosed spaces or whilst the tank is being filled up.
- Do not use differential lock on cornering.
- On carrying out electric welding operations on the vehicle and attached implement, disconnect cables from the alternator and the battery.
- Repair operations such as welding, grinding, drilling etc. must not be carried out on load-bearing or other safety-critical parts such as the frame, axles, trailer couplings and trailer frames etc.

8.2 General instructions regarding the brake system

Brake systems must comply with current construction regulations.

8.3 Design and fitting of the official license plates

The design and fitting of the official license plates must comply with the laws of the country concerned. Excerpt from the construction and operating regulations
The license plate must be firmly affixed to the front and the rear of the motor vehicle. In vehicles in which lamp brackets are permissible in accordance with article 49a Para. 9, the rear license plate must - additionally if necessary - be affixed to the lamp bracket. In all vehicles, the lower edge of the front license plate must not be less than 200 mm, and that of the rear license plate not less than 300 mm, above the surface of the road.
The license plate at the front and rear of the vehicle must always be legible from a sufficient distance at an angle of 30° on each side of the vehicle longitudinal axis.

8.4 Formula symbols and abbreviations used

Abbreviations:

ABS	Anti-lock brake system
AG	Aktiengesellschaft (Public Limited Company)
ALB	Automatic load-dependent brake proportioning
"Left" / "right"	Seen in direction of travel
ARL	Implement Mounting Directive
BM	Model
BMV	German Federal Minister of Transport
CAD	Computer Aided Design
CATIA	Computer-Graphics Aided Three Dimensional Interactive System (CAD system)
DBL	Daimler-Benz delivery regulation
DBN	Daimler-Benz standard
DIN	Deutsches Institut für Normung (German Standards Institute)
EC	European Community
EMC	Electromagnetic compatibility
FAP	Front mounting plate
Cab	Cab
FLK-R	Unshielded low voltage cables with thin-walled insulation for use in on-road vehicles
GBU	UNIMOG Division
GVW	Gross vehicle weight
HPC	House postcode
ISO	International Organization for Standardization
kW	Kilowatts

LBU	Light Series of the UNIMOG
Truck	Truck
lof	Pertaining to agriculture or forestry
max.	Maximum
MBU	Medium series of the UNIMOG
min.	Minimum
SA	Optional equipment
SBU	Heavy series of the UNIMOG
TEN	Technology/Development/Networks
LE, UE, IE	Lower, upper, inner edge
FA, RA	Front axle, rear axle
VDE	Verband Deutscher Elektrotechniker (Association of German Electrical Engineers)
FE, RE	Front edge, rear edge
X-axis	Longitudinal axis with positive direction opposite to the direction of travel
Y-axis	Transverse axis with positive direction to the right side of the vehicle
Z-axis	Vertical axis with positive direction to the top side of the vehicle
pGVW	Permissible gross vehicle weight
permissible	Permissible
PTOG	power take-off shaft transmission

Formula symbols:

h_s	Height of the center of gravity above the surface of the road
l_h	Distance between center of gravity - center of rear axle
l_v	Distance between center of gravity - center of front axle
G	Gross vehicle weight
G_h	Rear axle load
Q_h	Rear axle load with vehicle raised at the front
h'	Height by which the vehicle was raised
l	Wheelbase
h_a	Height of the center of gravity above the center of the wheel
r_{stat}	Static tyre loaded radius
G_v	Front axle load
Q_v	Front axle load with vehicle raised at rear
m	Tyre/road surface coefficient of friction
m_K	Lateral coefficient of friction for induction of the tilting procedure
D	Curve diameter (smallest possible curve diameter in the UNIMOG)
F	Force
h	Height of the center of gravity of the entire vehicle
s	Tread
V	Speed
v_k	Cornering tilt speed (level conditions)

9. Introduction to implement confirmation

UNIMOG – implement confirmation

Required implement data

Testing an implement combination with regard to issuing implement confirmation is carried out on the basis of technical documents which can be approved and checked, the form and content of which are comprehensively described in the following (introduction).

Enquiries are avoided via the provision of complete documentation, and the approval procedure is accelerated.

The documentation is to be submitted in the following form:

1 Written description of the implement (DATA SHEET - implement manufacturer's data, see 9.5)
2 Technical drawings
3 Figure pages

For clear classification, all documents which are submitted must be marked with the name of the implement manufacturer, implement, implement type, amendment status and, if necessary, allocated UNIMOG type (e.g. footer).

