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DAILY RANGE
BODYBUILDERS INSTRUCTIONS

LIGHT RANGE

IVECO

EDITION 1999

Follow these instructions carefully in order to preserve the efficiency and reliability of all vehicle components.
Our products are subject to constant development; as a result certain parts of this publication may not be fully up to date.

Produced by
SATIZ S.p.A©.
Editoria Tecnica
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Lungo Stura Lazio 49
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Foreword

For the technical information concerning modification of the vehicle, application of bodies and requests for technical documentation, please contact the relevant IVECO Commercial Sector.

These instructions refer to the vehicles of the Daily range that are currently in production.

For vehicles of the previous Daily range, please refer to the instructions given in booklet nr. 603.42.141.

Warning

The following symbols are widely used in this manual and the indications to which they refer should be carefully followed.

Danger to persons

Warning/Precautions

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SECTION

Alphabetical index to subjects

I. GENERAL SPECIFICATIONS

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1.1. General Specifications

Purpose

The purpose of these instructions is to permit modifications and/or fitting genuine IVECO parts while safeguarding the operation, safety and reliability of the vehicle and its components. The modifications and fittings made in compliance with the following instructions, except for the contents of point 2.1.1, require no specific IVECO approval.
All modifications and fittings not covered in these instructions are to be approved beforehand by IVECO.
IVECO shall not be held liable for any modifications or fittings where approval has not been requested or, if it has, where approval has been rejected or not given.

Departments to be Contacted and Documentation to be Submitted

Whenever equipment has to be constructed and this is not taken into consideration by the specifications contained in this manual, the responsible Departments, which can be contacted through the Sales Management of the Company, will provide the pertinent information. In these cases contact the IVECO Office in your zone.

When contacting these bodies two copies of the following documentation must be submitted:

a) Drawing of the vehicle including dimensions of the body or of the modified components or of the new equipment.

b) A break down of the weights, with indications regarding the centre of gravity where necessary.

c) Description of the auxiliary frame, dimensions, fastenings to the chassis of the vehicle.

d) Distribution of the forces and moments acting on the vehicle as a result of the equipment (cranes, cement mixers, hoists, concrete pumps etc.).

Reference must be made on the drawings themselves to all the points which differ from these specifications.
Furthermore, the use of the vehicle and the conditions under which it is to be used must be briefly described.

IVECO Technical Documentation Available on Computer

The specific IVECO - THB web site contains technical documentation on the product concerning:

- Instructions for bodybuilders;
- Technical descriptions;
- Bodybuilder drawings
- Chassis, transmission, P.T.O. diagrams;
- Type-approval data.

Access information can be requested directly from the above-mentioned IVECO office.
This same office will be able to provide you with CD-ROMs with the collection of chassis cab diagrams for the various product ranges in CAD - IGES and/or DXF format.

Authorization and Liabilities

The authorizations issued by IVECO concern solely the technical feasibility of the modification and/or fitting to be made on a genuine IVECO vehicle.
The bodybuilder is responsible for the:

- **project of the modification or fitting;**
- **choice and features of the products used;**
- **workmanship of the modification or fitting;**
- **compliance of the project and its implementation with all the instructions provided by IVECO;**
- **compliance of the project and its implementation with all the current regulations in the country where the vehicle is registered;**
- **operation, safety, reliability and generally the good handling of the vehicle as well as the effects the modifications and fitting may have on the performance and specifications of the vehicle.**

Guarantees

The bodybuilder/chassis converter who has built the body or who has modified the chassis must guarantee that the work was undertaken in a professional manner in full compliance with the specifications contained in this manual. IVECO reserves the right to declare void its own warranties for the vehicles where:

- These specifications have not been adhered to or where unauthorised equipment was installed, or unauthorised modifications were carried out.
- The chassis was used in a way which is not suitable for the equipment or for the intended purpose of the vehicle.
- The specifications, standards or instructions issued by the Manufacturer for the flawless execution of the operations have not been heeded.
- Original spare parts or components which the Manufacturer has made available for specific interventions were not used.

Maintaining Proper Operation of Parts and Vehicle

It is clearly understood that for all authorised modifications and applications, the proper functioning of the various parts of the vehicle, the safety of operation and use of the various elements of the vehicle, in compliance with the national and international regulations (EEC Standards) and to the norms pertaining to the prevention of accidents must be guaranteed.

Limits on Modifications

To ensure driving safety and good vehicle operation, the following assemblies in general must not be modified:

- Axles and rear axles
- Steering system
- Brakes
- Suspension (springs, brackets, anchor bars)
- Chassis
- Power unit
- Coupling devices
- Cab suspensions
- Electrical system.

Modifications to the above assemblies, where included in these directives, may only be carried out after approval has been received from IVECO (see 2.1.1).

Trademarks and Logos

Trademarks, nameplates and denominations must not be modified or displaced in relation to the original design. The appearance of the vehicle must not be changed or modified.
The application of trademarks tied to the transformation or trim levels must be authorised by IVECO. They must not be applied near to the IVECO tradenames or logos.

IVECO reserves the right to withdraw the tradenames and logos if the fitting or conversion fails to conform with requirements. The bodybuilder accepts all responsibility for the entire vehicle.

Instructions for Additional Units

When the vehicle is delivered the bodybuilder/chassis converter must supply all service and maintenance instructions and full parts list relevant to the units added where this information is held to be necessary.

Vehicle Identification

The correct choice of chassis, in the appropriate version, is very important if the outcome of the modification is to be successful.

Depending on the freight to carry, its volume and specific weight, and the type of mission to accomplish, call your IVECO Dealer to identify the most suitable vehicle with the right combination of wheelbase, engine, gearbox, and rear-axle ratio.

Before proceeding with the modifications, ensure that the vehicle supplied corresponds to the one requested by checking the information given on the order and in the technical documentation provided by IVECO.

The Daily range comprises the following segments:

- **Commercial** **(GVW 2.8 - 3.49 tonnes)**
- **Light** **(GVW 3.5 tonnes)**
- **Medium** **(GVW 3.51 - 5.2 tonnes)**

Identification comprises:

e.g. **29 L 9**

35 S 11

50 C 13

29, 35 and 50 = Total mass (: 10 tonnes)

Classe L = Single rear wheels (Commercial segment)

Classe S = Single rear wheels (Light segment)

Classe C = Twin rear wheels (Medium segment)

9, 11 and 13 = Engine power (x 10 in HP)

Daily vehicles have been type approved in the following categories, according to European Standards:

- M1 - Vehicles used to carry passengers with at most eight seats plus the driver's seat.
- M2 - Vehicles used to carry passengers with over eight seats plus the driver's seat and a total mass no greater than 5 tonnes.
- N1 - Vehicles used to carry freight with a total mass no greater than 3.5 tonnes.
- N2 - Vehicles used to carry freight with a total mass over 3.5 tonnes and no greater than 12 tonnes.

These are categories with the strictest limits (especially for passenger transport).

With the modifications, the bodybuilder will need to ensure compliance not only with them but also with the specific requirements of the standards in the country for which the vehicle is destined.

1.2. Dimensions and masses

1.2.1 General Specifications

The dimensions and maximum permissible mass on the axles are indicated on drawings, on technical specifications and, in greater details, on the official documentation issued by the Company.
The kerb weights refer to vehicles with standard equipment. Special equipment may involve considerable modification to the mass and its distribution on the axles.
On our vehicles, positioning lights and rear-view mirrors is designed for widths of up to 2140 mm; higher values up to 2350 mm require specific mirror arms, to be requested from IVECO.

Weighing the Chassis

As a result of production factors there may be a variation in mass of approx. 5%.

It is, therefore, advisable to determine the mass of the vehicle with its cab before fitting the body and equipment and establishing their distribution on the axles.

Road Usage

Limits of road usage can be made for each vehicle, chiefly defined by the:

- division of masses on the axles;
- width of mirrors used;
- position of rear underrun bar.

Higher values, in conformity with the authorized masses on the axles, may be authorized by IVECO after modifying components such as the chassis, underrun bar, mirrors, etc.

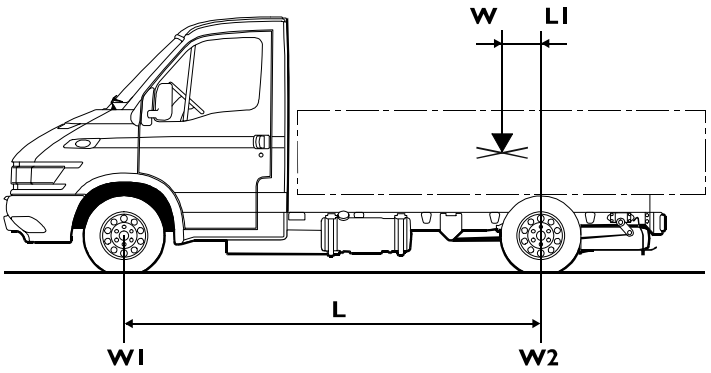
1.2.2 Determining the Centre of Gravity of the Body and Payload

Positioning on longitudinal plane

To establish the location of the centre of gravity of the body and payload the following examples below may be used as guidelines.

The technical documentation specific to each model (chassis cab drawing) give the positions permitted with the vehicle in its standard form. The masses and positioning of the single components of the vehicle are given in the chassis and weight distribution diagram.

Figure 1.1 Example to determine positioning of the centre of gravity of the payload plus body



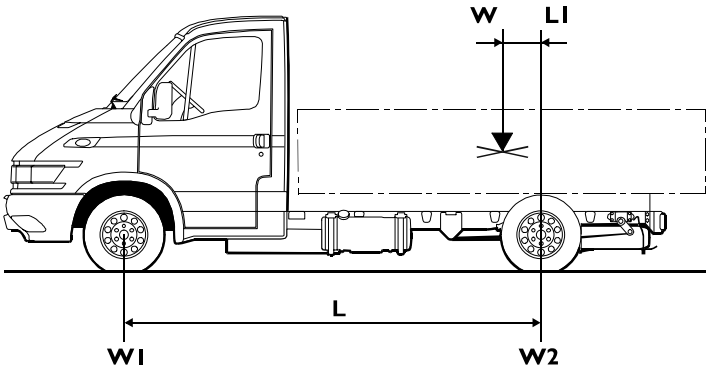
W = Payload plus body
W1 = Share of payload on front axle
W2 = Share of payload on rear axle
L1 = Distance of centre of gravity from centre line of rear axle
L = Wheelbase

$$L1 = \frac{W1 \cdot L}{W}$$

respectively

$$L1 = L - \frac{W2 \cdot L}{W}$$

Figure 1.2 Example to check compliance of permitted masses on axles



W = Payload plus body
W1 = Share of payload on front axle
W2 = Share of payload on rear axle
L1 = Distance of centre of gravity from centre line of rear axle
L = Wheelbase

$$W1 = \frac{W \cdot L1}{L}$$

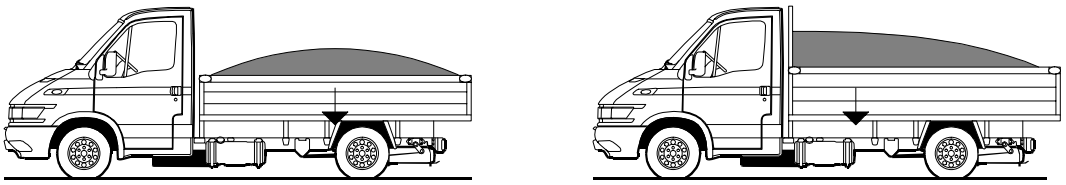
$$W2 = W \cdot \frac{(L - L1)}{L}$$

In order to apportion the payload on the axles, it must be uniformly distributed except when the shape of the loading surface itself entails a different distribution of the load.

As for equipment, the actual location of the centre of gravity is considered.

When building bodies or containers, loading and unloading systems for the transported goods must be devised which preclude excessive variations in the distribution of the load and/or excessive loads on the axles, also giving the relevant instructions to the users.

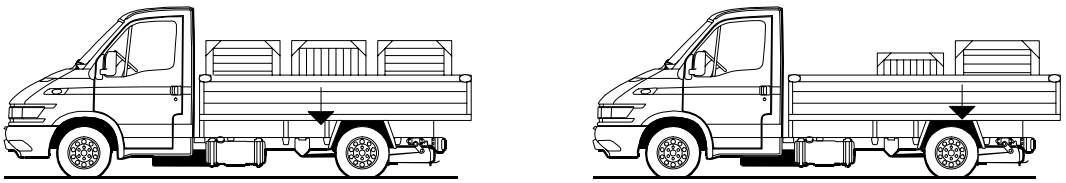
Figure 1.3



Uniform distribution of the load

Non-uniform distribution of the load due to the lack of a rear overhang

Figure 1.4



Uniform distribution of the load

Non-uniform distribution of the load (beware of load on axles and of minimum ratio)

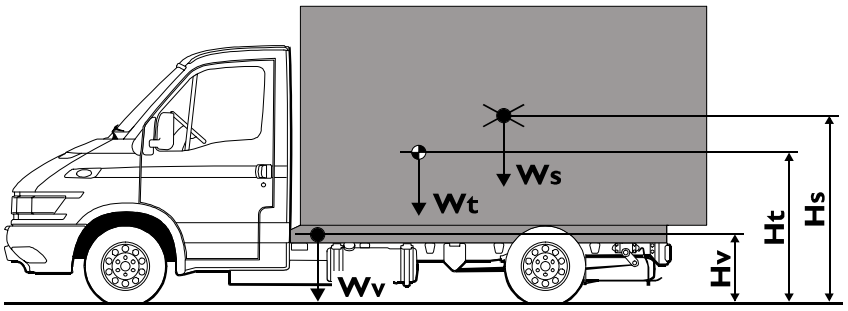
Height of the Centre of Gravity

The height of the centre of gravity of the chassis cab is given in the technical documentation specific to each model (chassis drawing).
For testing the vehicle complete with superstructure, the bodybuilder must check that the height of the centre of gravity of the equipment including the payload, or of the entire vehicle when fully loaded, falls within the maximum permitted values.
These limits are defined in compliance with the national or international regulations (e.g. EC Directive 71/320 regarding braking) or requested by the Manufacturer to ensure good handling of the vehicle (e.g. transverse stability of the moving vehicle).
In order to comply with the current EC Directive, IVECO provides information for the various models (wheelbase and specific body) on computer, regarding:

- Height of centre of gravity of chassis cab (e.g. chassis cab diagram, braking data);
- Maximum height of centre of gravity of complete vehicle at full load (e.g. national type-approval document);
- Braking capacity of each single axle (e.g. braking data).

Figure 1.5

Verification with full load:



$$Ht = \frac{Wv \cdot Hv + Ws \cdot Hs}{Wv + Ws} \qquad Hs = \frac{(Wv + Ws) \cdot Ht - Wv \cdot Hv}{Ws}$$

Wv = Chassis cab vehicle tare weight
Hv = Height of centre of gravity of chassis cab vehicle (laden condition)
Ws = Body and payload
Hs = Height of centre of gravity of body and payload in relation to ground
Wt = Vehicle mass when fully loaded
Ht = Height of centre of gravity of vehicle with full load

To check the vehicle with its body but no payload, use above formula but for Ws use only the body tare weight (The position for Hv will depend on the load and deflection of the suspension).

The height of the centre of gravity indicated in table 1.1 represents values which are not to be exceeded for each given equipment level. These values have been calculated only in terms of the transverse stability of the vehicle and are applicable to a mid wheelbase. Any other possible restrictive specification, e.g. braking regulation, should be taken into consideration.

The values given in table 1.1 refer to the superstructure with fixed payload. In versions where the payload tends to move sideways (e.g. suspended loads, fluid loads etc.) especially when turning, higher dynamic stress is generated which makes the vehicle less stable. This must be taken into consideration when providing vehicle operating instructions or for possible reduction in the height of the centre of gravity.

Using Stabiliser Bars

Supplementary stabilising or anti-roll bars, where available, spring reinforcements or the application of rubber components (in compliance with point 2.6) may increase the height of the centre of gravity of the payload which must be defined as each occasion arises. The modification must be carried out after careful consideration has been given to the specifications of the version, to the wheelbase and to the distribution of the cross-stresses acting on the suspension both at the front and at the rear of the vehicle. It must be borne in mind that it is often advisable to modify the rear axle only since a modified front axle would give the driver a false sense of stability making it more difficult to perceive the safety limits. Modification to the front axle may be made where the load is positioned behind the cab (e.g. crane) or where the superstructures are very rigid (e.g. van conversion).

Exceeding the Limits

When transporting goods with an exceptionally high centre of gravity (e.g. machinery, indivisible cargo etc.) from a technical point of view it is possible to exceed the values indicated in the table provided that the steering system of the vehicle is suitably adapted to this condition (e.g. low speed, gradual changes in path, etc.)

1.2.3 Observing the Permitted Weights

All limits indicated in our documentation must be adhered to. The mass of the front axle is of particular importance under varying load conditions, in order to ensure the correct steering characteristics on road surfaces of all types.

Particular attention must therefore be paid to vehicles with a weight which is concentrated on the rear overhang (e.g. cranes, tail-lifts, centre axle trailers) and to vehicles with a short wheelbase and a high centre of gravity (e.g. silo vehicles).

When positioning the body and equipment, the loads must be correctly distributed transversally. For each wheel a variation in the rated load (1/2 of the axial load) of 4% is permitted (e.g. admitted load on axle: 3,000 kg load admitted on each wheel: 1,440 to 1,560 kg) provided that the tyres permit it, without impairing braking or driving stability.

Apart from different specifications for specific individual vehicles, the following may be taken to be the minimum values for the front axle:

- 20% of the total vehicle mass with uniformly distributed loads
- 25% of the total vehicle mass for loads that are concentrated on the rear overhang.

The rear overhang of the body must be built in strict observance of the permitted axle loads, the minimum load required on the front axle, the limitations in length, the positioning of the tow hook and of the underride guard stipulated by the relevant laws and regulations.

Variations in the Permissible Mass

Special exceptions to the maximum permissible mass may be granted for particular applications for which, however, precise limitations regarding the use will be imposed in addition to possible vehicle reinforcements.

Such exemptions, if they exceed the limits imposed by law, must be authorised by the Administrative Authority.

The reduction in the permissible mass on the vehicle (derating) may involve changing various elements (such as suspension and brakes) and may require recalibration of the load sensing valve. In these circumstances necessary instructions will be supplied.

The request for authorisation must include:

- Vehicle type, wheelbase, identification number, designated use.
- Tare distribution on the axles (e.g. vehicles equipped with crane and body) including positions of the centre of gravity of the payload.
- Proposals concerning the reinforcement of the vehicle components where necessary.

Table 1.1
Maximum heights in relation to the centre of gravity of the payload and cornering stability [1)]

MODELS	BASIC EQUIPMENT with anti-roll bars		Max. height (approx.) of centre of gravity of payload (includ. body and equipment) in relation to the ground (mm)
	Front	Rear	
29 L	-	x	1500
35 S	-	x	1500
35 C (front cross bal.)	-	x	1800
35 C (front long. bar)	x	x	1900
40 C	x	x	1900
45 C	x	x	1950
50 C	x	x	1950

NOTE

1) values referred to the transversal stability of the vehicle bear in mind further possible restrictions imposed by the regulations in force (e.g. braking system).

x = with standard anti-roll bar

- = without anti-roll bar

1.3. Instructions for the Correct Functioning of the Parts of the Vehicle and Accessibility for Maintenance

As a rule, when modifying or installing any type of equipment, nothing must be altered which prevents the correct functioning of assemblies and parts of the vehicle under all operational conditions.

For example:

- Ready access to all parts requiring inspection or maintenance and periodic servicing must be provided. In the case of closed body types suitable opening doors must be provided.
- Adequate space permitting tilting must be assured for the cabs, in the case of structures involving the space above the driver's cab.
- Service access to chassis/driveline components must be retained. For instance repairing the gearbox or clutch must be possible without necessitating the removal of major components of the added structure.
- The cooling system (radiator cowling, radiator, air passages, cooling circuit, etc.) and the engine air intake must not be altered.
- The anti-noise panels must not be altered or moved in order to prevent changes in the approved noise levels of the vehicle. Should it be necessary to make openings (e.g. for the longitudinal runner of the body to pass through) these must be properly closed off using material with inflammability and soundproofing characteristics equivalent to those used originally.
- Adequate brake ventilation must be ensured.
- The positioning of the mudguards and wheel-arches must allow free movement of the rear wheels even when chains are being used.
- When vehicle body building has been completed the adjustment of the headlights must be checked for safety and re-adjusted where necessary. In these circumstances it may be necessary to adjust the screw on the headlights, factory set to a value of 1.2 %, or to check the adjustment range of the adjusting device when the vehicle is laden. The adjustment, according to the modification (truck, van, wheelbase, suspension type), must be carried out in compliance with the instructions given in the Owner's Manual in which the new values, if any, will be noted.
- In the case of parts which are supplied loose (e.g. spare wheel, chocks) it will be the responsibility of the bodybuilder to position and secure them in an accessible and safe manner in compliance with relevant national and international regulations.

1.4. Legal Provisions and Prevention of Accidents

On completing the vehicle, the bodybuilder/chassis converter must check the work (modifications, body + equipment etc.) to ensure that the legal provisions required in the country of registration are observed (e.g. weights, dimensions, braking, noise, emissions etc.). Information regarding these matters may be obtained from the competent Authorities or the IVECO Area Network.

The vehicles manufactured at our plant (except some versions for Extra-European countries) comply with the EEC directives. Converted vehicles must also comply with these directives. The only permissible exception is granted where local type approval differs from EEC homologation.

Prevention of Accidents

The structures and devices fitted to the vehicles must comply with the current regulations concerning the prevention of accidents and safety regulations in force in the countries where the vehicle is to be used. All the precautions dictated by technical awareness must be adopted to prevent malfunction and functional defects.

Compliance with these regulations will be the responsibility of the manufacturers of the structures and devices.

Warning

Components such as seats, upholstery, seals, protective panels etc, may constitute a potential fire risk if exposed to sources of intense heat.

Remove these components before undertaking welding or flame-cutting work.

When cleaning or grinding corrosion-proofing materials, take the necessary precautions against toxic gases and fumes, wearing safety equipment and using extractor fans.

1.5. Choice of material to use: Ecology - Recycling

Increasingly greater attention should be paid, at the study and design stage, to the choice of materials to be used. This is especially the case as regards the aspects connected with ecology and recycling in the light of domestic and international regulations that are constantly being developed in the sector.
In this connection:

- Everyone must be aware of the prohibitions on using harmful or potentially hazardous materials, such as ones containing asbestos, lead, halogen additives, fluorocarbons, etc.
- Use materials whose processing produces limited waste and that permit easy recycling after their first use.
- With composite synthetic materials, use components that are compatible with each other, envisaging also their possible utilization with the addition of other salvaged components. Affix the markings required in compliance with the current regulations.