The documents are to be submitted to:

Postal address: DaimlerChrysler, Gaggenau Plant
Department PBU/TES,
HPC 268
76568 Gaggenau

Fax: 07225-61-5512

Division of the implement data

Note: The complete sub-division and numbering of the individual sections can be seen from the detail pages and is to be adopted in the implement documentation (see 9.5).

9.1. Implement description

9.1.1 Implement identification

9.1.2 Corporate data

9.1.3 Implement function

9.1.4 Scope of delivery

9.1.5 Technical data

9.1.6 Ratings

9.1.7 Power requirements

9.1.8 Operating speed of the power take-off shaft

9.1.9 Minimum vehicle equipment

9.1.10 Recommended optional vehicle equipment

9.1.11 Instructions / operating regulations

9.1.12 Implement field of application

9.1.13 Possible combinations with other implements

9.1.14 Implement manufacturer's confirmation

9.1.15 Special confirmation

9.1.16 Modification to the vehicle

9.1.17 Other data

9.1.18 Confirmation of correctness

9.2 Drawing documents

Vehicle with implement in:
- Transportation position
- Operating position
- Detailed drawings

9.3 Figure pages

Vehicle with implement in:
- Transportation position
- Operating position
- Detailed views

9.4 Further procedure

9.5 Data sheet

Note regarding the data sheet: The form is available from PBU/TES as a Word data file (diskette or via e-mail).

9.1 Implement description

9.1.1 Implement identification

(The implement must be clearly recognizable on the basis of the implement identification)

Implement designation

(Trade name corresponding to the sales designation)

Implement type/groups

(Implement identification should be predominantly possible on the basis of the type designation)

Implement group No.	Designation
110 130 150	Ground work Sowing Care and fertilization
170 190	Harvesting Special cultures
210	Storage vessel (bunkers, barrels, etc.)
330	Cage wheels, chains
510 520 530	Loading implements Excavating implements Drilling implements
540 550 560	Land cables and line construction Overhead line construction Ditch cleaning implement

Implement group No.	Designation
610	Snowploughs
620	Gritting implements
630	Snow clearing implement, power take-off
640	Snow clearing implement with mounted engine
710	Road care
730	Road construction
750	Municipal implements
810	Cable winches
820	Forestry implements
840	Generators, compressors, pumps
910	Driving unit rear truck
920	Fire brigade bodies
930	Special bodies
940	Rail-road vehicles

Implement serial number

(With which the described version commences)

9.1.2 Corporate data

Please always state the complete postal address with the relevant contact person, telephone no. and fax no.

- **Supplier**
- **Manufacturer**
- **Operating instructions**
- **Customer service**
- **Spare part sales**

9.1.3 Implement function

- **Brief description of the implement**
  Nomination of the main implement components

- **Mounting on the vehicle**
  E.g. front mounting plate etc.

- **Drive**
  With implement-side drive components (drive train) up to the point of activity (operating tool)

  Instruction: If necessary, overload fuses must also be named.

- **Actuation**
  Details of the actuation facility(ies) e.g. control panel, UNIMOG hydraulic system etc. and all implement functions, e.g. raise/lower boom etc.

9.1.4 Scope of delivery

(Implement equipped ready for operation)

- **Basic equipment**
- **Optional implement equipment with details of:**
  function, drive, dimensions / operating width, weight, illustration page

  Instruction: If the conditions of use or vehicle loads change significantly on operation of implements with optional equipment, the technical data must be recorded in accordance with Point 1.5.

9.1.5 Technical data (here, for example: verge and embankment mower)

Dimensions in transportation position

(Vehicle + implement)

- **Overall length**
- **Overhang in vehicle longitudinal direction**
  Measured from coupling level/front mounting plate at the front, measured from vehicle rear lamp at the rear

- **Overall width**
- Lateral overhang
  Measured from the outer edge of the lens of the side marker lamps or rear lamps of the UNIMOG

- Overall height
  (Poss. also at the front edge of the implement)
- Ground clearance
  (Poss. with gradient of slope)
- Further dimensions, insofar as these correspond to the general Implement Mounting Directive necessary
  (E.g. in the case of rear pump attachment, clearance angle of the trailer hitch)

Dimensions in operating position

- Greatest boom length
  (From center of vehicle to outer edge of cutting tool)
- Telescopic travel
- Lateral movement
- Operating width
- Slewing range
- Other operating dimensions
  (e.g. clearance height etc.)

<u>Weights (in daN), all measurements without driver (1 daN » 1 kp)</u>

Abbreviations:

FA: Front axle load, FL: Front left wheel load, FR: Front right wheel load
RA: Rear axle load, RL: Rear left wheel load, RR: Rear right wheel load
GVW: Gross vehicle weight
Δ: (Delta) load change, determined via calculation

- **Vehicle empty;**
  <u>Instruction:</u> Weigh vehicle before mounting implement

- **Vehicle with implement in transportation position:**

- Vehicle with implement + ballast* in transportation position:
  * insofar as is necessary according to the general Implement Mounting Directive

- **Implement alone, in transportation position**

- **Ballast alone**

- **Vehicle with implement in operating position***

*** Test conditions:**

In the case of boom mower implements, maximum boom length, heaviest operating tool, movement or telescopic devices fully extended, tool <u>freely floating .</u>

In the case of front-mounted implements, weigh with ballast weight.
The smallest wheel load must be at least 10 percent of the relevant axle load. The lower absolute value is 400 daN.

If the implement is extended transverse to the direction of travel, the sum of the opposing wheel loads must not be less than 1/4 of the relevant gross vehicle weight.

These limit values must also be met if several implements are operated simultaneously. If corresponding combinations are approved (e.g. verge mower in conjunction with rear boom mower), the corresponding wheel load conditions must be met and verified by weighing.

Dynamic test:
Stability is also to be tested by intercepting the most rapid possible lowering movement of the outstretched boom:
The wheel opposite the boom must not be raised

In addition, a full/emergency braking maneuver must be carried out in the operating position from a speed of 10 to 15 kph. The combination must behave in a stable manner, i.e. the vehicle must not tip or jackknife, and the implement boom must not swing.

The implement manufacturer must confirm the fulfillment of the test conditions in writing.

Other implement-specific technical data
In the case of mowers, e.g.
- Cutting speed (at the tool)
- Rotor speed
- Fan speed
- Installed hydraulic output, pressure and volume flow

9.1.6 Ratings in the case of moderate operating conditions

In the case of mowers, e.g. driving speed (advance), daily performance, area performance, etc.

9.1.7 Power requirements

Mechanical
Maximum and mean power required for operating implements, which is taken off at the power take-off shaft or the high-speed auxiliary power take-off.

Hydraulic
Maximum and mean vehicle hydraulic system power required for operating implements
- maximum and mean operating pressure
- maximum and mean volume flow (pump output)
- number of hydraulic circuits
- number of cells required (control valves)
- loss of power which occurs in the implement (fluid heating)
- maximum volume of fluid consumed

Electrical
Maximum and mean vehicle electrical power and operating voltage required for operating implements

Pneumatic
Maximum and mean compressed air system power required for operating implements.
- maximum and mean operating pressure
- maximum and mean volume flow (pump volume)

Note: Supplying implement-side compressed air consumers is only permissible at the auxiliary consumers port (port no. 24, four-circuit safety valve, see vehicle operating instructions).

9.1.8 Operating speed of the power take-off shaft

Transmission stage 540 or 1000 rpm; poss. minimum and maximum speed

9.1.9 Minimum vehicle equipment necessary for operating implements

All optional vehicle equipment which is absolutely necessary for the use of implements must be stated. The list should be provided in the alphabetical sequence of the SA code in accordance with the currently valid UNIMOG price list. Insofar as the use of implements is designed for various UNIMOG models, the vehicle equipment must be listed in a correspondingly differentiated manner, e.g. in the form of a table.

Note: Final determination is carried out after the implement documentation has been checked by the vehicle manufacturer.

9.1.10 Recommended optional vehicle equipment for operation of implements

Here, all possible optional equipment, which leads to a significant improvement with regard to operating conditions, environmental compatibility, comfort, wear/stability, maintenance-friendliness, etc. and which is not, e.g. due to reasons of cost, listed under 9.1.9 (the vehicle manufacturer reserves the right to make additions), are to be named.

9.1.11 Field of application for the Implement

E.g. possible slope inclination, ground type, operating variables, areas of use with special tools, etc.

9.1.12 Possible combinations with other implements

E.g. front or rear-mounted implement, trailer, etc.
Please also state exceptions or implement space which is not obviously occupied (e.g. "Auxiliary load area partially occupied by ballast").

9.1.13 Implement manufacturer's confirmation

Confirmation that the delivered implements from construction year ...., serial number ....
comply with the design specified above.

Note: Certificate of conformity (+ CE symbol) required in accordance with Machinery Directive 89/392 EEC from 01.01.95
(see Info 10 for implement manufacturer, available from PBU/TES, Fax 07225-61 5512).