1.6. Quality System management

For some time IVECO has been promoting Quality System development and training for bodybuilders.
This is a requirement due not only to compliance with domestic and international regulations on product liability, but also the growing demand for increasingly higher quality levels. The creation of new forms of organization in the various sectors and the quest for increasingly more advanced levels of efficiency.
IVECO believes it expedient for bodybuilders to be equipped with an organization where the following are defined and available:

- Organization charts for functions and responsibilities
- Quality system
- Quality goals
- Technical design documentation
- Process and control phases with relevant resources
- Product improvement plan, obtained also with corrective actions
- After sales service
- Staff training
- Manufacturer liability documentation.

1.7. Vehicle delivery

Before delivering the vehicle to the Customer check that:

- The equipment requested has been correctly fitted.
- The vehicle and equipment is completely ready for service and fully operational.
- The functionality and safety of the vehicle and/or equipment has been respected.
- Information/documentation concerning the equipment has been included.
- New data have been entered on the appropriate plates (where applicable)

Concerning the periodical checks on the vehicle, please remember the instructions for correct battery maintenance, referred to on the specific information sheets on the vehicle before delivery to the customer.

The bodybuilder will moreover need to confirm that the operations carried out are in compliance with the latest bodybuilder instructions manual/documentation provided by IVECO and with the requirements of the law.

Guarantee

A guarantee is provided for all our vehicles, under the terms and conditions set out in the relevant documentation. An equivalent guarantee must be provided by the bodybuilder/chassis converter covering the work carried out by him.

2. VEHICLE MODIFICATIONS

Index

2.1 General

2.1.1 General instructions and IVECO approval for modifications

Any modifications must be carried out according to the criteria detailed in the following paragraphs. Particular attention must be given to the following points:

- **Welding to the bearing structures of the chassis is explicitly prohibited** (with the exception of the items described at points 2.2.4, 2.3, and 2.4).
- **Holes in the flanges of the side members are not permitted** (except for the items described at points 2.5 and 3.1.2);
- Where riveted connections exist and can be modified as explained below, these can be replaced by flanged-head screws and nuts of min. class 8.8 or by hex screws of the next greater diameter and self locking nuts. Screws greater than M12 must not be used (max. diameter of hole 13 mm) unless otherwise specified.
- In cases where the original joints were detached and rejoined with bolts or where rivets are replaced with bolts, the bolt torque must be checked after the vehicle has been driven approximately 500 - 1.000 kms.

IVECO Approval

The following modifications may only be performed following IVECO approval:

a) Modifications to the wheelbase following instructions given at points 2.2.3, 2.2.4, and 2.3.
b) Modifications to the rear overhang within the limitations imposed by weight and national legislation, following instructions given at points 2.2.3, 2.2.4 and 2.4.
c) Work on the braking system (see point 2.13) and on the steering system (after appropriate checks).
d) Modification to the characteristics of the suspension (see point 2.6).
e) Changing mechanical suspension into a pneumatic or mixed suspension (see point 2.6.1.).
f) Modifications to the driver's cab and bodywork (see point 2.11).
g) Modifications to the exhaust system and to the engine air intake (see point 2.7).
h) Modifications to the engine cooling system (see point 2.8).
i) Modifications to the engine assembly and driving gear (see point 2.3.2).
k) Modifications to the front and rear axles
l) Installation of retarder brakes (see point 2.17).
m) Installation of power take-offs (in cases where authorisation is required) (see paragraph 4).
n) Changing the tyre size (see point 2.12).
o) Transformation into tractor for semi-trailer (see point 3.8).
p) Special transformations (see instructions given below).

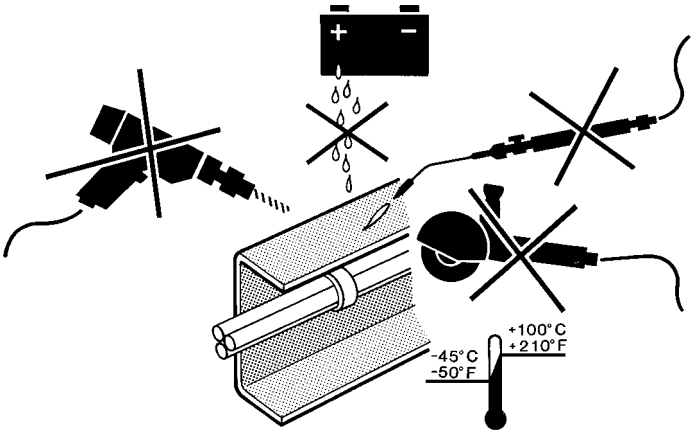
As a general rule, to obtain official approval, the request must contain full documentation illustrating the intended project which must reflect the general and specific specifications contained herein.

It is the responsibility of the bodybuilder to present the intended modification to the proper authorities and to seek their approval whenever called upon to do so by national laws.

2.1.2 Specific Precautions

During the welding, drilling, grinding and cutting operations when working in the proximity of brake lines and particularly **if these are of plastic material or electric wiring**, care must be taken to ensure their protection. Where necessary they should be removed (observe the instructions of points 2.2.4, 2.13 and 2.14).

Figure 2.1



Regarding the electrical equipment remember to:

a) Take precautions concerning the alternator and the electrical/electronic components. In order to avoid damaging the diode rectifier, never disconnect the batteries (or open the isolator) when the engine is running.
If the vehicle has to be tow started make certain that the batteries are connected. Should it be necessary to quick charge the batteries, disconnect them from the vehicle circuit.
In order to run the engine with external means and in order to avoid current peaks which might damage the electric/electronic components, do not use the "start" function in conjunction with external charge devices if such devices are equipped with this function. Starting will have to be carried out only with the external battery trolley, ensuring correct polarity.

b) Checking the earth connections.
As a general rule the original earth connections of the vehicle must not be changed. If it is necessary to move these connections or to implement further earth points use the existing holes on the chassis as far as possible and:
- Remove, mechanically, by filing and/or with an appropriate chemical product, the paint on the chassis side and on the terminal side creating a resting plane free from indentations or ridges.
- Apply appropriate high conductivity paint (e.g. BH 44D Premont or equivalent) between the cable terminal and the metal surface.
- Connect the earth cables within 5 minutes from the application of the paint.

Do not use the IVECO standardised M1 (battery earth connection) M2, (chassis earth connection) points for the earth connections for control switches (e.g. sensors or low absorption devices): see IVECO Workshop Manuals.
With regard to the electronic devices, avoid linking earth connections between the devices; only use single wire earths with optimised lengths (as short as possible).

c) Electric wiring.
The wires of the electrical equipment must be connected by waterproof connections of the same type as the original. The additional section of wire must be protected inside an appropriate sheath and suitably attached by clips. The new wiring must not be positioned on the side of the electronic circuits already existing on the vehicle.

For further information regarding the braking and electronic system, refer to chapter 2.13 and 2.14.

2.1.3 Protection against Rust and Painting

All parts of the vehicle (chassis, driver's cab, body etc.) which have been subject to modification must be protected against oxidation and corrosion.

Protection and painting operations must be carried out with due care on all the parts concerned.

In particular the frame, cab and various parts exposed to atmospheric agents and sunlight must be treated with a cycle which includes:

Ironphosphor - degreasing, anti-corrosion, sealing, primer coat and final coat (the enamel type primer can be replaced with powdered paint, the cab body excluded).

Miscellaneous parts (boxes, protective grills etc.) with complex forms (with boxed parts, joints, overlaps and areas not accessible using the traditional spray application) which are attached to the frame must be treated with a cycle which includes:

Ironphosphor - degreasing, electrophoresis or immersion anti-corrosion, enamel or powdered paint.

When joining surfaces by welding and when the electrophoretic stage is not used, it is extremely important to protect the contact surfaces with electrically weldable paints.

For those parts which are not directly in contact with atmospheric agents (e.g. inside the cab) reduced cycles are acceptable.

Ironphosphor - degreasing, powdered paints or phosphor - degreasing, electrophoresis or phosphor - degreasing, anti-corrosion.

The phosphor - degreasing process may be replaced by degreasing with solvents and wash primer (5 to 10 μm).

Other important operations included are: protection of the open or semi-open boxed parts using oil-wax products by injection using suitable probes, sealing of the joints and overlaps of the areas subject to abrasive action (wheel arches, under body, etc.) using specific products (elastomers, acrylics, etc.) after the anti-corrosion protection.

Parts mounted on the outside of the cab (brackets and bolts in general) must be of stainless steel or protected with "Dacromet". The coupling elements (hinges, handles etc.) used on the frame and/or body (floor panels, tanks etc) must be protected with "Dacromet" or with 12μm min. galvanising. The same quality of the parts used on the cab must in all cases be guaranteed.

Precautions

Suitable precautions must be taken to protect those parts whose preservation and operation could be damaged by paints such as:

- Rubber or plastic pipes for the air and hydraulic installations;
- Gaskets, parts in rubber or plastic;
- Flanges of the transmission shafts or power take-offs;
- Radiators;
- Shock absorber and hydraulic or air cylinder rods;
- Drainage and bleeder valves (mechanical components, air tanks, cold starting heater plug pre-heating tanks etc.);
- Fuel sediment filter;
- Nameplates and logos.

If the wheels are removed, protect the contact surfaces on the drums and hubs, avoid increasing the thickness and especially avoid the build-up of paint on the connecting flanges of the wheel disks and resting points of the fixing nuts. Ensure that the disc brakes are adequately protected. The electronic components and modules must be removed.

When the painting operation is to be completed by oven drying (max. temp. 80°C), all parts which may be damaged by exposure to heat must be removed.

When modifing the cab the application of noise deadening and insulating materials must be included inside the cab and under the floor to eliminate vibrations, contain noise levels and to restore the original heat insulation levels.

2.2 Specific Instructions

2.2.1 Drilling the Chassis

When it is necessary to mount assemblies or auxiliary units on the chassis, as a general rule, the existing holes made at the factory should be used.
Under no circumstances should the flanges of the supporting member of the vehicle be drilled unless in compliance with the indications given in point 2.5 and 3.1.2.

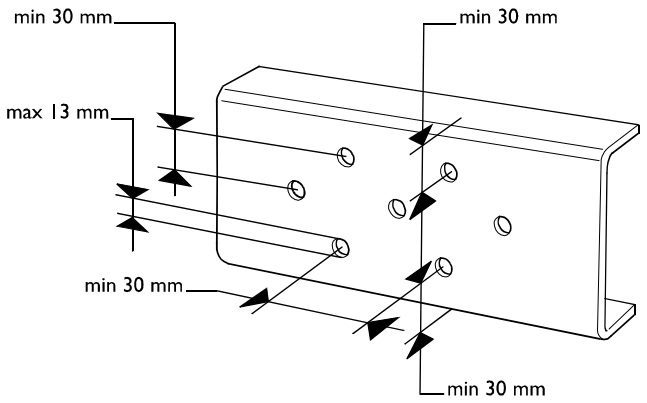
In those cases (installation of shelves, brackets etc.) where it is necessary to drill new holes, they must be drilled on the vertical web of the side member and must be carefully deburred and reamed.

Position and Size

The new holes must not be made in areas of high stress (such as supports for springs) and at variance with the cross-section of the side member.

The diameter of the holes must be proportional to the thickness of the steel. Under no circumstances must this exceed 13 mm unless otherwise specified. The distance from the centre of the hole to the edges of the side member must not be below 30 mm. The centres of the holes must never be located at a distance of less than 30 mm from each other or in relation to the existing holes. The holes must be staggered as shown in figure 2.2. When relocating spring supports or cross members, the same drilling arrangements must be preserved.

Figure 2.2



2.2.2 Bolts and Rivets

In general, fixings of the same type and class designed for similar fixings of the original vehicle should be used. Use class 10.9 bolts for high-stress fixings (e.g. spring supports, bar connections, shock absorbers etc.). When space permits it, use flanged head screws and nuts.

2.2.3 Characteristics of the Materials to be Used when Modifying the Original Chassis

For the modification of the vehicle's chassis and for the reinforcements applied directly to the side members, the material used must correspond both in quality and thickness to that of the original chasses. The material to be used must meet these minimum standards:

Vehicles with single wheels and twin wheels with wheelbase $\geq$ 3750 mm:

Chassis made of high yield steel		FeE420 (QSt E 420 TM)		
Tensile strength	R	≥ 530	N/mm^2	(53 kg/mm^2)
Yield point	R 0,2	≥ 420	N/mm^2	(42 kg/mm^2)
Stretching	A 5	≥ 21%		

Vehicles with twin wheels with wheelbase up to 3450 mm:

Chassis made of high yield steel		Fe 360 D		
Tensile strength	R	≥ 370	N/mm^2	(37 kg/mm^2)
Yield point	R 0,2	≥ 240	N/mm^2	(24 kg/mm^2)
Stretching	A 5	≥ 25%		

As an alternative, only for extending of the rear overhang, Fe510D (QSt 52-3; BSI 50D) steel with the following characteristics may be used:

Tensile strength	R	≥ 520	N/mm2	(52 kg/mm^2)
Yield point	R 0,2	≥ 360	N/mm2	(36 kg/mm^2)
Stretching	A 5 ≥ 22%			

For the dimensions and thicknesses, see the information given in the relevant documentation.

2.2.4 Welding the Chassis

The welding operations may be carried out only by specialist, trained personnel using equipment that is suitable to ensure high quality workmanship (see Specifications EN 287).

Welding is permitted:

- for the junctions of the side members if they are lengthened or shortened.
- for the application of reinforcing L section flitch on a side member that is to be modified as detailed below (see Fig. 2.5).

For vehicles equipped with electronic devices (e.g. ABS, ABD, EBD, etc.) disconnect the connectors of the control units (see wiring diagram in the relevant documentation); see their positioning on the vehicle in section 5.
Should close welding be required, remove the control unit from its position.

During welding earth the welding machine directly to the piece that is to be welded in order to protect the electrical equipment (alternator, batteries). Ensure that the negative pole of the battery has been disconnected.

Plastic pipes must be protected from heat sources and splashes of material during welding. If necessary these parts should be removed.

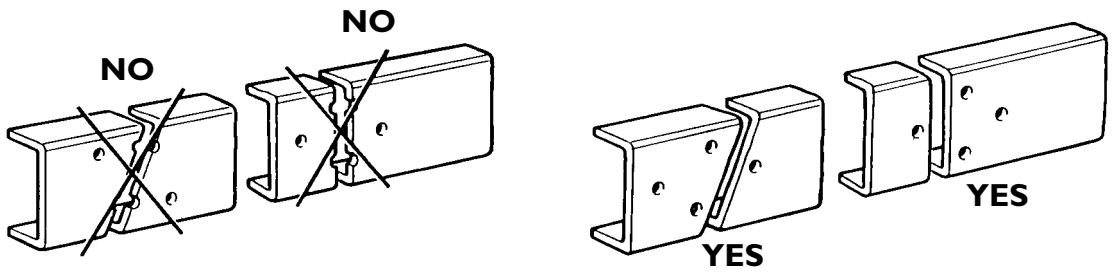
The surfaces of the leaf springs and air springs must be protected against weld splashes during welding. Do not allow the electrodes or conductors to come into contact with the spring.

As part of the procedure it will be necessary to remove the paint and deoxidise the parts of the chassis that are affected by the welding operation as well as those parts which may have to be covered by possible reinforcements. When work has been completed, the modified part must be protected with adequate rustproofing (see point 2.1.3.).

The instructions given below should be followed to ensure that welding is carried out correctly.

a) Cut the side members with a diagonal or vertical cut. (We recommend that the diagonal cut be used particularly for the section between the wheelbase) Cuts are not permitted in areas in which the profile of the side member as well as the chassis width change or in those where there is a high concentration of stresses (e.g. spring brackets). The cuts must not be made through the holes present in the side member (see Fig. 2.3.).

Figure 2.3



b) on the inner side of the side member give the parts that are to be joined a V-shaped chamfer of 60° along the entire length to be welded (see Fig. 2.4).

c) archweld in stretches using carefully dried basic electrodes. The recommended electrodes are:

for Fe 360 D: DIN 1913 - E 4343 B 10
FeE420: DIN 1913 - E 51 54 B 1023

Diameter of the electrode is 2.5 mm, current intensity approx. 90A (max. 40A for each millimetre of diameter of the electrode).

Using MIG-MAG welding use a welding rod with the same characteristics as the material to be welded (diameter 1-1.2 mm).

Recommended welding rod: DIN 8559 - SG3 M2 5243
gas DIN 32526-M21 or DIN EN 439

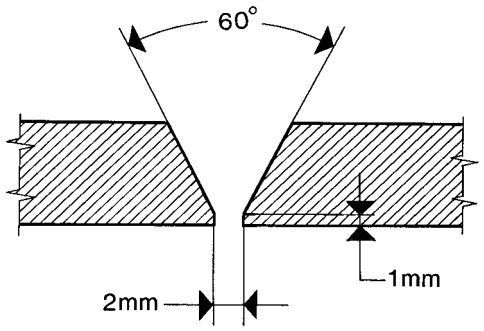
Avoid current overloading. Welding must be free from marginal cuts and waste material.

d) Repeat the operation on the reverse side by welding as detailed in point **c)**.

e) Allow the side members to cool slowly and uniformly. Cooling by air, water or other means is not permitted.

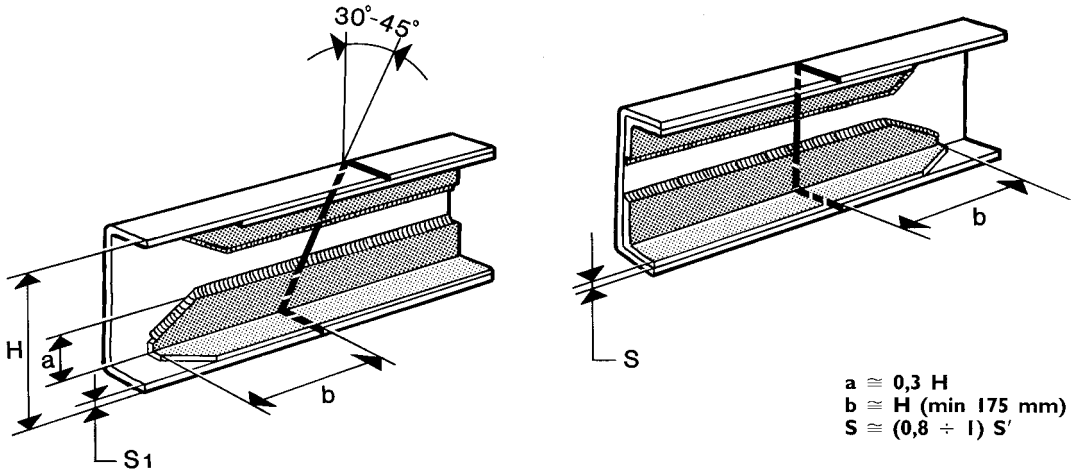
f) Remove excess material resulting from the welding operations by grinding.

Figure 2.4



g) On the inner side reinforcing L-section flitches should be applied. These should be made of steel and have the same characteristics as the steel used for the chassis. The minimum dimensions are given in Fig. 2.5.
The reinforcements may only be fixed to the vertical web of the side member using welding beads, plug welds, bolts or rivets (Huck rivets may also be used).
The cross-section and the length of the weld bead, the number and distribution of the plug welds, bolts or rivets must be adequate to transmit the bending and shearing moment of the section.

Figure 2.5



Closing of existing holes

If, when making new holes, the existing holes are found to be too close (see Fig. 2.2) these may be closed up by welding. To ensure the success of this operation the outer edge of the hole should be chamfered and copper plate used for the inner part.

For holes with a diameter of over 20 mm, chamfered plugs may be used, welded on both sides.

2.3 Modifying the Wheelbase

2.3.1 General Specifications

As a rule, for each vehicle, modification to the wheelbase must be carried out on the standard wheelbase, among the ones envisaged by IVECO, above or closer to the new wheelbase required.

The measurements given in the written authorisations will apply in all cases particularly for extensions made to the longest standard wheelbase.

Cutting the chassis must be done by following the instructions given in point 2.2.4. Whenever permitted by the body size, wheelbases should be made equal to those planned in our production. This enables the original propeller shafts and previously defined cross member positions to be used.

When making the wheelbase longer than the standard IVECO wheelbases, particular care must be taken to comply with the limits set by national regulations particularly with regard to the limits for overall dimensions (where specified).

Chassis Stress Level

When lengthening a wheelbase, in addition to local reinforcement on the side member joint, the bodybuilder must provide sufficient reinforcements to achieve the section moduli of the side member section no lower than that designed by IVECO for the same wheelbase or for next size up. Alternatively, when permitted by local regulations, larger subframe sections can be used.

When prescribed by national regulations the bodybuilder must check that the stress limits are not exceeded. In any event such stress must be no greater than that of a chassis with the original wheelbase assuming that the load is evenly distributed and taking the chassis to be a beam resting on the spring hanger brackets.

When extending out from the longest original wheelbase the reinforcements must depend on the length of the extension, the type of body built and the use to which the vehicle is to be put.

Approval

The alteration of the wheelbase for the 4x2 versions is permitted without specific approval by IVECO in the following cases:

- if the wheelbase is to be lengthened and the new value is still within the standard range of length with the same side member section and material as the original. These dimensions can be found in the relevant technical documentation or in tables 3.3, 3.4 and 3.5.
- if the wheelbase is to be shortened without falling below the standard minimum values established for each model.

Provided the chassis converter gives sufficient guarantees from the technological and control point of view (qualified personnel, adequate operating processes, etc.).

For the 4x4 versions (all-wheel drive) the wheelbase may only be modified following specific approval by IVECO, for which the position of the transfer box must be maintained in relation to the front axle.

The conversion must be carried out in compliance with these instructions and the appropriate adjustments (e.g. LAV adjustment) or adaptations made (e.g. change in the layout of the exhaust pipe) and taking those precautions (e.g. adherence to the minimum rear axle load with unladen vehicle) which are normally taken by IVECO for the corresponding original wheelbases.

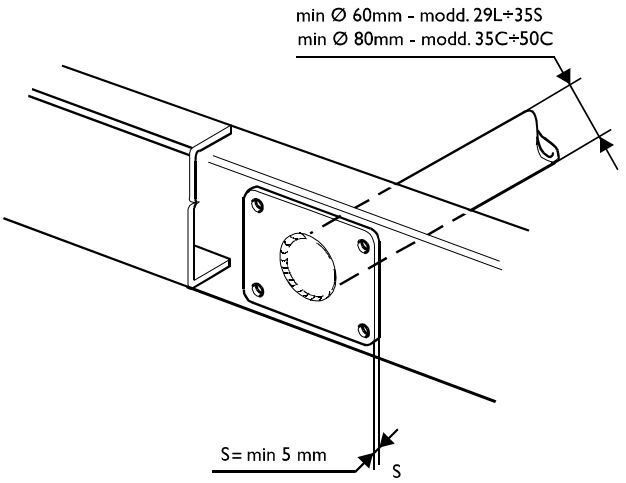
Cross Members

The necessity of applying one or more cross members depends on the extent of extension, the location of the transmission shaft support, the welding area, the introduction points of the forces produced by the body and the condition under which the vehicle is to be used.