9.1.14 Special confirmation

E.g. field of visibility test in accordance with StVZO, if front-mounted implements project into the driver's field of visibility in the transportation position (12 m circle).

9.1.15 Modifications to the vehicle

All modifications to the vehicle, required for the attachment and/or operation of the implement, must be named and, if necessary, documented in accordance with Point 9.2. and 9.3.

Note: For modifications for which approval must be sought, see Chap. 4.3

9.1.16 Other data

Review-relevant data, which cannot be allocated to the above mentioned points.

9.1.17 Confirmation of correctness

The correctness of all data and documents which are submitted must be confirmed by signature with place, date and company stamp.

9.1.18 Instructions for the operation on public roads, operating regulations etc.

The necessary operations, which have to be carried out before each journey so that the implement or the implements are moved from the operating position into the transportation position specified in accordance with StVZO, and are protected with the necessary transportation restraints against unintentional actuation and movement, must be listed.

Instruction:
The driving speed must be adapted to the relevant road and road traffic conditions, whereby the influence of the implements on braking, cornering, driving on slippery road surfaces, etc. must be taken into consideration. The industrial safety and accident prevention regulations of the relevant
employer's liability insurance associations are binding. Insofar as these are necessary, special operating regulations must be documented
via the submission of corresponding instruction signs (e.g. stickers on the implement or in the cab, operating instructions, etc.)
(The vehicle manufacturer reserves the right to make additions).

9.2. Drawing documents

The vehicle/implement combination should be depicted in a general scale drawing so that the main implement components and dimensions in both transportation and operating position can be clearly seen.

Drawings which are submitted should basically include the following data:

- Designation with vehicle and implement type
- Drawing number
- Company names / title block
- Date of creation
- Amendment status
- Blueprints with date
- Scale (1 : 20 recommended)

Insofar as is necessary, review-relevant data must be depicted separately.

9.3. Figure pages

The combination should be photographed in transportation and operating position from the front, both sides and the rear.

In order to ensure that submitted photographs are not confused, these must be submitted on illustration pages containing the vehicle and implement type, vehicle identification number, implement serial number and date (date of photography).

Any necessary detailed photographs must include additional data such as nomination, viewing direction (in reference to the direction of travel), installation position, etc.

9.4. Further procedure

Following the examination of the above mentioned documents, implement or body confirmation* is issued for the corresponding combination in the event of a positive result.

* Depending on whether this involves an implement or body implement.

The implement or body confirmation can only be issued for implements or bodies if it has been verified, via **drawings** and **a description by the implement manufacturer**, that the construction condition principles are adhered to. This does **not** include evaluation of the details of the construction - especially the free implement/vehicle space, handling, braking stability and other criteria which assume official type approval; this is the sole **responsibility of the implement/body manufacturer**.

9.5 DATA SHEET - implement manufacturer's data

1. Implement identification

Implement designation	
Implement type/ group	
Serial number of implement	

2. Corporate data

	Address	Contact person	Tel / Fax
Supplier			
Manufacturer			
Operating instructions			
Customer service			
Spare part sales			

Note: If space in the field is not sufficient, please use a copy of the relevant data sheet with the note "additional page" (Page ..a, ..b, ..c).

Company	Implement type	UNIMOG type	Date

3. Implement function

3.1 Brief description of the implement

3.2 Mounting on the vehicle

Company	Implement type	UNIMOG type	Date

3.3 Drive

3.4 Actuation

Company	Implement type	UNIMOG type	Date

4. Scope of delivery

4.1 Basic equipment (implement equipped ready for operation)

4.2 Optional implement equipment, stating:

Function	Dimensions/operating width	Drive	Weight	Figure page

Note:
If the conditions of use or vehicle loads change significantly on operation of an implement with optional equipment, techn. data must be recorded in accordance with "Technical data" Point.

Company	Implement type	UNIMOG type	Date

5. Technical data

5.1 Dimensions in transportation position	Dimensions [mm]	Comments
Overall length		
Overall width		
Overall height		
Front overhang		
Left lateral overhang		
Right lateral overhang		
Rear overhang		
Ground clearance		
Further dimensions required in accordance with the general Implement		
5.2 Dimensions in operating position	Dimensions [mm]	Comments
Greatest boom length		
Telescopic travel		
Lateral movement		
Operating width		
Slewing range		
Other operating dimensions		

Company	Implement type	UNIMOG type	Date

5.3 Weights, all measurements without driver

Abbreviations: FA: Front axle load, FL: Front left wheel load, FR: Front right wheel load, RA: Rear axle load, RL: Rear left wheel load, RR: Rear right wheel load, GVW: Gross vehicle weight, Δ: (Delta) Load change

Vehicle data;

Fuel tank display	full☐	¾ ☐	½ ☐	¼ ☐	reserve ☐
Vehicle Ident. No.	WDB				
Tyres					
Track width					

Vehicle empty

[daN]	[daN]	[daN]
FL	FR	FA
RL	RR	RA
		GVW

Vehicle with implement in transportation position:

[daN]	[daN]	[daN]
FL	FR	FA
RL	RR	RA
		GVW

Company	Implement type	UNIMOG type	Date

Vehicle with implement + ballast in transportation position:

[daN]	[daN]	[daN]
FL	FR	FA
RL	RR	RA
		GVW

Implement alone, in transportation position

[daN]	[daN]	[daN]
ΔFL	ΔFR	ΔFA
ΔRL	ΔRR	ΔRA
		ΔGVW

Ballast alone

[daN]	[daN]	[daN]
ΔFL	ΔFR	ΔFA
ΔRL	ΔRR	ΔRA
		ΔGVW

Vehicle with implement in operating position

[daN]	[daN]	[daN]
FL	FR	FA
RL	RR	RA
		GVW

Company	Implement type	UNIMOG type	Date

5.4 Other implement-specific technical data

In the case of mowers, e.g.

Cutting speed (at the tool)			
Rotor speed [rpm]			
Fan speed [rpm]			
Installed hydraulic system	Pressure [MPa/bar]	Volume flow [l/min]	Standard output [kW]
Circuit I			
Circuit II			
Circuit III			
Circuit IV			

6. Ratings at moderate operating conditions

Driving speed (advance)	
Daily performance	
Area performance etc.	

7. Power requirements

7.1 Mechanical

Maximum and mean power required for implement operation taken off at the power take-off shaft or the high-speed auxiliary power take-off.

	∅	max.
Power take-off shaft [kW/bhp]		
High-speed auxiliary power take-off [kW/bhp]		

Company	Implement type	UNIMOG type	Date

7.2 Hydraulic

Maximum and mean vehicle hydraulic system power required for implement operation

Maximum and mean operating pressure [MPa/bar]	∅	max.
Maximum and mean volume flow (pump output) [l/min]	∅	max.
Number of hydraulic circuits		
Required number of cells (control valves)		
Loss of power which occurs in the implement (fluid heating) [kW]		
Maximum volume of fluid consumed [l]		

7.3 Electric

Power and operating voltage necessary for implement operation

	min	∅	max
Operating voltage [V]			
Current [A]			
Electric power [kW]			

7.4 Pneumatic

Compressed air system power necessary for implement operation.

	min	∅	max
Operating pressure [MPa/bar]			
Volume flow [l/min]			

Note:

Company	Implement type	UNIMOG type	Date

Implement-side compressed air consumers may only be supplied at the auxiliary consumer port. (port no. 24, four-circuit safety valve, see vehicle operating instructions).

8. Operating speed of the power take-off shaft

			Operating speed[rpm]	
	Gear stage 540	Gear stage 1000	min.	max.
Front power take-off shaft	☐	☐		
Rear power take-off shaft	☐	☐		

9. Minimum vehicle equipment necessary for implement operation

Code	Description	Code	Description

Note:
Final determination is carried out after the implement documentation has been checked by the vehicle manufacturer.

Company	Implement type	UNIMOG type	Date

10. Optional vehicle equipment recommended for implement operation

Code	Description	Code	Description

11. Field of application of the implement

Company	Implement type	UNIMOG type	Date

12. Possible combinations with other implements

Please also name exceptions or implement space which is not obviously occupied
(e.g. "Auxiliary load area partially occupied by ballast").

Company	Implement type	UNIMOG type	Date

13. Implement manufacturer's confirmation

We confirm that the delivered implements

from construction year:
____

serial number: ____

comply with the design specified above.

Note:
Conformity certification (+ CE symbol) in accordance with Machinery Directive 89/392 EEC is required from 01.01.95 (see Info 10 for implement manufacturer).

14. Special confirmation

☐ none ☐ according to Appendix

Company	Implement type	UNIMOG type	Date

15. Modifications to the vehicle ☐ none ☐ according to Appendix

16. Other data ☐ none ☐ according to Appendix

Company	Implement type	UNIMOG type	Date

17. Confirmation of correctness

We confirm the correctness of all submitted data and documents:

____

Place, date

Company stamp/signature

Company	Implement type	UNIMOG type	Date