Any supplementary cross members must have the same features as those already existing (flexural strength, torsional strength, quality of the material, connection to the side members, etc). Fig. 2.6 shows an example of the application. A cross member is mandatory for any extension over 600 mm.
As a general rule the distance between the two cross members must not be greater than 1,000 to 1,200 mm.

The minimum distance between the two cross members particularly for "off-road" vehicles must not be less than 600 mm. The "light" cross member supporting the transmission and shock absorbers is excluded from this limitation.

Figure 2.6



Recommended Procedure

To ensure the success of the operations proceed as follows:

- Arrange the vehicle so that the chassis is perfectly level, using the appropriate stands.
- Remove the transmission shafts, brake lines, electrical wires and any devices that may prevent the work from being carried out efficiently.
- Identify the reference points on the chassis (e.g. pilot holes, suspension supports).
- Mark the reference points with a light line of punch marks on the top flange on both side members after ensuring that their joining line is perfectly at right-angles to the longitudinal axis of the vehicle.
- When re-positioning the spring hanger brackets, identify the new position using the reference marks made previously.
  Check that the new measurements are identical between the left and right sides. Differences no greater than 2 mm should emerge from diagonal checking of lengths not less than 1,500 mm. Unless another tool is available, make new holes by using the supports and gussets of the cross members as a template.
  Fix the supports and cross members with rivets or bolts. If using bolts, fix the supports by reaming the holes and using class 10.9 calibrated bolts with nuts equipped with a device that prevents them from working loose. When space permits it use flanged-head screws and nuts.
- If cutting the chassis, make a second line of reference points so that the area affected by the modification is included between these and the previous points (in any event ensure a distance of not less than 1,500 mm. measured when the work has been completed). Inside these two reference lines make points to mark out the area of the cut then proceed as indicated in point 2.2.4.
  Before welding, ensure that the side members, including any added portion, are perfectly aligned and take measurements on both sides and diagonally to check, as previously described. Fit the reinforcements as instructed at Point 2.2.4.

Further indications

- Protect the surfaces from oxidation as described in point 2.1.3.
- Restore the electrical and braking systems as described in points 2.13 and 2.14.
  For vehicles with anti-lock brake systems (ABS, ABD, EBD) follow the instructions given in point 2.13.4.
- For work on the drive line follow the instructions given in point 2.3.2.

Chassis reinforcement

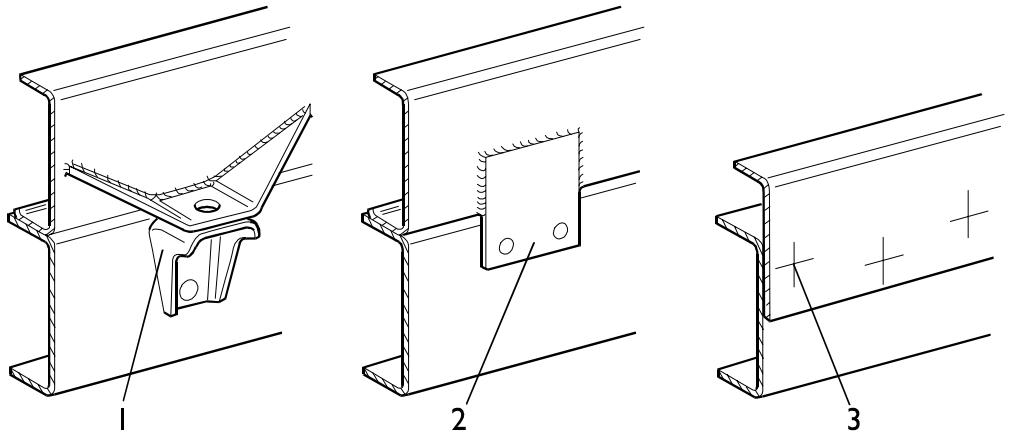
Fig. 2.7 shows some examples of possible solutions. The reinforcement must be continuous, covering the entire length of the vehicle's chassis as far as the cab. To join them to the side member, considering an angular profile, it is necessary to use bolts or rivets of class 8.8; their diameter and distribution must be such as to enable the section to provide the required strength.

If using a subframe kind of reinforcement (see point 3.1), it is possible to use the planned anchorages on the chassis (if any) for the connection, alternatively follow the instructions given in point 3.1.2 and following.

In the area of the rear overhang and for approximately half the wheelbase (in any case to no less than 2 m from the front axle), we advise making a shear resistant join.

In any case the reinforcement must meet the requirements of all the calculation standards that may be required by local regulations. There must be bending stresses on the modified chassis no greater than those of the chassis of the original vehicle in the corresponding sections.

Figure 2.7



1 Bracket
2 Plate
3 Bolts or rivets

It is not permitted to apply strengthening plates directly on the flanges of the side members with holes filled with welding. This is to prevent non-workmanlike welds impairing the strength of the original sections.

Only in special cases and with specific IVECO authorization is this possible, when there is proven difficulty in fitting bodies on afterwards.

If this application is essential, because of the deterioration in the properties of the material after welding, it is wise when checking the stresses in the various sections to consider a reduction in the material specifications of approximately 15%.

When sizing the reinforcement, the following static stress on the vehicle chassis must not be exceeded:

CHASSIS MATERIAL	Permitted static stress on chassis (N/mm^2)	
	Road use	Heavy-duty use (e.g., tipping)
(FeE420)	120	80
(Fe360D)	80	50

More restrictive limits fixed by national standards in any case hold good.

2.3.2 Modifying the Drive Line

Following the modification of the wheelbase, work on the transmission, as a general rule, is carried out on the basis of the transmission of a similar vehicle with approximately the same wheelbase. The maximum value of the inclinations of the propeller shafts used for standard production vehicles is to be retained. This rule must also be applied when any modifications to the suspension and rear drive axles are made.

In cases of particular difficulty, the assistance of the Company may be sought. A diagram giving the length and inclination of the proposed new transmission must accompany the request.

The technical instructions given in the drive line manufacturer's manuals (e.g., GKN, Dana Spicer) can be used to make and install the segments.

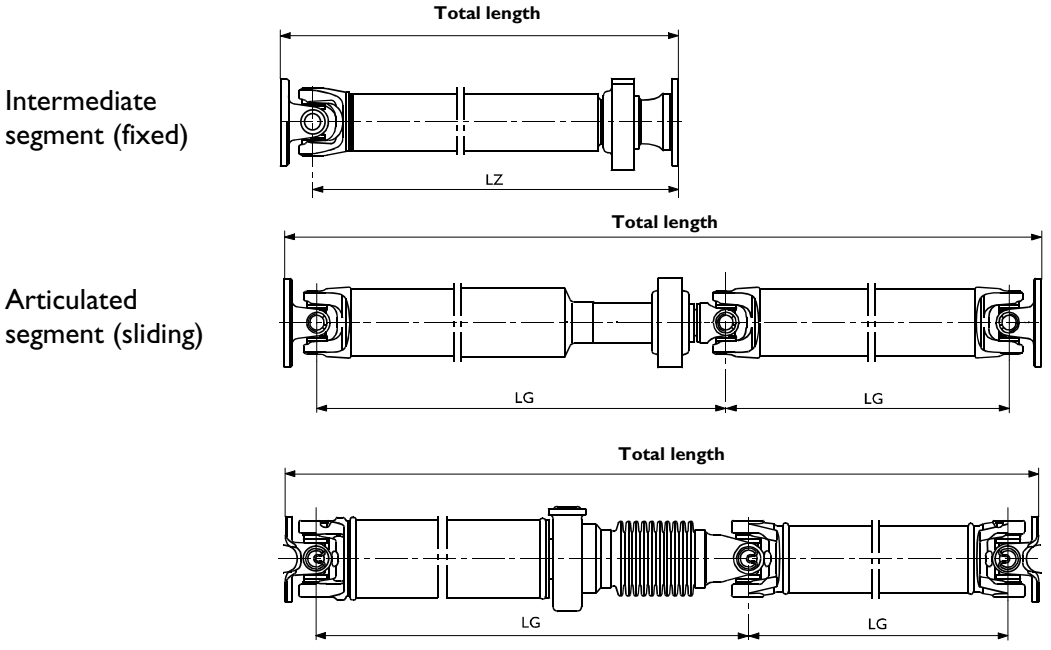
The purpose of the specifications contained in this manual is to ensure the proper functioning of the transmission, to limit its noise and to avoid the build-up of stress transmitted from the engine assembly. In no way does this diminish the responsibility of the bodybuilder for the work he has completed.

Permitted lengths

The maximum operating lengths obtainable for both the intermediate shaft sections and the sliding shafts "LG" or "LZ" (see Fig. 2.8) can be determined according to the external diameter of the tube existing on the vehicle and the maximum operating rotational speed (see formula). These are specified in table 2.2.

For the propeller shaft length specified in Table 2.2. when the tube diameter is not sufficient, a new shaft section with the same characteristics as the existing shafts must be used. As an alternative, in some cases the transmission shaft with a larger diameter tube can be used. The tube diameter required can be determined in compliance with the required length and the maximum rotational speed, directly from table 2.2.

Figure 2.8



The maximum propeller shaft speed is determined on the basis of the following formula (the necessary data may be derived from the vehicle specifications and from the data plates on the engine, gearbox or transfer case).

$$n_G = \frac{n_{max}}{i_G \cdot i_V}$$

nG = Max. prop. shaft speed (rpm)
n_{max} = Max. engine speed, max. rpm in no-load conditions (see Tab. 4.2)
i_G = Gearbox ratio at top speed (gearboxes with ratio 1:1 or 1:0,78).
i_V = Ratio of power drive transmission in road gear (only for shafts downstream of transfer case)

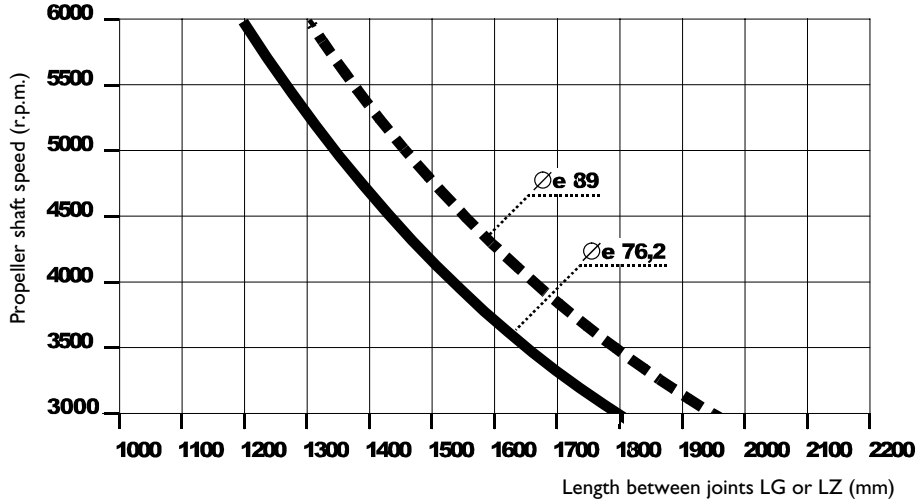
The greater thickness of the tube depends on the class, i.e. on the torque that the original shaft has to transmit and on the design of the driveline (torque, ratios of kinematic chain, power axle load).

A reference value for the thickness of the tube of a general validity cannot be given. When, for example, a tube of a larger diameter is to be used, its thickness should theoretically be reduced until the torsional strength of the original tube is achieved. It should however be noted that, to determine the thickness of the tube, the following points are to be taken into account: the size of the male element of the fork, the possible necessity of adapters and the sizes of the tubes available.

Therefore the thickness of the tube should be agreed upon as each occasion arises with the workshops authorised by the manufacturers of the transmission shaft depending on its dimensions (i.e. size of the universal joint).

The minimum operating length (from flange to flange) must not fall below 600 mm for the sliding sections and 300 mm for the intermediate sections.

Table 2.2.
Obtainable propeller shaft characteristics



Note

The maximum possible lengths given above refer to the original shafts; plan for shorter lengths (-10%) for segments obtained for transformation.

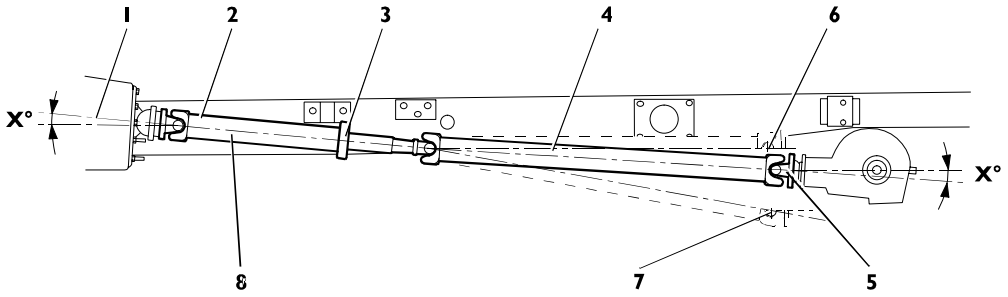
Determining Driveshaft Positions

In the case of a drive line consisting of several segments, the single shafts must all be approximately of the same length. As a general rule, the difference in length between an intermediate and a sliding shaft (see Fig. 2.9) must not exceed 600 mm; while between two intermediate shafts the difference must be no greater than 400 mm. For sliding shafts there must be a margin of at least 20 mm between the minimum working length and the fully closed length.

Complying with the useful travel of 85 mm, position the static arrangement in an area as central as possible.

When the required length of the drive line exceeds the permissible length, an additional driven shaft must be provided as illustrated in Fig. 2.10.

Figure 2.9

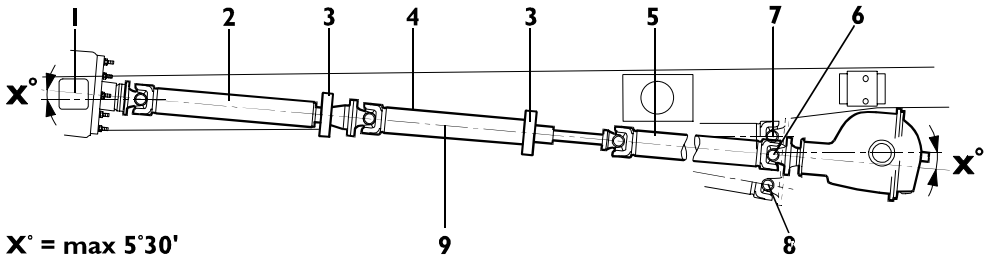


1 Engine, clutch, gearbox axis
2 Articulated shaft (sliding)
3 Shaft support
4 Articulated shaft (fixed portion)
5 Inclination of rear axle case (static load)
6 Inclination of rear axle case (max. compression)
7 Inclination of rear axle case (max. compression)
8 Articulated shaft (sliding) and axle case axis must have the same inclination

The intermediate shaft and the inclination of the rear axle case must be aligned accurately. The difference in their inclination relative to the engine-clutch-gearbox axis must not vary more than 1°. This may be achieved by placing a wedge between the rear axle case and the spring. The angle of the rear axle case must, however, be between 4° and 5°.

When the lengthening of the wheelbase is substantial, it may become necessary to employ a supplementary intermediate shaft as shown in fig. 2.10. In this case the same inclination must be maintained between the engine-gearbox axis, the second intermediate shaft and the axis of the differential housing.

Figure 2.10

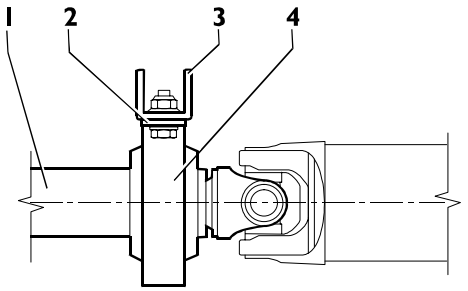


1 Engine, clutch, gearbox axis
2 Intermediate shaft
3 Intermediate shaft support
4 Articulated shaft (sliding)
5 Articulated shaft (fixed portion)
6 Inclination of rear axle case (static load)
7 Inclination of rear axle case (max. compression)
8 Inclination of rear axle case (unladen)
9 Gearbox, sliding articulated shaft and rear axle case axis must have same inclination.

The elastic supports must be fitted with supporting plates at least 5 mm thick (see Fig. 2.11) joined to cross members with similar specifications to the IVECO specifications.

When reducing the wheelbase it is recommended that the intermediate shafts be removed if the length of the splined shaft is less than approximately 600 mm.

Figure 2.11



1 Intermediate shaft
2 Support bracket
3 Backing plate
4 Support of intermediate shaft

If the drive line consists of a single shaft (articulated), the inclination of the axle housing must be the same as the inclination of the engine-gearbox axis.

For these modifications it is recommended to use genuine drive lines made by IVECO or by the Manufacturers who originally equipped the vehicle. Should this not be possible however, hardened steel tubes with a yield point of not less than 420 N/mm^2 (42 kg/mm^2) may be used.

Modifications to the universal joints are not permitted.

Whenever the transmission or part thereof, is modified, each modified section must be subjected to careful dynamic balancing.

Important

Since transmission is important to vehicle driving safety, it should be borne in mind that any modification to it must bear maximum operational guarantees. Only very specialised and transmission manufacturer-certified companies should therefore be employed to carry out work of this kind.

2.4 Modifying the Rear Overhang

In modifying the rear overhang it must be borne in mind that such modification entails changes in the distribution of the payload on the axles relative to the loads established by IVECO (see point 1.2). The limitations established by national laws must also be respected as well as the maximum distance from the rear edge of the body and the ground clearance prescribed for the underrun bar and possibly for the tow hook.

Should the bolted rear cross member, if any, be re-positioned, the same standard type of connections should be maintained (i.e. number of screws, dimensions, class of resistance).

When the installation of a tow hook is planned, an adequate distance (approximately 350 mm) must be left from the rear cross member to the next nearest cross member for mounting and removing the tow hook wherever necessary.
If the modifications are carried out competently and in compliance with the specifications contained in this manual, the towable weight originally established may be retained. In any case responsibility for the work rests with those who have carried it out.

Authorisation

The extension of the overhang at the rear of the chassis, employing body overhang values up to the ones originally envisaged for the specific wheelbases and modifications, besides shortening down to the minimum serial value of each model, require no specific approval by IVECO provided that the operations are carried out in compliance with these instructions.

For special transformations (e.g., caravans, retail outlet vans, etc.) where the distribution of the load is predefined and checked, it is possible to achieve values normally up to 60% of the wheelbase, provided the maximum mass on the rear axle, the minimum ratio between the masses on the front and rear axles, and the permitted stress on the chassis side members are always observed.

2.4.1 Reducing the Overhang

When reducing the length of the rear overhang of the chassis (e.g. in the case of tippers) the last cross member, if any, must be moved forward.

If, when reducing the length of the overhang, the rear cross member is found to be located too near to an existing cross member, the latter must be removed if it does not affect the suspension supports.

2.4.2 Increasing the Overhang

Various methods of increasing the length are given in Figs, 2.12 and 2.13.

The connection of the added section is to be carried out in compliance with the specifications given in point 2.2.4.

The frame may also be cut straight. The minimum dimensions of the reinforcements that are to be applied to the modified section are indicated in Fig. 2.4.

Fig. 2.12 shows a typical method of extension for increases of up to 300 - 350 mm when there is a rear cross member. In this case, the reinforcing L bars, which also serve to connect the cross member and chassis frame, must be of the same thickness and width as the original gusset plate. The connection of the cross member and the plates, originally achieved with rivets or by welding, may be made with class 8.8 bolts with the next larger diameter and self-locking nuts.

When there is no rear cross member, this operation should be performed as indicated in Figure 2.12a.

When the increase exceeds 350 mm, Fig. 2.13 shows the procedure to be used.

Figure 2.12

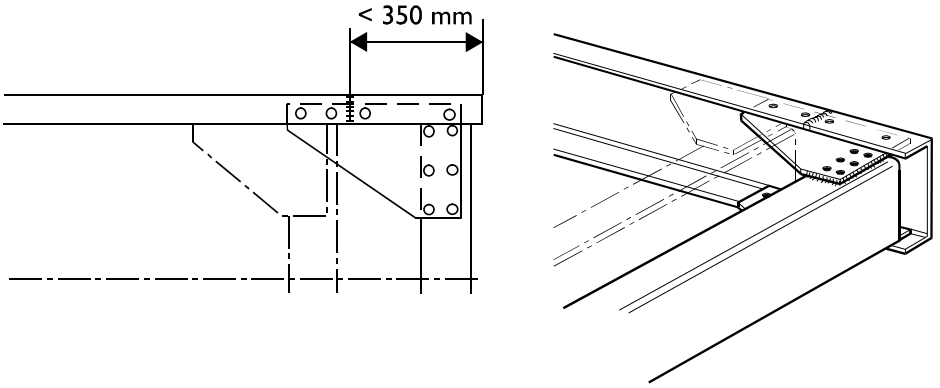


Figure 2.12a

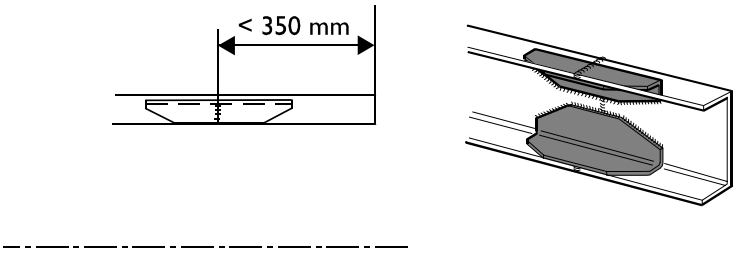
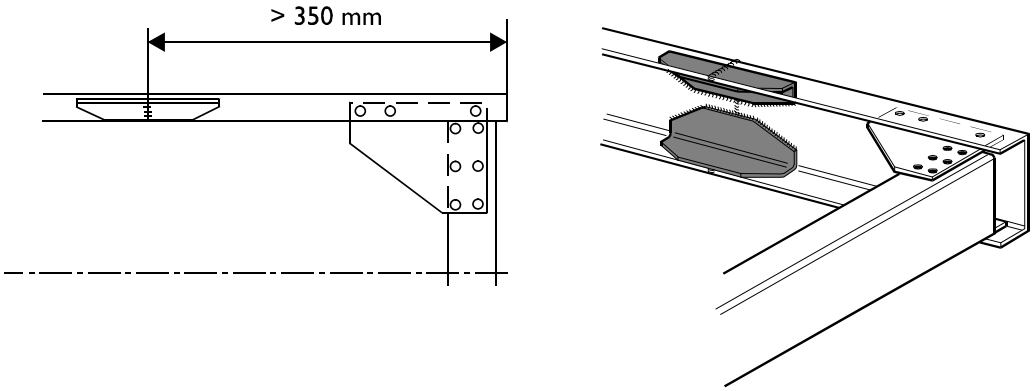


Figure 2.13



When the extension reaches a certain dimension, it will be necessary to examine on a case by case basis, the feasibility of installing a supplementary cross member to give the frame sufficient torsional rigidity. Adding a supplementary cross member with the same properties as the standard production cross member is necessary whenever the distance between two cross members is greater than 1,200 mm.

2.5 Installing a Towing Device

2.5.1 General Specifications

Without prior authorisation, the installation of a tow-hook is permissible only on those cross members which are intended for that use and on those vehicles which IVECO has intended for towing a trailer.

The subsequent installation of a tow hook in vehicles for which the installation of a tow hook was not originally contemplated, must be authorised by IVECO.

In addition to the permissible towing weight, the authorisation will specify all other possible specifications that are to be adhered to such as the use of the vehicle, the transmission ratio, the type of braking system as well as possible specifications concerning reinforcements to be applied to the rear cross member or the necessity for employing specially intended cross members.

Choosing a Hook

When selecting the appropriate hook and for the use of reinforcements (where necessary) for the rear cross member, the effect of the horizontal forces produced by the mass of the tractor and trailer must be taken into account in accordance with the following formulas:

$$D_c = 9.81 \cdot \frac{T \cdot C}{(T + C)} = kN$$

D_c = Representative value of the hook class (kN), for central axis trailers.
T = Maximum mass of tractor, in tonnes, including the vertical load of the trailer.
C = Maximum mass of trailer, in tonnes, transmitted to the ground by its axle(s).
S = Static vertical load, in kg, transmitted to the hook by the central axle trailer.

For central axle trailers with a mass of over 3500 kg, for approval to EC Directives, the cross member or towing structure with the hook must also take into account the vertical reference force V:

$$V = a \cdot \frac{x^2}{l^2} \cdot C$$

where:

a = Vertical acceleration in the tow bar/hook coupling area; depending on the rear suspension of the tractor, use the following values:
- a = 1,8 m/sec^2, for vehicles with air suspension (or the equivalent)
- a = 2,4 m/sec^2, for vehicles with another suspension

x = Total length of the trailer loading area (in m)
l = Length of trailer wheelbase (distance between centre of tow bar eyelet and centre of axle or axle centreline of the trailer) expressed in m.

The tow hook must be suitable for the permissible load and be of a type approved by National Requirements.

Since tow hooks are important to vehicle driving safety (in some countries they must be specifically certified) they must not be modified in any way.

Clearances to observe

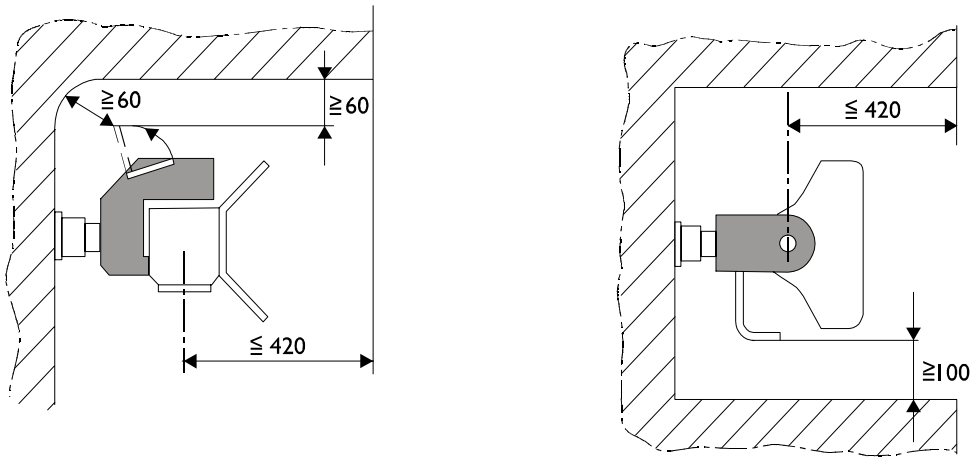
When mounting the tow hook to the cross member, the specifications of the hook manufacturer as well as the limitations imposed by current standards - such as minimum space required for the brake and electrical connections the maximum distance between the swivel hook axis and the rear edge of the body - must be respected.

This may vary depending on local regulations. In the European Community a maximum of 420 mm can be reached. If higher values are required, check the EC Directive for the conditions to be able to accomplish this.

Should the dimensions of the hook coupling flange not match the holes on the rear cross member of the vehicle, in some case drilling may be authorised on the cross member after mounting adequate reinforcements.

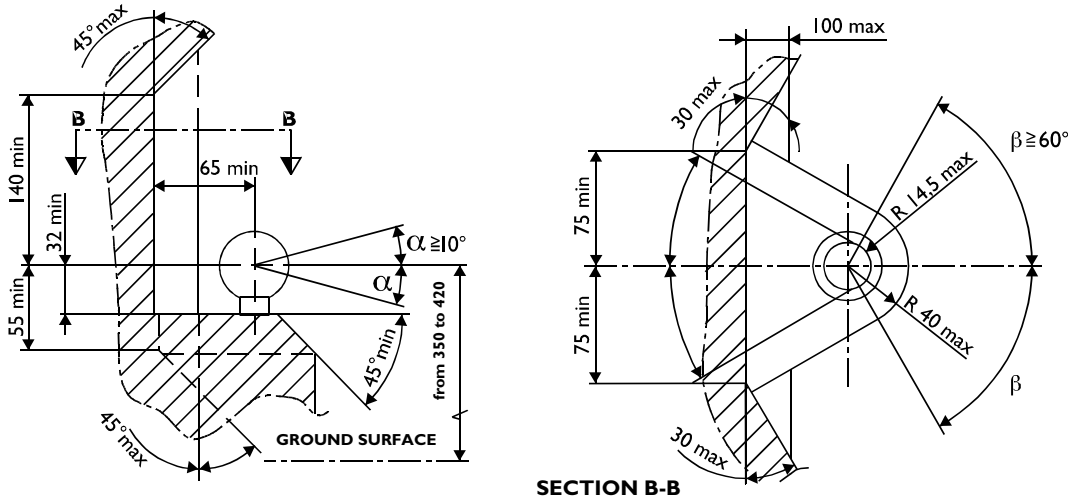
Pin hooks (automatic): Clear space for handling

Figure 2.14



Ball hooks: Clear space for handling

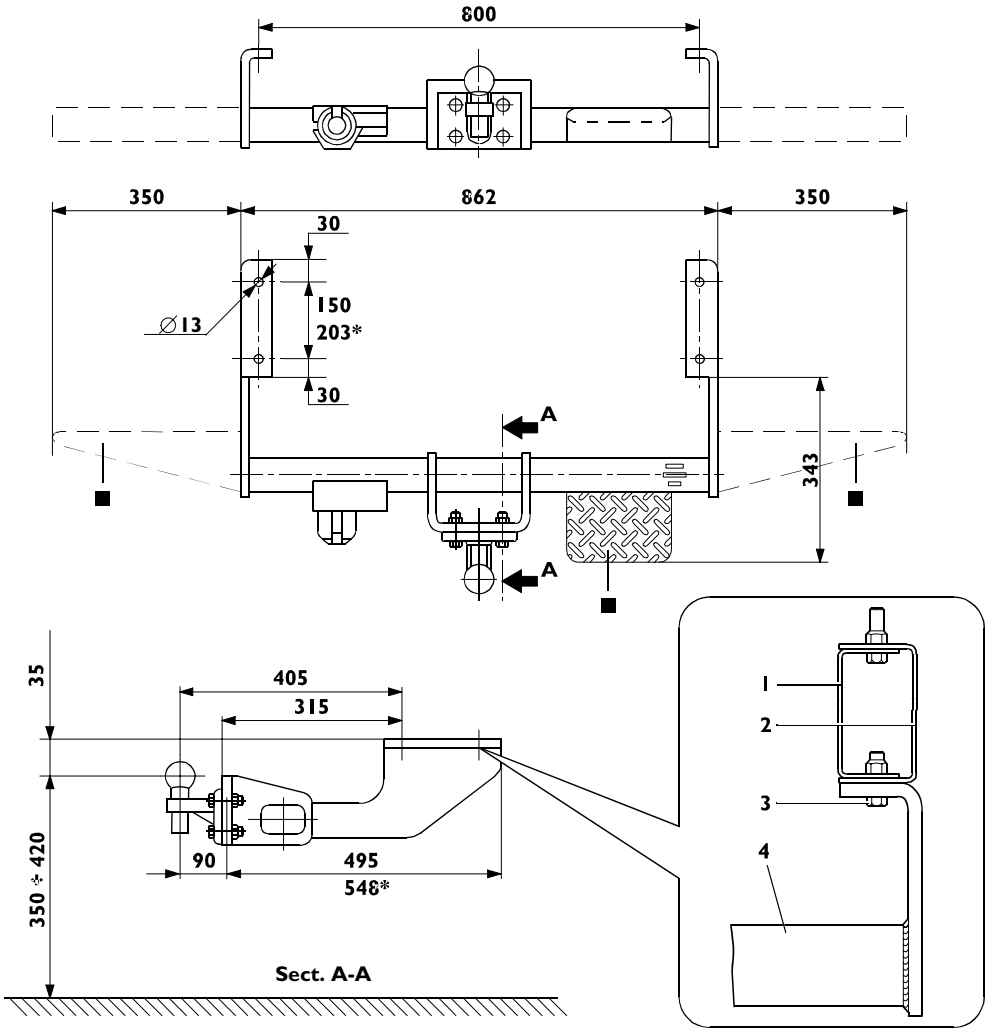
Figure 2.15



Ball hooks

The suitable towing structures for the ball hook are available on request, in both truck and van versions (see Fig. 2.16 and 2.17).

Figure 2.16 Towing structure with ball hook for models 29L and 35S (trucks and vans)

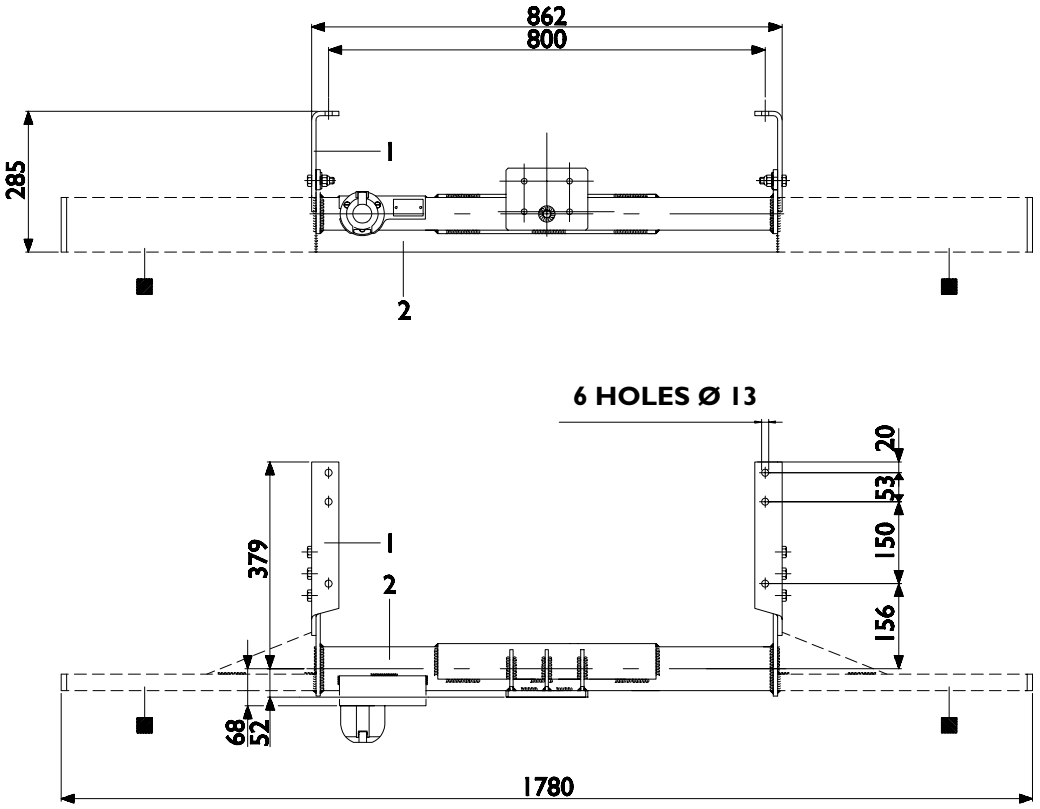


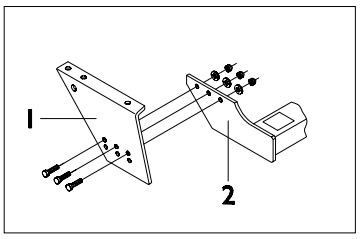
Dc = 14 kN
S = 150 Kg

1 Strengthening section
2 Chassis frame
3 Fixing
4 Towing structure

■ On vans only
⁜ For the version with Wheelbase 3000 mm Overhang 840 mm

Figure 2.17 Towing structure with ball hook for models 35C – 50C





Note: Make provision for strengthening inside the chassis frame, as shown in Figure 2.16.

Dc = 22,5 kN
S = 250 Kg

1 Anchoring bracket
2 Towing structure

■ On vans only

In fitting the ball hook, in accordance with the manufacturer's instructions, it is necessary to observe the guidelines laid down by the national and international regulations (e.g., EC Directives).

If required, the installer will need to present the necessary documentation to comply with the requirements of the law.

Pin hooks (automatic)

These are to be fitted on the truck version, subject to using a suitable cross member. Unless supplied directly by IVECO, they will both need to have type approval in compliance with current standards. They must be installed according to the instructions provided by the respective manufacturers.

13-Pole connector

When not provided for directly by IVECO, follow the instructions given in point 2.15 to install it.

2.5.2 Increasing the Towable Mass

For those vehicles which IVECO regards as suitable for towing a trailer, a request may be submitted to evaluate the possibility of authorising a towable mass exceeding that which is normally permitted.

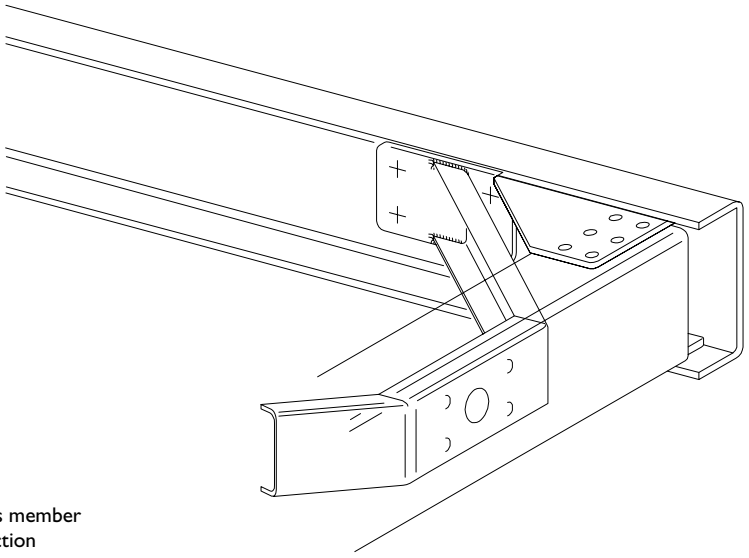
Such authorisation will include the conditions that must be complied with and, where necessary, specifications concerning modifications and work to be carried out on the vehicle.

These include possible reinforcements to the standard cross member (see Fig. 2.18), the instructions for installing a reinforced cross member when available, and those on the brake system to be made.

The tow hook must be suitable for the new use. Its connecting flange must match that of the cross member.

To fasten the cross member to the chassis frame, preferably use flanged head nuts and bolts or hex head screws of minimum class 8.8. Use self-locking nuts.

Figure 2.18 Example of reinforcing the towing cross member with a C-section fastened to the vertical web of the side members



1 Original rear cross member
2 Reinforcement section
3 Connecting plates

Remarks on the payload

It will be necessary to check that the static load on the hook does not exceed the permitted load on the rear axle(s) of the vehicle and that the minimum mass on the front axle is observed, as indicated in point 1.2.1.

Rating plates

Some countries require a plate to be fitted, near the towing device, giving the maximum permitted towable mass and vertical load.

If not already fitted, this must be done by the bodybuilder.

2.6 Work on the Suspension

Company authorisation must be obtained to re-work the suspension systems and springs (e.g. additional spring leaves, different cambering etc.) since these are important components for the operation of the vehicle.

As a general rule no modification of the parabolic springs is permitted. On vehicles equipped with these springs, installation of elastic rubber components may be authorised for special versions or uses in order to increase the stiffness of the suspension. In very specific cases, and for specific uses, the possibility of adding an extra leaf to the parabolic spring may be evaluated. This operation should be carried out by a specialised firm following approval by IVECO.

The use on the same axle of one parabolic spring and one trapezoidal spring is not allowed.

In vehicles equipped with load apportioning valve (LAV) for the braking system, modification of the rear suspension requires adjustment of the compensator (see point 2.13).

2.6.1 Changing a Mechanical Suspension into a Pneumatic or Mixed Suspension

Modifications of this kind are generally authorised for the rear axle only. Modification proposals presented by bodybuilders to the Company may be examined upon submission.

The responsibility for the dimensions of the air actuated springs and their installation, for the counteracting bars, the effectiveness of the suspension and their effect on the behaviour of the vehicle and the pneumatic supply system rests solely with the firm that has carried out the modification. Suspension and anchoring components are very important to vehicle safety so that the firm carrying out the modification must undertake the necessary design and testing.

On vehicles which are equipped with a load apportioning valve , this must be replaced with a pneumatically controlled LAV actuated by the pressure of the air in the springs. It must be calibrated in order to create the same braking performance in relation to the load on the axle, as that on the original vehicle. The bodybuilder must ensure that the respective values are indicated on the plate made for that purpose.

The air tank for the suspension must be connected to the specially designed circuit, supplied by the specific air compressor.

2.7 Modification of the Engine Air Intake and Exhaust Systems

Modification which would alter the characteristics of the air intake and exhaust systems may not be carried out without prior authorisation.

Any work done must not alter the existing vacuum values of the intake or the exhaust back pressure.

The routing of the tubing must be as even as possible. Bends must not have an angle of over 90° and the radii should not be lower than 2.5 times the external diameter. Avoid kinks and use cross-sections which are no smaller than those corresponding to the original system. Any connections on the intake duct must guarantee resistance of the tube to penetration by water or dust.

Sufficient clearance should be maintained (min. 150 mm) between the exhaust pipe and the electrical system, plastic hoses, the spare wheel etc. Lower values (e.g. 80 mm) may be permitted if suitable sheet metal shielding is used. Further reductions require the use of heat insulation and the substitution of the plastic tubes with steel pipes.

Any work done on the exhaust system of the vehicle requires that the vehicle be homologated again with regard to noise and smoke wherever government regulations require it.

The air intake must be positioned to avoid the intake of hot air from the engine and/or of dusty air or snow and rain. The apertures for the intake of air which may have to be made in the bodies of vans, must have a working surface of not less than twice that of the master hose located upstream of the filter. These apertures (e.g. openings in the grill) must be of such a dimension that they do not become obstructed.

It is not permissible to modify or substitute the original air filter or exhaust system without prior consent from IVECO. Modifications to the equipment (fuel injection pump, regulator, injectors etc.) are not permissible as this may alter the correct functioning of the engine and adversely affect the emissions of gases from the exhaust.

2.7.1 Vertical Exhaust

Apart from the general matters discussed in the above point, ensure that:

- The exhaust is far enough away from the inlet area.
- A suitable supporting structure duly braced and fixed to the vehicle chassis, is made for the vertical section of the pipe.
- A section of flexible hose is fitted to free the silencer elastically from the rest of the added pipe.
- Arrangements are made to prevent the direct entry of water into the end part of the pipe.

2.8 Modifications of the Engine Cooling System

The proper functioning of the original system, especially in connection with the radiator, the free surface of the radiator and hoses (dimensions and layout) must not be tampered with. In any case, whenever modifications must be made that entail work on the engine cooling system (e.g., modifications to the cab), the following points must be considered:

- The useful area for the passage of air for the cooling of the radiator must not be less than that which is available on vehicles with the standard cab. Maximum venting of air from the engine compartment must be ensured and care must be taken - possibly using shields or baffles - to avoid stagnant air pockets or back flow of air. The performance of the fan must not be altered.
- If it is necessary to re-position the hoses this must be done without affecting the complete filling of the system (which must occur at a continuous flow of 8-10 litres/min. without forming blockages at the mouth) or the normal flow of water. The maximum stabilising temperature of the water must not be altered even under the most severe operating conditions.
- Hoses must be located so that air pockets are not formed (i.e avoiding air traps and providing appropriate bleeding points) that could hinder the circulation of water. So, it is necessary to check that the water pump primes immediately on starting the engine and later operates with the engine idling (accelerate a few times, if necessary) even when the circuit is not pressurized. In addition to this check that the delivery pressure of the water pump, when the engine is running under no load and at maximum RPM, is not lower than 1 bar.

2.9 Installation of a Supplementary Heating System

When the installation of a supplementary heating system is deemed necessary, it is advisable to use the types recommended by IVECO.

For vehicles on which IVECO has not anticipated the use of supplementary heaters, the installation should be carried out in compliance with the supplier's instructions (i.e. heater arrangement, piping, electrical system etc.) and following the directions given below.

All national rules and regulations relevant to the matter should be adhered to (i.e. inspections, particular installation for dangerous cargo transportation etc.). The supplementary heating system must not make use of the equipment that is specific to the vehicle which is subject to approval if the use is liable to impair or alter the performance of the equipment.

Furthermore:

- Ensure correct operation of the vehicle components and equipment (i.e. cooling system).
- Check the electrical system to ensure that the battery capacity and alternator output is sufficient for the higher current requirements (see point 2.14). Provide the new circuitry with a protection fuse.
- Connect the intake of the newly added fuel system to the reservoir connected to the engine fuel return line. Direct feed from the vehicle fuel tank is permitted only if this is independent from the engine fuel system and the new circuit is perfectly leakproof.
- Trace pipe and cable paths, the location of brackets and hoses bearing in mind that the overall dimensions and heat affect the various units on the chassis. Avoid runs and arrangements that could lead to hazards when the vehicle is running. Use shields or armouring if necessary.
- When installing a water heater, original vehicle heating and engine cooling circuits are involved (see point 2.8), it is advisable to follow the instructions listed below to ensure reliability of the heating system and safe operation of the original system:
  - specify in detail the connecting points of the newly added system to the original one. Agreements with the company may be obtained if necessary;
  - determine a rational arrangement for piping, avoid neckings and siphonings;
  - install proper venting valve (bleeding points) to ensure proper filling of the system;
  - supplementary plugs should be installed to ensure draining of the system, if necessary;
  - proper insulation should be used to prevent heat dissipation.
- When air heaters are used and when the installation is to be made directly in the cab, make sure that the engine exhaust system does not touch the added installation (to prevent contamination) and have the correct warm air distribution by avoiding direct air flows.
- The complete installation should be designed to ensure good accessibility for quick and easy servicing.

2.10 Installing an Air-Conditioning System

When the installation of an air conditioning system is deemed necessary, it is advisable to use the types recommended by IVECO.

If this procedure is not applicable, the installation must be carried out in accordance with the supplier's instructions and the following points:

- The installation must not interfere with the correct operation of the vehicle components and of equipment which may be connected with the installation.
- Check the electrical system to ensure that the battery capacity and alternator output is sufficient for the higher current requirements (see point 2.14). Provide the new circuitry with a protection fuse.
- With the agreement of IVECO, establish a method for installing the compressor, if fitted on the engine (see point 4.3).
- Trace pipe and cable paths, the location of brackets and hoses bearing in mind that the overall dimensions and heat affect the various units on the chassis. Avoid runs and arrangements that could lead to hazards when the vehicle is running. Use shields or armouring if necessary.
- The complete installation should be designed to ensure good accessibility for quick and easy servicing. At vehicle delivery, the bodybuilder will supply all service and maintenance instructions which are deemed necessary.

Furthermore, according to the system operations:

a) Equipment installed inside the cab
- The condenser should not impair the original engine cooling system features (reduction in the radiating area of the engine radiator).
- The best arrangement is for the condenser not to be combined with the engine radiator but in a separate compartment, suitably ventilated.
- The arrangement of the evaporator-blower unit in the cab (if not anticipated by IVECO) should be designed to make sure that the accessibility control and operating equipment is not impaired.

b) Equipment fitted on the cab roof
- When the equipment (condenser, evaporator, blower) is fitted on the cab roof, make sure that its mass is not higher than that permitted for roof installation. Furthermore, the bodybuilder should provide for proper reinforcement to the roof frame if necessary, in relation to the mass of the unit and the extent of the modification introduced (see point 2.11.3.).

2.11 Cab and bodywork modifications

2.11.1 General Specifications

Any work on the driver's cab and bodywork must be authorized previously by IVECO.

Modifications must not prevent operation of the control devices located in the area affected by the modifications (e.g. pedals, linkages, switches, pipes etc) or alter the strength of the load-bearing elements (uprights, reinforcement sections etc.). Due care must be taken when carrying out work that may affect the cooling system and air inlet pipes of the engine.

The variations in the weight of the cab as well as its different depth must be considered when positioning the payload, in order to ensure correct distribution of the permitted weights on the axles (see point 1.2).

For operations that require the removal of sound deadening panels or internal protective elements (panelling, padding) restrict the removal to the absolute minimum, taking care to restore the protective elements to their original condition, ensuring the previous operating capability.

Controls and equipment (power take-off engagement control, external operating cylinder control etc.) may be fitted in the cab provided that:

- They are positioned rationally, properly and are easily accessible to the driver.
- Safety, control and warning devices are fitted which meet the requirements of use and safety of the vehicle and its equipment as well as the requirements of national and international regulations.

Ensure that the pipes and wires are correctly positioned particularly when the cab is tilted. Use the necessary fixings taking care to observe the appropriate distances from the engine, heat sources and moving parts.

Provide the necessary protection from corrosion for all modifications to the structure (see point 2.1.3.).

Ensure that the seals are fitted correctly and apply sealant to those areas which require it.

Ensure that a perfect seal is provided against the infiltration of water, dust and fumes.

The bodybuilder must check that after modification, the cab satisfies legal requirements regarding both the inside and outside of the vehicle.

2.11.2 Crew Cabs

When making crew cabs (e.g., 8+1), cabs for special vehicles, for municipal use, fire fighting, etc., check whether the cab's suspension requires uprating due to the increase in weight, also taking into account any extra seating arrangements made. Before doing this kind of work on a cab, IVECO's approval is required to confirm whether the original suspension devices are suitable.

As a rule, solutions equivalent to those designed by IVECO for similar versions may be adopted.

In order to help preserve the integrity and rigidity of the cab, we recommend that, as far as possible, the rear structures are kept intact. The cut may be made at the side, taking care that the door opening remains intact.

The bodybuilder must make the necessary connections to the load- bearing structure, comprising the longitudinal runners and uprights and connect the new floor to the existing structure. Provide inspection panels if necessary.

Take particular care when preparing the surface of the elements to be welded by applying a zinc primer, taking the necessary precautions to ensure that the primed surface is properly prepared for subsequent painting (see point 2.1.3).

The cab suspension system must be adapted to the additional weight and the new dimensions. This must be done rationally, without hindering normal cab movement.

When working out a suitable cab suspension system, the following points must be observed:

- The cab's attitude, designed for the standard vehicle, must not be altered.
- The added part with its weight must not affect the original portion of the cab with its suspension.
- Ensure normal oscillation of the cab along the vertical, longitudinal and transverse plane.

The modification to the cab may involve components such as the air intake and filter. Using genuine parts, already contemplated for similar bodies, may be a good solution and permit compliance with legal requirements.

Precautions

Modifications of this type influence the operation and safety of the vehicle (suspension, tilting operations) which means that they must be carried out carefully and undertaking all the necessary steps to ensure safety.

2.11.3 Roof Panel Modifications

Installation and modification work to achieve specific refurbishments must be carried out with great care to safeguard the strength of the cab and ensure that its operation and protection are maintained.

When fitting assemblies or systems onto the roof (e.g., air-conditioning systems, spoilers), check that the weight of the appliance does not exceed that permitted for the cab. These limits will be provided upon request depending on the assembly or system to be fitted.

When making the opening, ensure that:

- The connection radii are not less than 50 mm.
- Do not modify any ribs that may be present.
- Do not change the curvature of the roof.

Fitting a spoiler

Upon request, the various versions designed by IVECO can be delivered with relevant instructions for installation. It is recommended that these versions are used as they are specifically checked.

If fitting a spoiler other than the one envisaged by IVECO, follow the manufacturer's instructions for its installation.

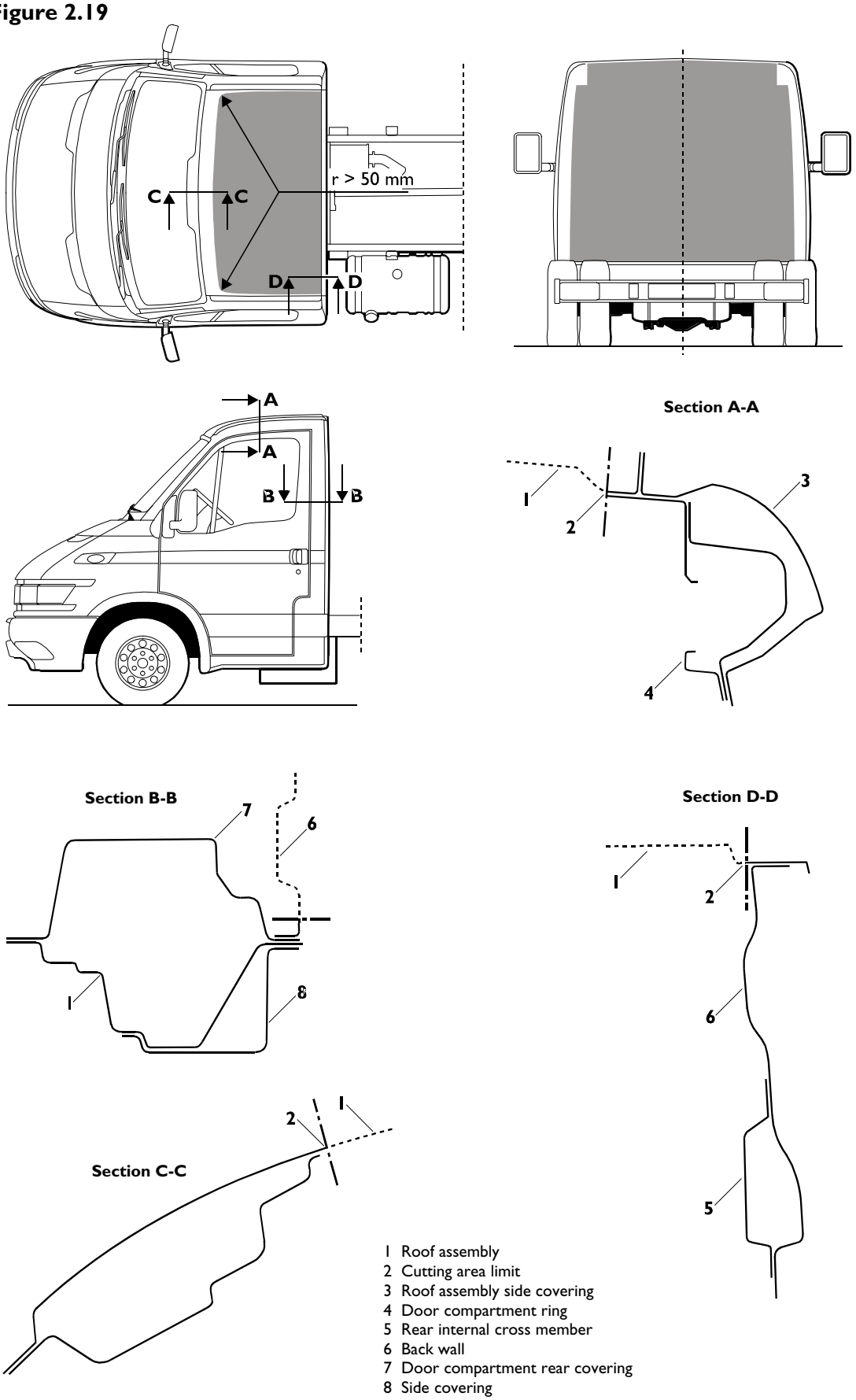
Whenever national regulations require it, these installations will be inspected by the responsible agencies.

Modifications on the roof assembly and on the cab rear wall

If it is necessary to remove the back wall and partially the roof assembly (e.g., motor homes), the work will need to be done as instructed here:

- Make the cut as shown in Figure 2.19, taking care you observe the minimum radiuses of connection shown. Having eliminated the structure for the rear cross member at the level of the roof assembly, in order for the top connections of the safety belts to remain effective, it is necessary to restore the resistance with a suitable structure capable of ensuring the uprights will not deform.
  For this structure, make provision for a resistance to compressive stress under the action of a force of at least 800 dN applied in correspondence with the framework removed.
- Make the connection with the new structure by following the general guidelines given above.

Figure 2.19



1 Roof assembly
2 Cutting area limit
3 Roof assembly side covering
4 Door compartment ring
5 Rear internal cross member
6 Back wall
7 Door compartment rear covering
8 Side covering

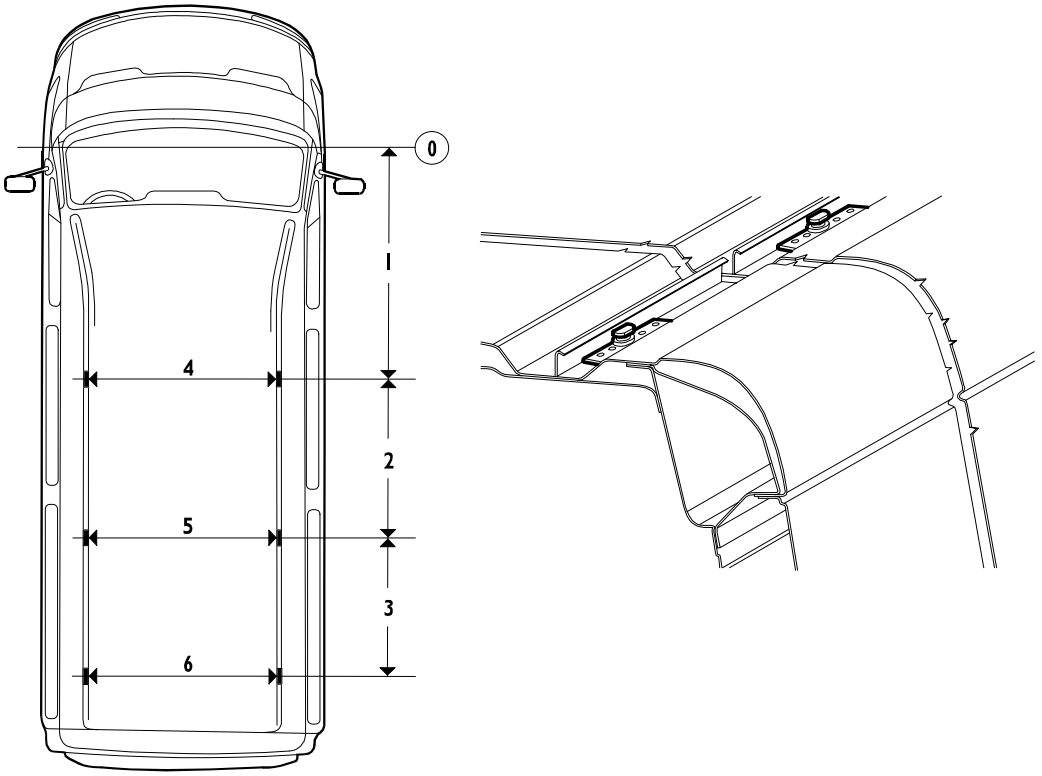
2.11.4 Van and combi bodywork modifications

Fitting roof rails

Installation must be performed with the specially designed fixing devices on the roof assembly only on the versions with a low or medium roof (see figures), bearing in mind the following guidelines:

- The fixing element must include the anchoring device, ensuring the necessary resistance to longitudinal and transverse forces. There are 3+3 fixing elements for all wheelbases.
- To ensure good stability on bends, the following total value of 150 kg must not be exceeded.
- The permitted mass for each fixing element must not exceed 25 kg.

Figure 2.20



Dimensions (in mm)	1	2	3	4	5	6
Van wheelbase 3000 low roof - short overhang	1760	754	932	1548	1548	1548
Van wheelbase 3000 low roof - long overhang	1760	954	932	1548	1548	1548
Van wheelbase 3000 medium roof - short overhang	1895	734	932	1229	1229	1229
Van wheelbase 3000 medium roof - long overhang	1895	734	932	1229	1229	1229
Van wheelbase 3300 medium roof	2549	1082	935	1229	1229	1229
Van wheelbase 3950 medium roof	2769	1512	1315	1229	1229	1229

Modifications on the roof panel

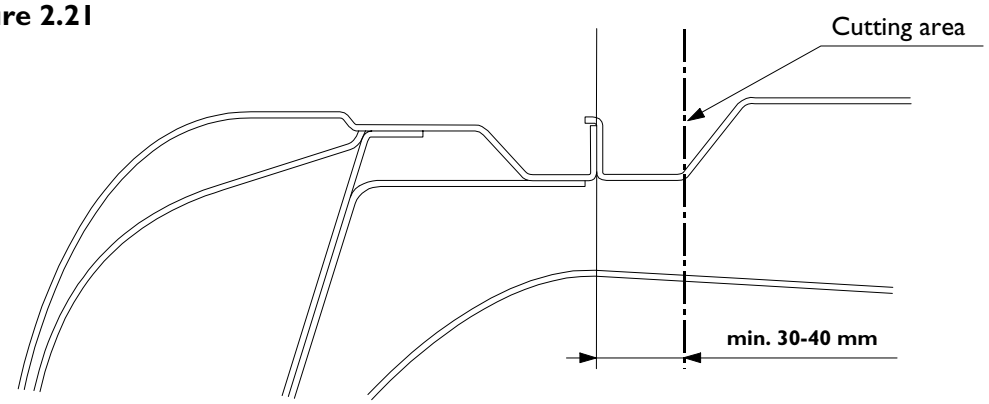
a. Fitting a translucent roof

There is the option of having a translucent roof fitted directly in the factory. This should be requested whenever necessary.

For vehicles that have already been manufactured, the modification is possible by proceeding as follows, taking the necessary precautions.

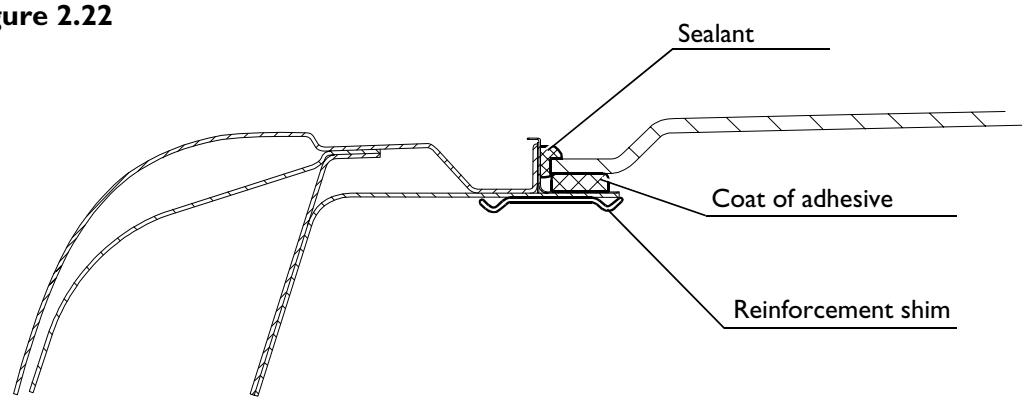
- Identify the area for cutting. The following diagram shows a possible solution.

Figure 2.21



- Leave approximately 30 - 40 mm from the original joint area.
- Install the translucent roof (part no. 500360077) according to the diagram shown below, using suitable adhesives (e.g., Betafill, etc.).

Figure 2.22



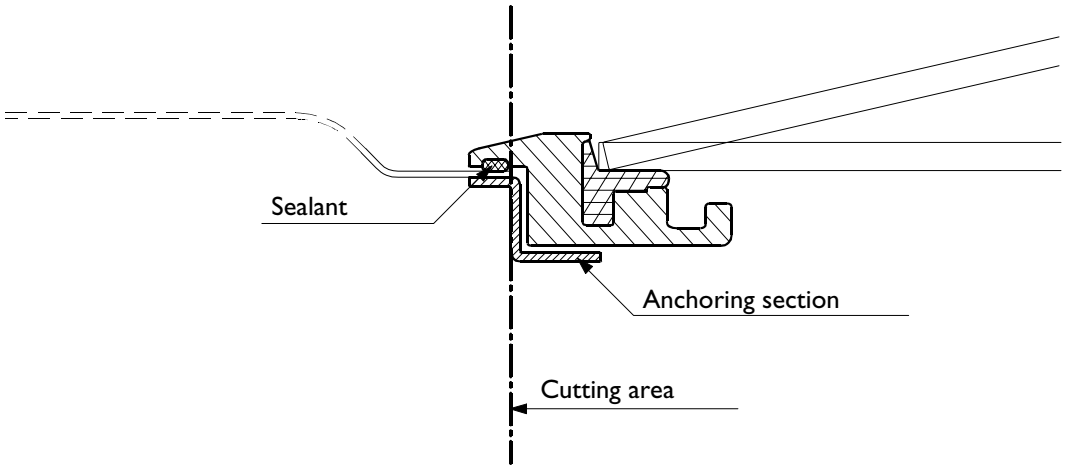
- Fit a reinforcement shim 50 - 60 mm wide, 0.7 - 1 mm thick, extending from one hoop to the next.
- Seal the surrounding area appropriately with specific products (e.g., Curit, Essex, etc.).

b. Fitting a trapdoor

It is possible to fit a trapdoor on the roof panel provided this modification does not affect the hoops and it is done ensuring the seal and strength of the modified part.

Fig. 2.23 shows an example of installation.

Figure 2.23



c. Modifying the roof panel height

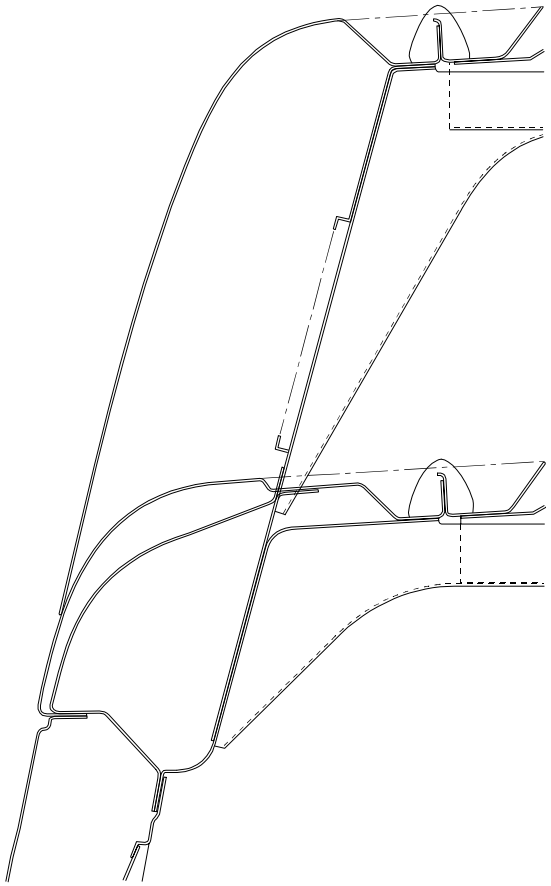
There are three internal heights of the roof assembly available on request:

- Low roof = 1595 mm
- Medium roof = 1900 mm
- High roof = 2300 mm

Modifying the height of the roof panel once the vehicle has been manufactured is extremely demanding and costly. This possibility is moreover restricted to the medium and high roof versions that have the same roof assembly structure.

Fig. 2.24 shows the layout of the two versions, where it is possible to see that the roof panel is a unified structure.
The bodybuilder will need to make a side panel framework with suitable modification to the hoops to permit joining up with the original roof panel correctly.

Figure 2.24



d. Making side windows

Making side windows in vans requires taking the specific precautions indicated here:

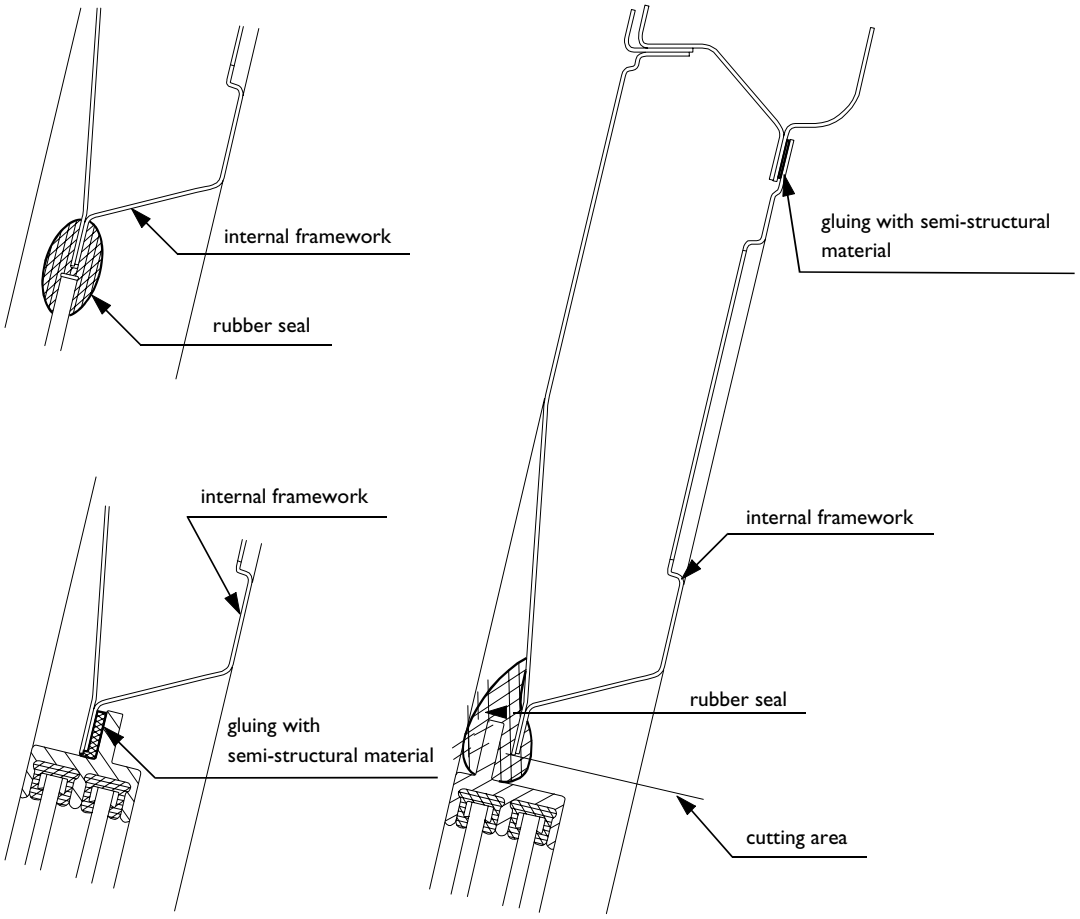
Cut the sheet as shown in Figure 2.25, taking care to keep a circumferential profile with a minimum width of:

- 15 mm (for glass secured with rubber seal);
- 20 - 25 mm (for glass secured with adhesive).

An internal framework will need to be made (see Fig. 2.25) so as to ensure the necessary resistance. Make the connection as shown in the figure.

Remove the upright in the area of the window, providing a suitable reinforcement at the base node.

Figure 2.25



e. Internal shelving

This must be done taking care that the shelves are stiff enough and self-supporting.

The bottom support must involve the floor framework (cross members and longitudinal sections) and be made so as to distribute the load evenly.

The anchoring on the side structure, made without creating any effects of pre-loading, may involve:

- the boxed uprights, where there are already holes;
- the top connecting beams.

f. Work on the structure and floor

Observe the guidelines and precautions given above, in particular remember:

- When drilling the boxed sections, avoid areas where there is a higher concentration of stresses.
- The holes for anchoring to the floor will need to be protected and sealed against infiltration of water, dust and exhaust gas.

2.11.5 Occupant protection

The airbags, safety belt connections (the positioning of the belt retractors and pre-tensioning devices), seat anchorages, as remembered below, are an integral part of the overall safety of the occupants.

Any modification to these components may jeopardize the safety of the people transported and compliance with the requirements of the law.

Airbags

No modifications must be made or components installed in areas that could impair airbag operation, such as:

- modifications to the front structure of the vehicle;
- alterations in the area where the control unit is installed (arranged under the floor between the front seats), at the points involved by the system of sensors and its wiring;
- installation of components close to the opening on the dashboard.

If necessary, refer to an authorized IVECO garage for any further information.

Note

With an airbag on the passenger's side, observe the legal requirements for installing and using baby seats.

Anchoring safety belts

Work done in the areas of the safety belt connections may affect their compliance with CE certification.

The person doing the work must check compliance with the requirements of the law.

Seats

The seats have been anchored to the floor structure in compliance with the requirements of the law on locking systems.

Moving them or fitting additional seats requires making suitable anchorage areas in the structure under the floor, in accordance with the provisions originally made by IVECO, to remain in compliance with the requirements of the law.

2.12 Changing the Size of the Tyres

IVECO's approval must be sought prior to replacing the tyres with others of a different size or load capacity from those which were approved at the time the vehicle was homologated.

Changing the size of the tyres may involve replacing the wheels with others of a correspondingly greater loading capacity. In this case check whether the spare wheel carrier needs to be changed.

Mounting tyres of different sizes or types of construction on the same axle is prohibited.

Changing the size of the tyres may affect the ground clearance of the rear underrun guard, therefore compliance with the national legal requirements must be verified. Its supporting brackets, where necessary, may be replaced with other appropriate, type-approved brackets.

The use of larger tyres always necessitates verification of the safety margins for the mechanical parts, wheel arches etc., under all dynamic conditions of steering and bump travel. In certain cases the use of wider tyres may entail a check on the axles to assess the space required for the suspension components and the length of wheel studs etc.

The use of tyres with a different outside diameter affects the performance of the vehicle in terms of speed, maximum gradability, pulling force, braking power etc. The tachograph must be recalibrated by an authorised workshop. The load capacity and the relative reference speed must always be compatible with the performance of the vehicle. When the tyres with a load capacity or speed limit are chosen for a given vehicle, the permissible loads of the vehicle or its performance, must be reduced accordingly. On the other hand, the use of tyres with a greater load capacity does not automatically increase the maximum permissible mass on the axles.

The size and load capacity of the tyres are established on the basis of international and national norms (ETRTO, DIN, CUNA etc.) and are listed in the manuals of the respective tyre manufacturers.

Specific performance characteristics may be established by government regulations for special use in the case of fire-fighting vehicles, vehicles for winter duty, airport tankers, buses etc.. Whenever so required by government regulations the vehicle must be presented to the respective government agency for inspection of the parts that have been replaced and entry of the respective modifications in the vehicle documents.

2.13 Modifications to the Braking System

2.13.1 General Specifications

The braking system and its components are very important to traffic safety and vehicle dependability.

No modifications are admitted on equipment such as the vacuum pump on the engine, servo-brake, brake calipers, parking brake, braking load apportioning valve, ABS, ABD, EBD distributor, pressure relief valves, etc. that are considered safety components.

Any modification to the braking system such as modifying pipes, fitting other brake cylinders, adjusting or replacing the braking load apportioning valve (except when changing the wheelbase), etc., needs IVECO authorization.

For new equipment we recommend the same make as those fitted to the original vehicle.

When required by national regulations, the vehicle must be submitted for testing to the respective authority.

2.13.2 Brake Pipes

When the wheelbase is modified, the brake pipes concerned must preferably be replaced by a single length of new pipe. Where this is not possible, the connectors used must be of the same type as those used originally on the vehicle. When replacing, observe the minimum internal dimensions of the existing pipes.

Pipes must never be welded.

The new pipes must have the same characteristics and be of the same material as those used originally on the vehicle. The installation must be carried out so that the piping is protected and the correct function of the system ensured.

For the supply and fitting of material we recommend that you contact our Service Centres or specialised workshops.

Metal Pipes

For the hydraulic system pipes, any additions and replacements must be as follows:

- Pipes (materials, sizes, connectors) : ISO 4038 standard
- Curvature radii (referred to pipe centreline Ø = 4.76 mm) : min. 25 mm
- Tightening torque
  rigid pipes, connectors M10x1 and M12x1 : 12 – 16 Nm
  flexible hoses, male connectors M10x1 : 17 – 20 Nm

Plastic Pipes

They are used on vehicles with air suspension to connect the air springs to the integrated control unit and to control the brake load apportioning valve.

When replacing pipes, plastic must not be used:

- in areas where the temperature reaches more than 80°C (e.g. within 100 mm of the engine exhaust system);
- between fixed and moving parts, in this case special hoses are to be used.

During modification the following must be observed:

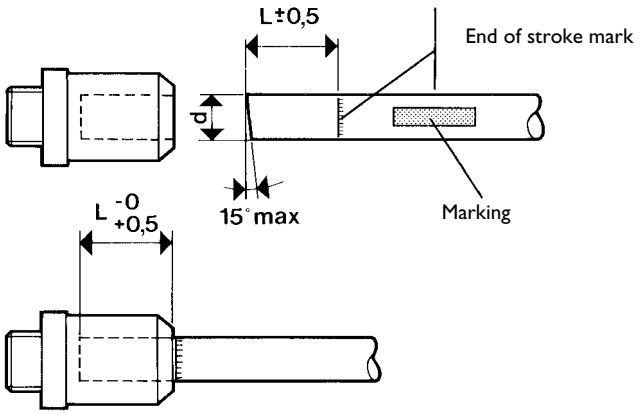
- Material and dimensions : Standard DIN 73378 e 74324 (max. operating pressure 11 bars)
- Radii of curvature (referred to the pipe centreline) : min. 6 · Ø est

Preparation and installation

Cut the pipe at right angles (max. permissible variation 15°) using the correct tools to avoid flaws which could impair tightness.

Mark the portion of the length L (see Fig. 2.26) to be inserted in the connector with indelible ink or adhesive tape to ensure tightness. Mark the pipe to avoid confusion while it is being installed for subsequent modifications.

Figure 2.26



d mm	L mm
4	19,5
6	19,5
8	20,5

As a rule quick coupling connectors should be used. We recommend that the same makes present on the original vehicle be used. When necessary (e.g. near bends), connectors with metal inserts may be used. Before inserting the pipe into the connector the latter must be screwed into its threaded seat on the component (e.g. pneumatic valve) adopting the tightening torques indicated below.

Thread	Tightening torque (Nm ±10%)
M 8 X 1 mm	5-6
M 12 X 1,5 mm	24
M 14 X 1,5 mm	28

Insert the portion of the length L, previously marked, of the pipe into the connector applying force for 30 to 120 N depending on the dimension of the pipe.

The replacement of the components (valves etc.) is made possible since the coupling and connector may be internally rotated while screwing or unscrewing.

Precautions

Should piping be replaced, use new connectors. After opening, connectors must not be reused.

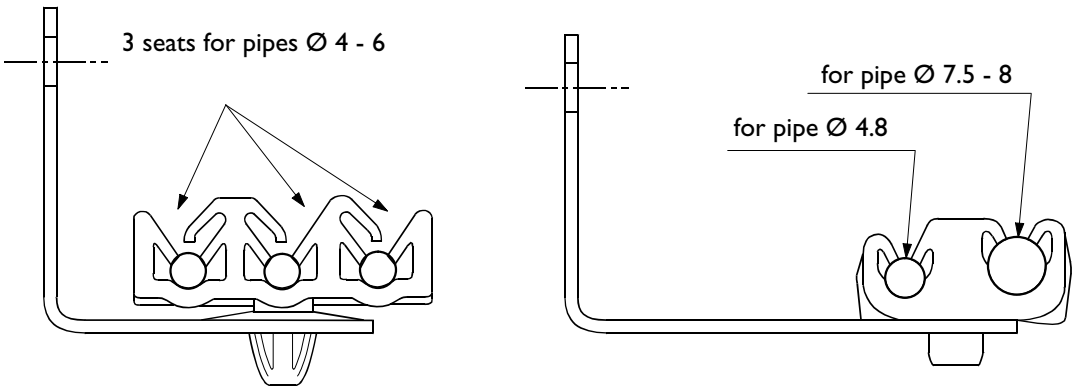
2.13.3 Installing pipes on the vehicle

New pipes must be thoroughly cleaned inside before use (e.g. by blowing through with compressed air).

Pipes must be fixed in their correct position. The fixing elements must go right round the pipe. They may be of plastic, metal or rubber.

Figure 2.27 shows two examples of brackets with retaining clips to secure the brake pipes along the chassis frame.

Figure 2.27



When a pipe has to pass through the chassis frame (side or cross members), appropriate precautions must be taken to avoid damage.

Observe adequate distances between the various fixing elements. As a rule the maximum distance of 500 mm is applicable.

For plastic pipes, in order to prevent distortion and tension on the connectors when fitting them, take the necessary precautions when working out on the run and fitting the fixing elements onto the chassis. Flawless fitting of the fixing elements will ensure that the pipes do not rub against the fixed parts of the chassis.

Observe the necessary safety distances from moving parts and heat sources.

Important

After completing any work either on the system or on the equipment, bleed off the air properly, following the instructions given in the IVECO manuals. The efficiency of the braking system must then be checked.

2.13.4 ABS anti-lock brakes, with EBD electronic braking load apportioning valve and ABD traction control

To check the systems work properly, refer to the instructions given in the IVECO manuals, among which:

- When braking, the brake pedal may be subjected to light pulses indicating anti-lock brake action.
- When the engine is running, the ABS+EBD warning lights come on to indicate a system fault. In this case, braking sharply may lock the wheels and the vehicle might side-skid. If just the ABS warning light comes on, the EBD may continue to work while the ABS and ABD functions are lost. In these cases, drive the vehicle without braking sharply until you reach the nearest Service Centre to have the system checked.
- The ABD indicator light starts flashing when the system comes into operation (it is only active up to a speed of approximately 40 km/h). If this light is on steady, it may indicate:
  - a fault;
  - temporary system deactivation due to heavy use. Reactivation is automatic.

Important

Accident risk: a fault with the ABS-EBD device changes the behaviour of the vehicle when it brakes. Refer to a Service Centre as soon as possible, driving extremely cautiously.

The ABS, ABD and EBD modulator devices, on the chassis frame in the engine bay, should not be moved.

When modifying the wheelbase, the electric wires between the sensors on the rear axle and the control unit must be modified using new wires or extensions with appropriate connectors. Brake pipes downstream from the modulator must be similarly modified.

Warning

During these operations you need to pay special attention the pipes are connected correctly for each single wheel.

Run the necessary tests after each job at an Authorized Garage with the specific equipment to check the systems work properly.

2.13.5 Instructions for adjusting the braking load proportioning valve

a. Load proportioning valve version

Two types of proportioning valve are used (not present on the version with ABS):

- version for dual circuit (crossed)
  fitted on vehicles with single rear wheels (mod. 29L and 35S);
- version for single circuit
  fitted on vehicles with twin rear wheels (mod. 35C, 40C, 45C, 50C).

b. Load proportioning valve adjustment

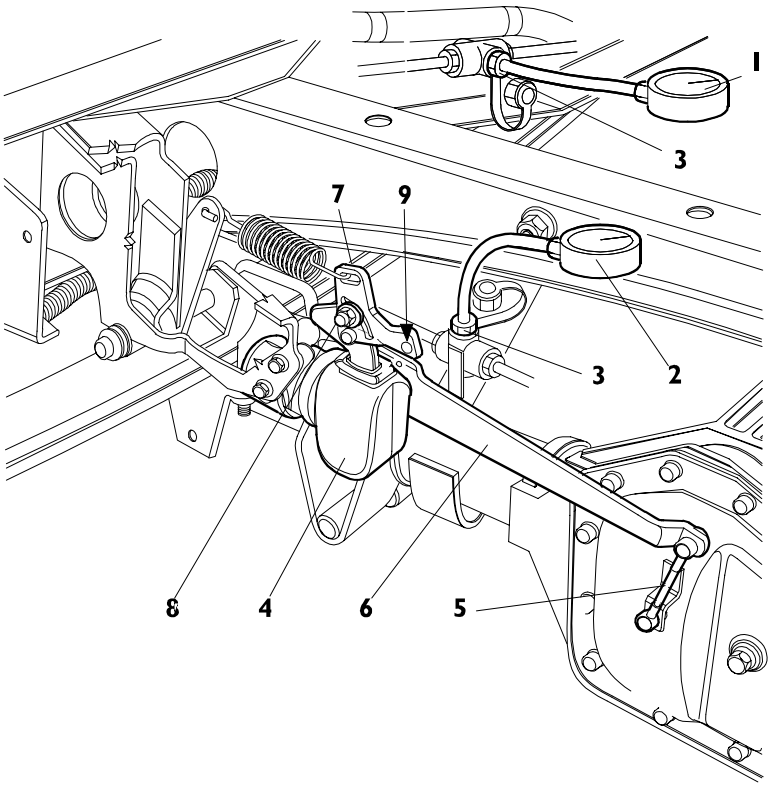
This adjustment is made on each vehicle in the factory. It permits loading the vehicle or fitting standard bodies in compliance with the deceleration and road holding values required by the relevant EC Directives.

The adjustment and control data are given on the appropriate rating plate, whose location on the vehicle is given in the specific literature.

Needing to adjust the braking load proportioning valve, proceed as indicated here (see Fig. 2.28).

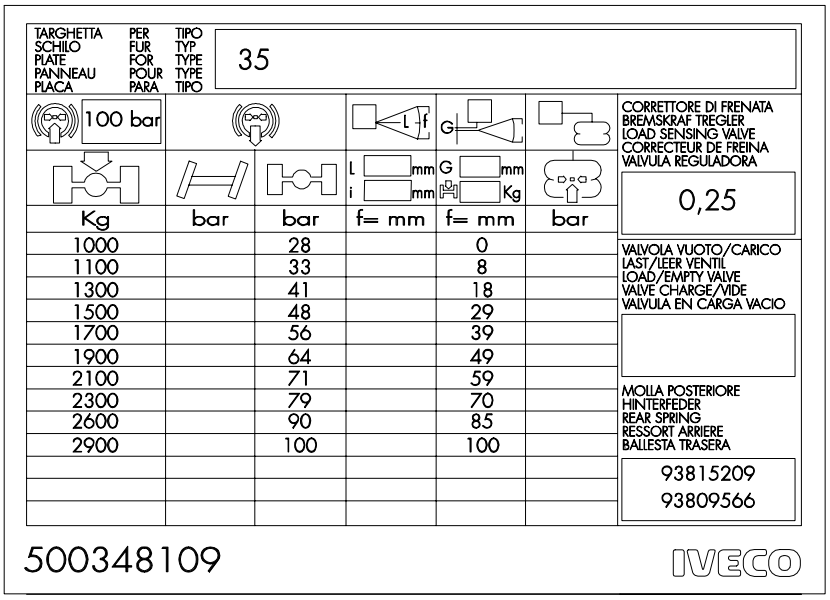
In the case of new springs, remember it is first necessary for the rear suspension to settle properly. To obtain good results it is necessary to load the vehicle partially (approximately 2/3 of its permitted limit) and make a few runs over a rough surface, braking a number of times while travelling forwards and reversing.

Figure 2.28 The example shows the single-circuit braking load proportioning valve of the 35C model



1 Pressure gauge upstream from the load apportioning valve
2 Pressure gauge downstream from the load apportioning valve
3 Test fittings
4 Braking load proportioning valve
5 Rod
6 Main lever
7 Adjustment lever
8 Joining screw
9 Hole to apply setting load

Figure 2.28a



- Connect the pressure gauges 1 and 2 to the pressure test points upstream and downstream from the braking load proportioning valve with the test fittings 2.
- Loosen the joining screw 8 of the proportioning valve adjustment lever 7.
- On hole 9, apply the specific adjustment load for each model and for each spring, after loading the engine axle according to the required reference value. Check the specific values on the IVECO Garage manuals. The following table gives some examples:

Models	Rear leaf spring Type (part no.)	Load on adjustment lever (kg)	Reference load on ground on rear axle (kg)
29 L	single blade (500314624)	9	1500
35 S	single blade (99469088)	6,5	1500
35 C	semi-elliptic (93815209)	3.5	1500
40 C	semi-elliptic (93812674)	2,8	1500
45 C	semi-elliptic (93812688)	4	1800
50 C	semi-elliptic (93812689)	9	1800

- Tighten the joining screw 8 to the required torque of 16 – 19 Nm.
- Operate the brake pedal to reach the control pressure of 100 bars in the circuit upstream from the load proportioning valve.
- Check that the output pressure corresponds to the value given on the rating plate, corresponding to the ground mass accomplished.

c. Modifications to the rear suspension

Changing the features of the rear spring (e.g., no. of leaves, action loads, etc.) requires adapting the braking load apportioning valve adjustment data so as not to alter the vehicle's braking performance. When work on the suspensions follows rather large changes in the permitted loads on the axles or the total mass of the vehicle, it may be necessary to adapt the braking forces to permit compliance with the requirements of the law on braking; the necessary instructions will be given on the authorizations issued by IVECO.

If the modification of the specifications of the rear spring does not require changing loads on both axles and total mass, the braking load apportioning valve must be adjusted by an authorized Garage. So as not to alter the vehicle's braking capacity, it is necessary to observe the ground load/braking pressure ratio (in the various load conditions) given on the rating plate of the braking load apportioning valve.

In these cases, to adjust the braking load apportioning valve, you may proceed as directed in point b., applying a load on hole 9 corresponding to the stiffness of the new spring.

Of course, it will be necessary to check the ground load/braking pressure ratio is observed for all load conditions.

Should this not be, contact IVECO for a fresh check on compliance with the requirements of the law.

Changing the data on the rating plate of the load apportioning valve requires it to be replaced with another one giving the new data.

2.14 Electrical System: Modifications and Drawing Off Power

2.14.1 General Information

The vehicles operate on a 12V electric system for normal requirements and the chassis is an earth return. This acts as a current return wire between relevant components, such as battery and alternator. All component negative terminals are connected through the chassis in the absence of an insulated return wire.

Installation of auxiliary equipment or circuits added by the bodybuilder must take into account the instructions given below. Depending on the complexity of the modification, suitable documentation (e.g. electrical diagram) must be provided for inclusion with that relating to the vehicle.

Using colours/codes for wires and connectors equal to those used on the original vehicle makes the installation more consistent and facilitates repair work.

Remarks

More detailed information regarding the electrical system of the vehicle can be found in the relevant specific Workshop manual no. 603.43.371.

This manual can be obtained from the IVECO After-Sales Network or from the relative departments of the IVECO Sales Management.

Precautions

The vehicles are equipped with sophisticated electrical/electronic systems controlling their operation.

Electrical connections of equipment not made in conformity with IVECO instructions or carried out by unskilled personnel can severely damage the systems (control units, wiring, sensors, etc.), jeopardizing safety and operation of the vehicle besides causing significant financial damage that is not covered by warranty.

Always disconnect the batteries before commencing any work on the electrical system. First disconnect the negative and then the positive power cable.

Use fuses with the required capacity for their specific function. Never use fuses of higher capacity. Change them only after eliminating the trouble, with keys and users disconnected.

Restore the original conditions of the wiring (routing, guards, binding, etc.) if any work has been done on the system.

During work on the chassis frame, to safeguard the electrical system, disconnect the relevant components and the earth connections, follow the guides given in points 2.1.2 and 2.2.4.

To safeguard the electrical components on the vehicle the following precautions should be taken:

Never disconnect the connectors from the control units when the engine is running or when the control units are powered.

Never power components interlocked by electronic modules with the rated voltage of the vehicle through wander cables.

The earth signal originating from analogue sensors must only be wired to a specific receiver. Additional earth connections could result in false output signals being emitted from these sensors.

The wiring looms for the electronic components with low intensity signals must be arranged in parallel to the metal datum plane i.e. it must adhere to the chassis/cab structure in order to reduce the parasite capacity. It should be spaced from additional wiring looms as far as possible.

Additional equipment should be connected to the system earth with the utmost care (see point 2.1.2.). The relative wiring must not be fitted alongside the existing electronic circuits in order to avoid electromagnetic interference.

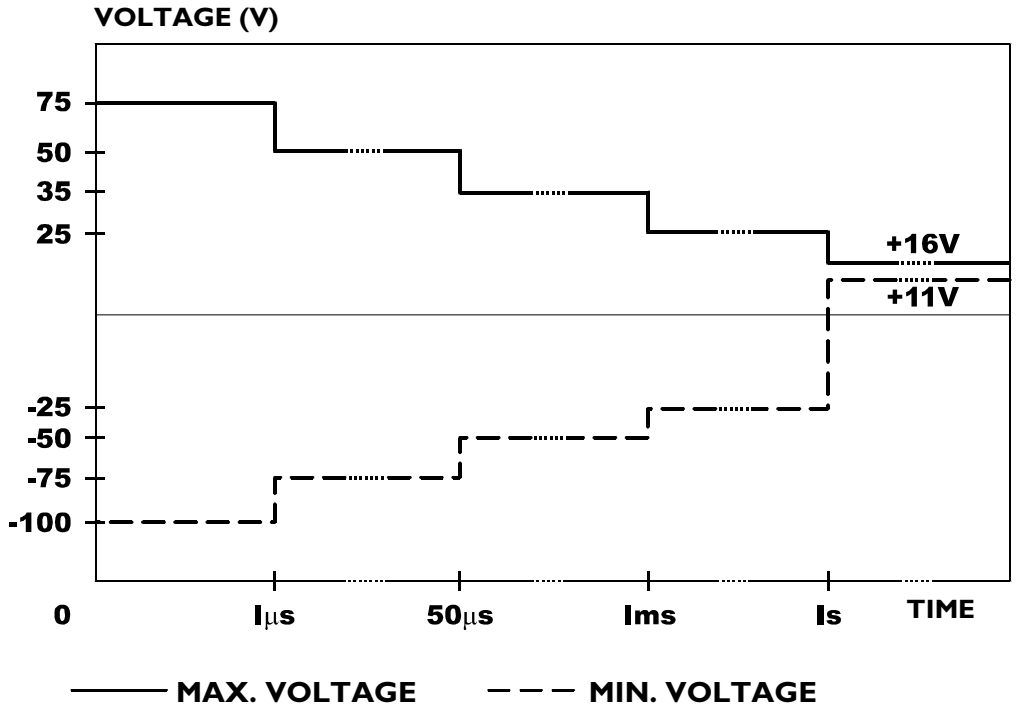
The wiring of the electronic systems (length, conductor type, arrangement, clamping, connecting shield braids etc.) must follow the original IVECO standards. Carefully reset the original system after carrying out any work.

We recommend that electrical, electro-mechanical and electronic devices which comply with the following immunity requirements for electromagnetic emissions, both irradiated and conducted, are used:

- Electromagnetic immunity level required for the electronic systems:
  Secondary systems 50 V/m for frequencies variable between 20 MHz and 1 GHz
  Main systems 100 V/m for frequencies variable between 20MHz and 1 GHz

- Required electromagnetic emission levels for electrical/electro-mechanical/electronic systems:

a) Maximum range of transient voltage for 12V systems.



b) Max. levels of radiated and conducted emissions.

Type of disturbance	Type of band	Type of detector	Acceptable disturbance limits in dBμV (normal unit of measurement at CISPR for measurement of emissions)				
			150 KHz 300 KHz	530 KHz 2 MHz	5.9 MHz 6.2 MHz	30 MHz 54 MHz	70-108 MHz, 144-172 MHz 420-512 MHz, 820-960 MHz
Radiated	Broadband	Quasi-picco	63	54	35	35	24
Radiated	Broadband	Picco	76	67	48	48	37
Radiated	Narrowband	Picco	41	34	34	34	24
Conducted	Broadband	Quasi-Picco	80	66	52	52	36
Conducted	Broadband	Picco	90	76	62	62	46
Conducted	Narrowband	Picco	70	50	45	40	30

Use electrical/electronic equipment in compliance with the EC Directives on electromagnetic compability, i.e use suitable components for vehicle applications marked "e.." (the EC marking is not sufficient). If in any doubt, call the IVECO Service Network.

These levels are guaranteed only if the system comes from "IVECO Spare Parts" or it has been certified as per ISO, CISPR, VDE international regulations. In the case of systems which use the primary or secondary civil electric network (220V AC) as a supply source, the relevant characteristics have to comply with the IEC regulations.

Transceiver System (C.B., 2 metres and cellular telephone).

The installation of C.B. apparatus (27 MHz) 2 m (144 MHz) and cellular telephones must use the power supply system already fitted to the vehicle, connecting directly to terminal 30 with an additional fuse. This apparatus must be homologated to conform to legal requirements and be of the fixed type (not portable). Install the transmitting part in a separate area from the electronic components of the vehicle. The antenna must be installed externally where possible on a wide metallic base, observing the assembly instructions and warnings from the manufacturer. The connections and positioning of the cables pertaining to the installations must be made ensuring that:

- a good quality antenna is used particularly with regard to the visible covering of the protective shield.
- Fit the cable so that an adequate distance (min. 50 mm) is left between it and the existing wiring and ensure the minimum distance from the metallic structure of the cab, avoiding bends or restrictions in the cable itself. It should be fitted to the right or left side of the vehicle where possible.
- Ensure that both the base of the antenna and the containers holding the apparatus are correctly earthed to the structure of the vehicle to ensure the highest levels of power transfer.

The power supply for the apparatus, where this requires a voltage which differs from that of the existing equipment, must be obtained using an adequate transformer, if not already fitted. The power supply cables must be as short as possible, avoiding the presence of coils (no twisting) and maintaining the minimum distance from the reference plane.

The use of non-homologated transceivers or the application of supplementary amplifiers could seriously compromise the correct operation of the electronic/electrical devices normally fitted to the vehicle and negatively affect the safety of the vehicle and/or its driver.

Warnings

When fitting devices such as:

- Retarder
- Auxiliary heaters
- Power take -offs
- Air conditioning systems
- Automatic gearboxes
- Fleet management
- Anti theft devices
- Cellular phones etc

which could interact with the other electrical systems already fitted to the vehicle (e.g. ABS, EDC etc.), contact IVECO in order to optimise the installation.

Remarks

For the operations which might cause interference with the basic system, it is necessary to carry out diagnostic checks in order to make sure that the system has been properly fitted.

These checks can be carried out using the self-diagnosis system of the on-board control units (blink-code) or at the IVECO Service Network.

IVECO reserves the right to decline its own warranty cover on the vehicle should any work be carried out which does not comply with the regulations of the Company.

2.14.2 Additional equipment

The vehicles system is designed to provide the necessary power to all the standard equipment. Each piece of equipment has its own specific protection for its own function and the appropriate dimensions of the wires.

Fitting of additional equipment must include the provision of suitable protection and must not overload the vehicle's system.

The earth connections of the additional devices must be made with a cable of an adequate size. It should be as short as possible and permit movement of the apparatus in relation to the chassis of the vehicle.

If batteries of a greater capacity are used, due to the demand of the added loads, it is advisable to request optional batteries or alternators with a greater capacity.

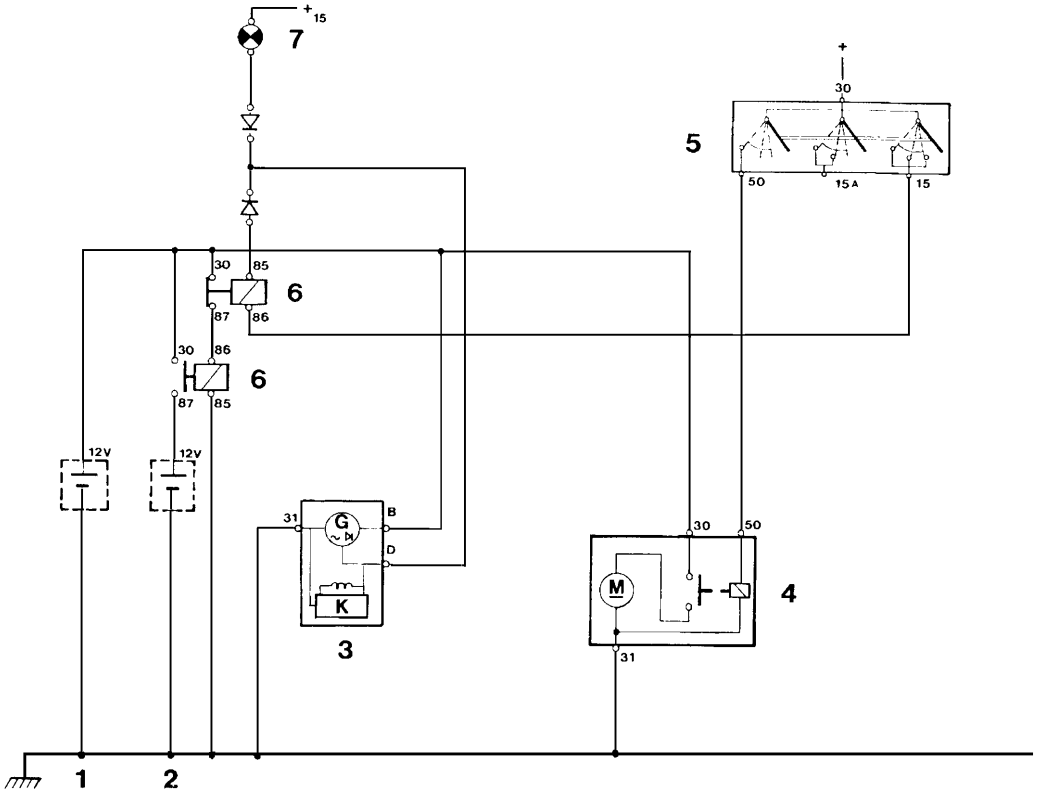
In any case we recommend that the increase in the capacity of the batteries should not exceed 20-30% of the maximum values provided as an optional extra by IVECO so as not to damage some components of the system (e.g. Starter motor). If greater capacities are required, use additional batteries making the necessary arrangements for recharging as described below.

Additional Batteries and Alternators

Installing high power-consumption electric equipment (e.g. electric motors used frequently or for a long time without using the vehicle's engine, as, for example, with the tail lifts in urban applications) or a great deal of additional electrical equipment, may require power which the vehicle's standard system is unable to deliver. In such cases additional batteries of the appropriate capacity must be used.

Their insertion into the vehicle's circuits must include a separate recharging system (see Fig. 2.29) integrated with that of the vehicle. In this case it is advisable to provide supplementary batteries with the same capacity as the batteries originally installed in order to ensure correct recharging of all batteries.

Figure 2.29
Installing additional batteries



1 Standard batteries
2 Supplementary batteries
3 Alternator with built-in regulator
4 Starter motor
5 Starter key
6 Relays
7 Battery charging condition tell-tale

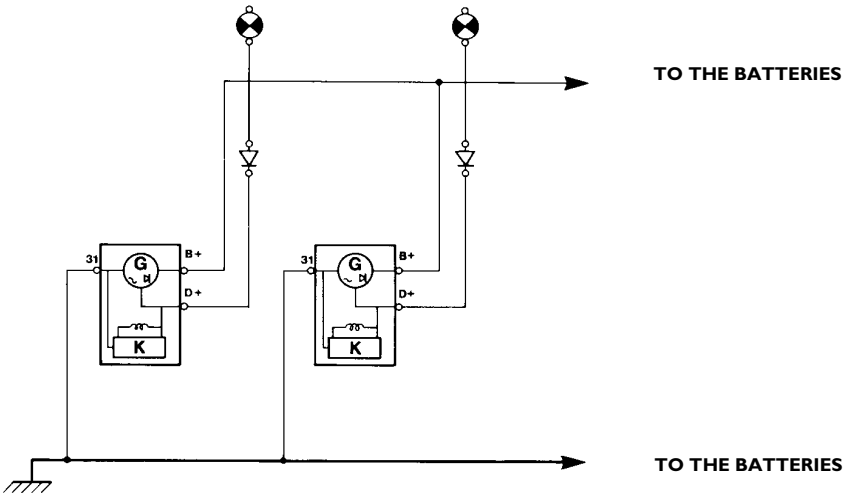
Installing additional batteries involves checking that the alternator is of a sufficient capacity to recharge. If necessary, an alternator with larger power or an additional one must be used. In this case connect up as shown in Fig. 2.30.

When using electric motors which are activated only while the vehicle engine is running, instead of supplementary batteries, it could be sufficient to use a larger power alternator or a supplementary one.

Such alternators have to be equipped with Zener diode rectifiers in order to avoid damaging the electrical/electronic systems already fitted which might arise from accidental disconnection of the batteries.

Figure 2.30

Installing an additional alternator



2.14.3 Drawing off power

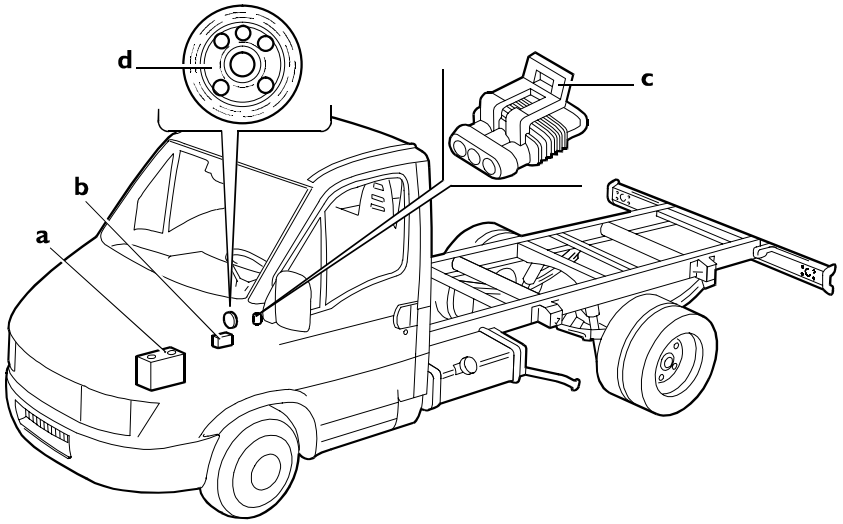
The information about the points from which power draw-off is possible (see Fig. 2.31), the available current and the precautions to be observed are as follows:

Precautions:

Use appropriate fuses, where necessary, fitting them near the power tap.

Protect the added cables in suitable sheaths, installing them in accordance with the instructions of point 2.14.4.

Figure 2.31

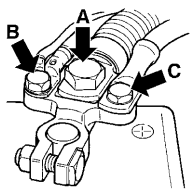


a. From the battery (engine bay) - b. From the junction box (engine bay) - c. From the three-way connector (in the cab) - d. Bulkhead connector (cables passing between engine bay and cab).

a) From the battery (+30)

After inserting a suitable fuse, it is possible to draw off power through the specific terminal C, specially fitted for this purpose.

Figure 2.32

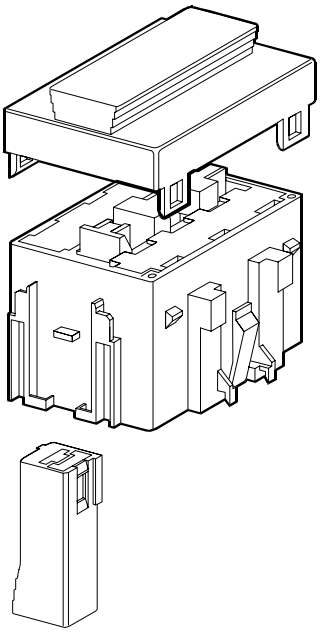


A: Starter motor
B: Terminal for IVECO circuit
C: Terminal for bodybuilders

With engine off:	10A for 1 hour 20A for 1/2 hour
With engine running:	Another 5-15A may be drawn off, depending on the engine speed.

b) From the 6 way junction box (+30)
(in the engine bay, near the servo-brake)

Figure 2.33

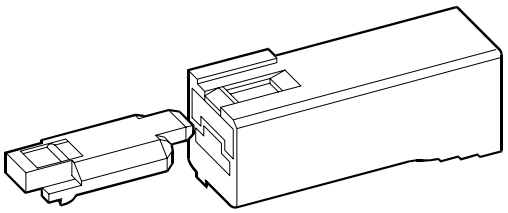


At the bottom of the connector there are some free pins through which it is possible to draw off 10A (total, with engine off or running), after inserting an appropriate fuse.

Use the right connectors and cable terminals.

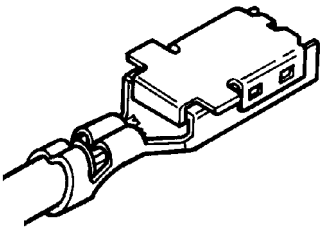
Female connector **IVECO code 1/23097/97**

Figure 2.33a



Female cable terminal **IVECO code Type A 1/92058/94**

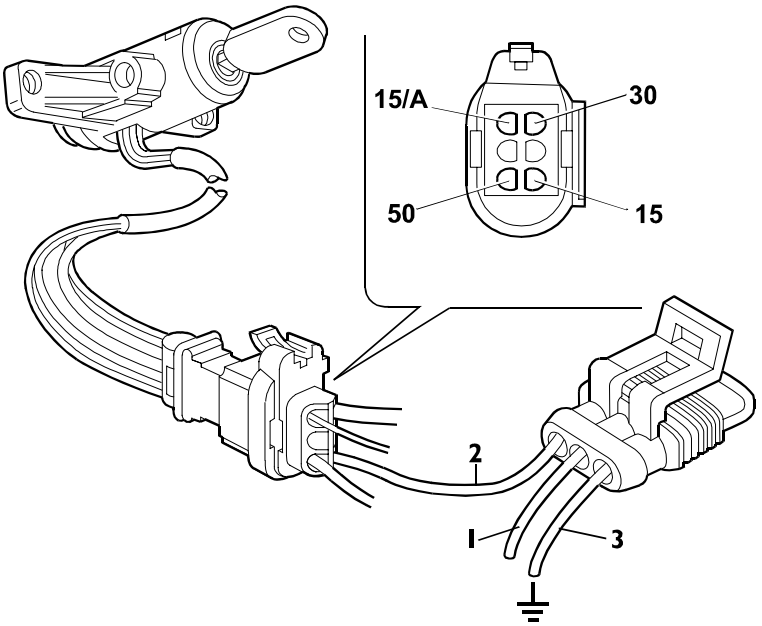
Figure 2.33b



c) From the three-way connector (in the cab)

This connector is located near the fuse and relay-holder control unit (left-hand side under the dashboard).

Figure 2.34



Draw-off possible from pins 1 and 2.

- 1: 10A directly from the battery positive (+30)
- 2: 4A from the key positive (+15)
- 3: earth

The power supplies of pins 1 and 2 are to be protected with a suitable fuse. The return to earth from pin 3 must not exceed 10A.

Interface to use:

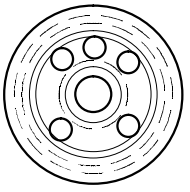
-	Male connector:	9843	5341	N°1
-	Half shell:	9844	7231	N°1
-	Cable terminal:	9843	5370	-
-	Rubber gasket:	486	1936	N°3

d) Bulkhead connector

In the engine bay, close to the servo-brake, through the five holes diameter 10 mm in the bulkhead connector (see Fig. 2.35), it is possible for electric cables to pass from the cab to the engine bay.

Seal the area where the cables pass appropriately in order to prevent fumes getting through to the cab from the engine bay.

Figure 2.35



2.14.4 Additional Circuits

These must be separated and protected by a fuse from the vehicle's main circuit.
The wires used must be of a size to suit their functions and be properly insulated. They must be suitably protected in sheathing (not PVC) or ducted in corrugated pipes in the case of several functions (we suggest type 6 polyamide material for the corrugated pipes) and be correctly fitted, **shielded from impact and heat sources**. Their passage through the components of the structure (cross members, runners etc.) must be via grommets or protective conduits. Take great care to avoid rubbing with other components, especially with the sharp edges of the bodywork. They must be fixed separately by insulating (e.g. nylon) wire clips at the appropriate intervals (approx. 350 mm apart).
In the case of external panels, use a suitable sealant on both cable and panel to prevent infiltrations of water, dust and fumes.
Make provision for adequate distances between the wiring and the other components:

- 10 mm from static components;
- 20 mm from moving components (at their minimum distance);
- 150 mm from components generating heat (e.g., engine exhaust).

Where possible it is recommended that different runs are used between wires (looms) with high intensity absorption signals (e.g. electric motors, solenoid valves) and those with low intensity absorption signals (e.g. sensors) to avoid any interference between them. All should be kept as close as possible to the metal structure of the vehicle.

Connections with plugs and terminals must be protected (resistant to dirt and moisture) by using components of the same type as originally used on the vehicle.

Depending on the power drawn, use cables and fuses with the following specifications:

Max. continuous current [1] (A)	**Fuse capacity [2] (A)**	**Cable cross-section (mm^2)**
0 - 4.9	5	0.5
5 - 9.9	10	1
10 - 18	20	2.5
19 - 28	30	4
29 - 35	40	6
36 - 48	50	10
49 - 69	70	46
70 - 98	100	25
99 - 123	125	35
124 - 148	150	50

1) For uses longer than 30 seconds

2) Depending on the position and therefore on the temperature that may be reached in the housing bay, choose fuses that can be charged by up to 70% - 80% of their maximum capacity.

Precautions

- New wires must not run alongside wires that transmit signals (e.g. ABS). These latter wires have been allocated a special run to satisfy electromagnetic requirements (EMI)
  When grouping several wires together, remember that there will be a reduction in their intensity as compared to the rated value of a single cable due to reduced heat dissipation.
- On vehicles where the engine is frequently started up, with power drawn off and limited engine speed (e.g., vehicles with cold storage), periodically charge the battery to keep it effective.

2.14.5 Operations to change wheelbase or overhang

Should it be necessary to lengthen the wires on the chassis owing to the new dimensions of wheelbase and overhang, a watertight junction box must be used which has the same characteristics as those used on the standard vehicle. The components used such as wires, connectors, terminal blocks, conduits etc. must be of the same type as those used originally and be correctly fitted.

As regards the ABS system, follow the instructions given at point 2.13.4.

2.14.6 Battery main switch

An electric battery disconnector is available on request, fitted underneath it. It is controlled with a key switch.

For special modifications (e.g. transportation of fuel, dangerous cargos transport) it may be necessary to use a safety switch that completely isolates the batteries and alternator from the rest of the system. Solutions specific to the markets are available on request.

2.14.7 Trailer 13-pole connector

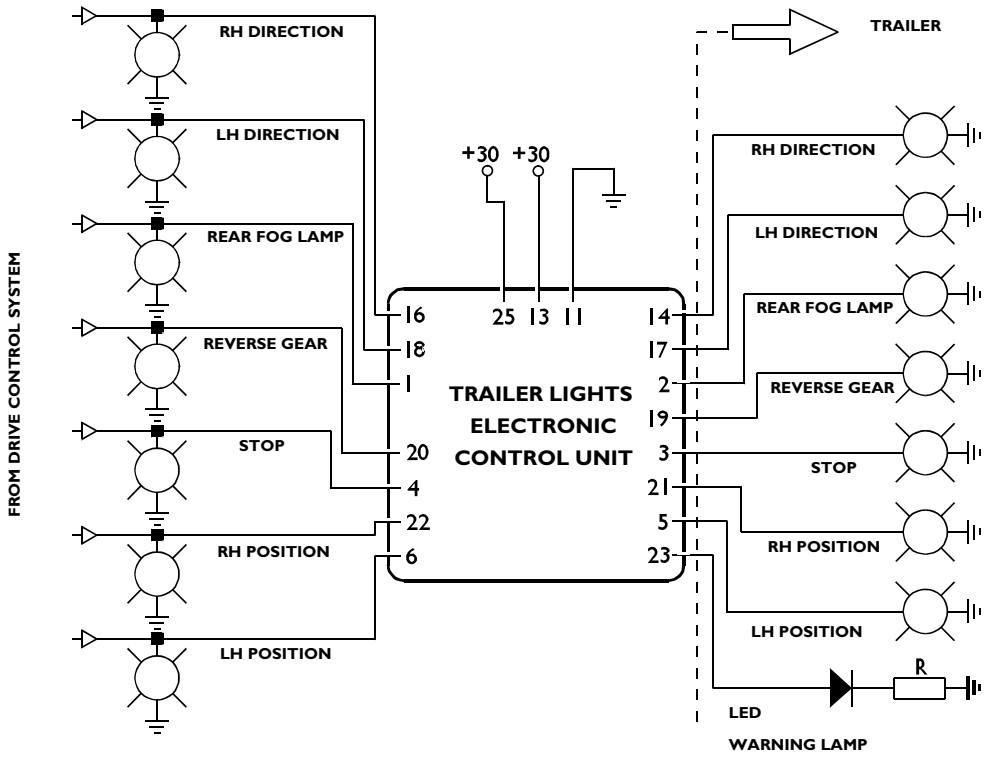
To install this connector you must not make a direct connection with the facility cables in order to avoid current overloads on the drive control system.

The connection has to be made via an electronic control unit, to be installed on the chassis frame near the fuel tank, using these components:

- Control unit: IVECO part no. 500347590
- Fixing bracket: IVECO part no. 500349245

Make the connections as shown in the diagram in Figure 2.36.

Figure 2.36



Operation

All controls received from the drive control system are repeated on the truck unit.

The direction indicator LED output flashes at the same frequency as the direction input controls.

With the control ON and the direction lamp off (or output shorted to earth), the LED is off.

With the control OFF the LED is off.

Electrical characteristics

Rated voltage:	13,5 V
Operating voltage limit:	10 V - 15 V
Operating temperature:	-25° – +65°C
Current with no control:	≤1 mA

Outputs self-protected against shorting to earth

Requirements for installation on vehicle

- Installation position: Vertical with connectors facing downwards
- Installation diagram: See Fig. 2.36.

2.14.8 Installing Side Marker Lamps

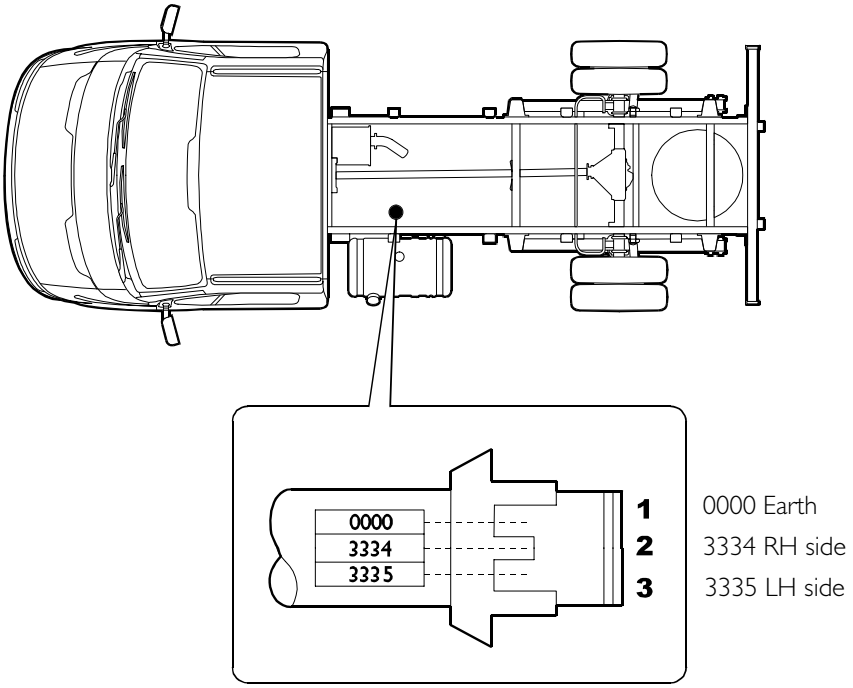
In some countries, regulations (domestic or EC) require the vehicle to be equipped with side marker lamps, depending on its overall length.

The vehicles in the Daily Range are equipped with specific terminals to which the side lamps can be connected.

Making the connections and installing the lights must be done by external bodybuilders on the added structures (box-bodies, vans, etc.).

Here we show the position of the above-mentioned terminal on the chassis-cab vehicle (see Fig. 2.37):

Figure 2.37



Connector on vehicle	Interface to use per connector			
Female connector 9843 5344	Male connector	9843	5341	N°1
	Half bearing	9844	7231	N°1
	Cable terminal	9843	5370	N°3
	Seal	486	1936	N°3A

2.15 Repositioning Parts and Mounting Auxiliary Assemblies and Equipment

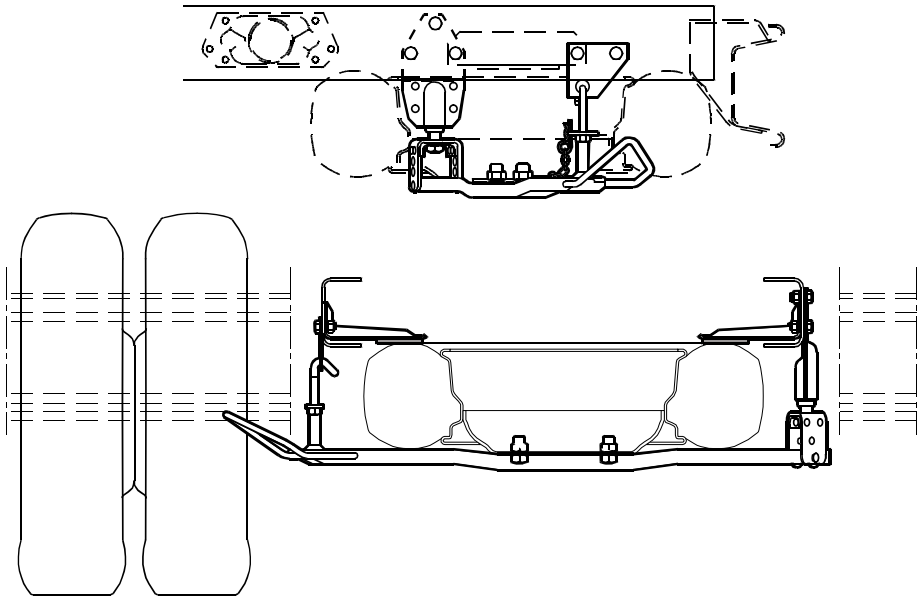
Whenever, in the course of modifying the vehicle, it should become necessary to reposition assemblies such as the fuel tank, batteries or the spare wheel, such relocation is permitted provided that the functioning of these parts is not impaired and provided that the same type of connections as originally in use are re-employed. Their transversal location on the vehicle's chassis may not, when their weight requires it, be changed radically.

Spare wheel carrier

In the case of chassis cabs not equipped with a spare wheel carrier, and vehicles in which the spare wheel carrier must be relocated, the spare wheel must be set on a support that allows the wheel to be readily removed. Figures 2.38 and 2.39 show two possible solutions.

To secure the spare wheel to the side of the vehicle with a support attached to the web of the side member, it is advisable to use a local reinforcing plate on the inside or outside of the side member. The size of this plate must take into account both the weight of the wheel and the possible presence of other reinforcements on the side member (see Fig. 2.39).

Figure 2.38

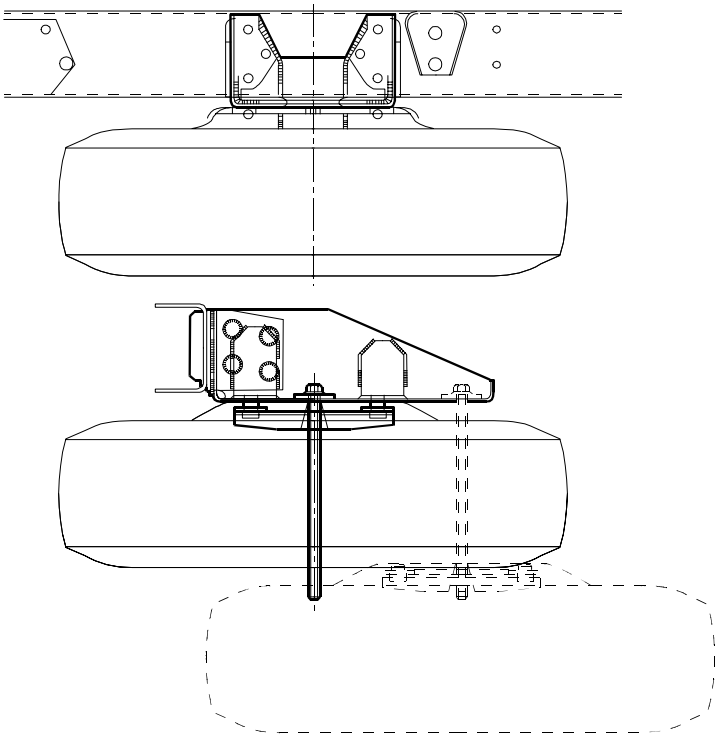


In order to limit the torsional stresses on the vehicle chassis, we recommend that the plate be fitted where there is a cross member, particularly in the case of heavy units.

A similar procedure should be adopted when fitting additional units such as tanks, compressors etc. When positioning them, due consideration must be given to the distribution of the weights (see point 1.2). In any event, an adequate distance of their height from the ground must be ensured with due consideration given to the use of the vehicle.

Any holes that are necessary for the relocation must be made on the web of the side member in accordance with the specifications given in point 2.2.1. Holes already present must be made use of to the greatest extent possible.

Figure 2.39



Fuel tank

When tank filling is hindered by the position of the body structure, the tank mounting brackets may be installed lower down, checking the minimum height off the ground is observed.

If a supplementary fuel tank is to be added, the best solution is to use the same system arrangement already used for original fuel tank, using, whenever possible, original elements. The use of a switching system allows alternative feeding from the two tanks.

The use of the above system is advisable when the added tank is located on the side opposite the original one. When the tanks are in line on the same side it is possible to maintain fuel feed from the original tank, the added one being connected directly to the former through hoses. The arrangement must conform to national rules and regulations. The tank-to-tank connecting line must be leakproof and not of a smaller internal dimension, have the same technical characteristics as those envisaged for the original system and be properly secured.

Fuel filling-pipe on the cab side upright

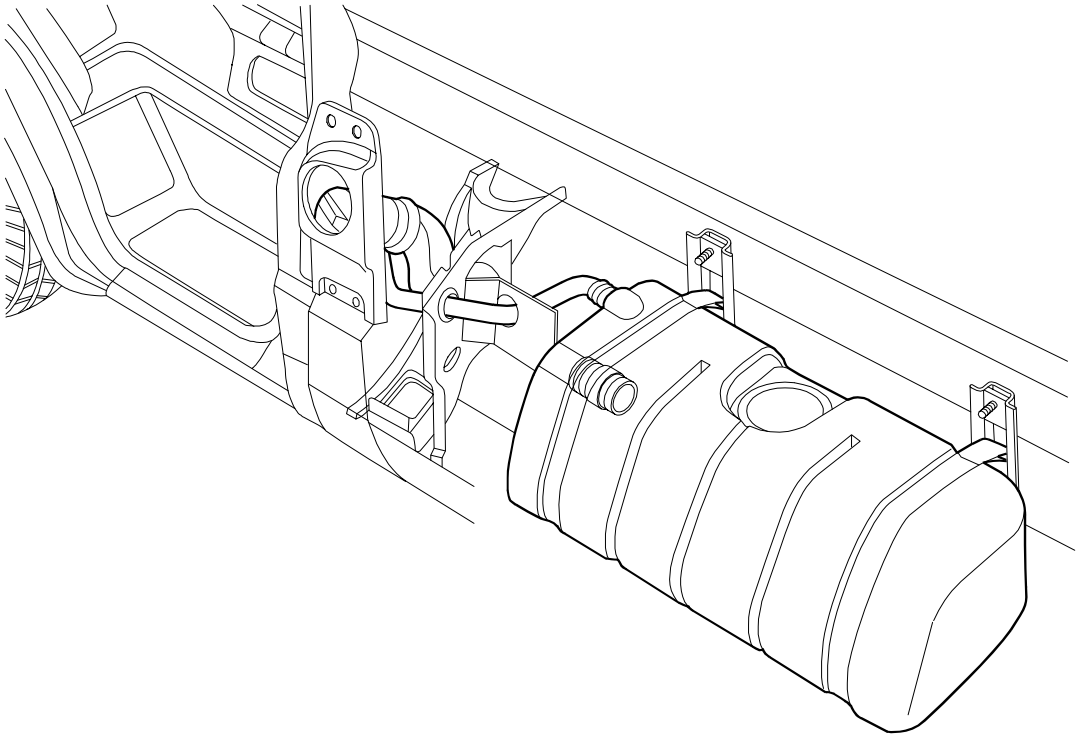
For the truck version a solution is available on request (opt. 6164) with the fuel filling-pipe on the left side upright of the cab (see Fig. 2.40).

It may be especially useful for bodies requiring a clear space on the left-hand side at the back of the cab (e.g., crane stabilizer system).

Installation on vehicles that have already been manufactured and at a Service Centre requires getting the necessary components from IVECO Spare Parts according to the position of the tank on the chassis frame and its capacity:

- filling-pipe including air vent;
- specific tank (70 or 100 litres) with its connections to the chassis frame.

Figure 2.40



2.16 Transporting Dangerous Cargo

Vehicles used to transport dangerous cargo - for instance inflammable materials or explosives - must be built in compliance with the safety specifications established for this type of transport by national or international regulations.

On the assumption that the Bodybuilder is aware of, and in compliance with, the particular specifications relative to this subject we would like to recall, nonetheless, that all vehicles crossing borders within Europe must be in compliance with the "European Agreement on international transport of dangerous substances on roads" (ADR), now included in the specific EU Directive.

As a case in point, we list below some of the requirements in the above mentioned Agreement (ADR), which in any case must be carefully examined:

1) Electrical equipment.
Electrical wiring must be suitably insulated and protected in conduits from impact, stones, heat etc.
Circuits must be protected against overloads by fuses or automatic disconnectors.
A general circuit breaker (excluding the tachograph supplied directly by the batteries) with suitable safety devices, located close to the batteries, with direct or remote control in the cab or outside.

2) Braking:
Compliance with the specific EU Directives.
Anti-lock braking system (ABS) and retarder compulsory in the cases required by the law.

3) Protection of the cab.
Use of virtually flameproof materials, in conformity with ISO 3795, with combustion speeds no greater than 100 mm/min. Otherwise, have a protective wall between the driver's cab and the transported container.

4) Exhaust system.
Those parts of the exhaust system which reach temperatures of more than 200°C and cannot be moved in front of the protective wall, must be adequately insulated.
If the exit of the exhaust cannot be turned outwards, in the case of tranporting explosives, it must be equipped with a spark arresting device.
(If any modifications of the exhaust pipes are necessary, they must be carried out in accordance with point 2.8).

5) Fuel tank.
This needs to be positioned so it is protected against bumps. In the event of it overturning or of leakage, the liquid has to run off straight onto the ground.

6) Independent heater.
This must be safe as regards fire protection. It has to be positioned in front of the cab rear panel, at least 80 cm off the ground, with the heated parts protected.

7) Safety equipment.
A minimum of two fire extinguishers, two portable lamps that are independent from the electrical system of the vehicle, and whose operation cannot cause the combustion of the cargo being transported.

Check the availability of these outfits for our models with IVECO.

2.17 Retarder installation

An extra retarder (e.g., eddy current drag brake or hydraulic brake) may be positioned on the transmission (separate installation) and must be authorized by IVECO.

Installation on some vehicles can be carried out at our plants (as optional extra). Later installation on these vehicles must match the original solution (as for brake manufacturer co-operation).

In the remaining cases, the brake manufacturer's workshops must carry out the installation in compliance with points 2.2.1, 2.3.2 and 2.14 of these instructions. The firm authorized to carry out the installation is responsible for correct operation, anchoring part size and good workmanship.

In the presence of electronic system installed on the vehicle (e.g. ABS, EDC etc.) which interact with the retarder, contact IVECO in order to optimise the application.

2.18 Modifications to the Rear Underrun

Our vehicles are fitted with a rear underrun bar in accordance with EC Directives, 70/221 and 81/333.

The maximum permitted distance from the bar to the rearmost part of the body is 400 mm, deducting the distortion of approx. 5-10 mm found during approval tests. For further information see the official information issued by IVECO.

Whenever the chassis modifications affect the rear overhang, the underrun bar must be repositioned (in compliance with current regulations) so as to be able to obtain the same connection with the chassis as on the original vehicle.

When modifying the vehicles or installing special equipment (e.g. tail lifts) it may be necessary to modify the structure of the underrun bar. Such modifications must not change original resistance and stiffness specifications (comply with local government regulations, if any). The firm carrying out the modification must be prepared to present the relevant documentation on the required specifications upon request.

Whenever different underrun bar must be used, check relevant current regulations. Documentation or quality control certificates must be presented upon request from the competent authority.

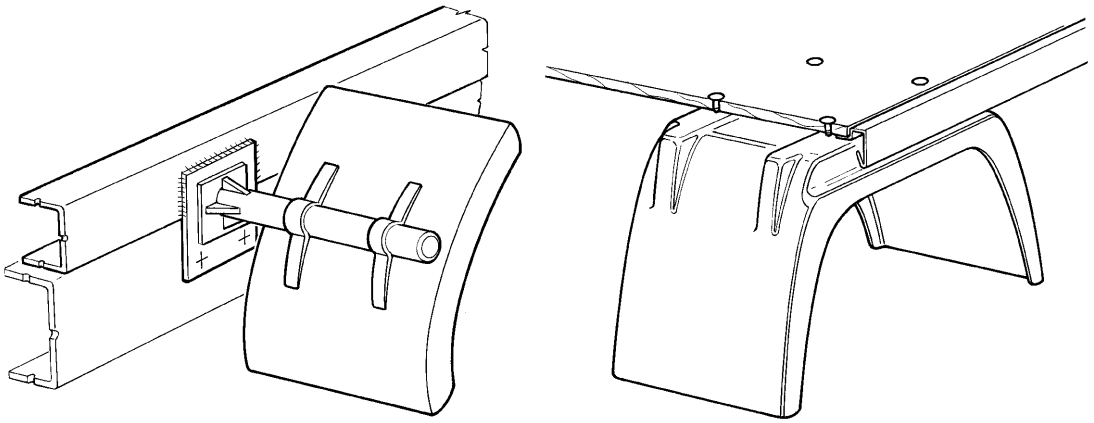
2.19 Rear Mudguards and Wheel Boxes

When vehicles are supplied without mudguards, the bodybuilder must fit them using similar installations as used by IVECO on similar vehicles. In making the mudguards, wheel arches, as well as the shape of the body, bear in mind that:

- Ensure the wheels can turn even in the full bump condition with snow chains fitted, in compliance with the limits shown in the documentation supplied by IVECO.
- The maximum width of the vehicle over the tyres must comply with the legal limits.
- The supporting structure should be sufficiently strong enough, avoiding any sudden variation in section.
- The connection can be made to the vertical web of the vehicle's side members or to the longitudinal sections of the subframe. In the first case, the connection must be made solely with screws, or directly under the superstructure (e.g., body, van, etc.), see Figure 2.41.

If the supports are fixed the body longitudinals they can be welded or bolted.

Figure 2.41



2.20 Mudflaps

If legally required, unless already fitted ex-factory, the bodybuilder must ensure that the complete vehicle is fitted with mudflaps. When mounting them legally required distances must be complied with.

2.21 Side Guards

In some countries local or EEC regulations require that the vehicle be fitted with side guards. The Bodybuilder who finishes off the vehicle must ensure compliance with the required characteristics unless it is already equipped with them ex-factory.

On permanently fitted structures such as fixed platform bodies, vans etc, the side guards will be fitted directly to their basic structure (floor ribbings cross members) whereas on mobile structures (such as tippers, interchangeable equipment, removable containers), the side guards will be connected to the auxiliary frame by way of suitable brackets or installed directly on the chassis. In the latter case, we suggest that the Bodybuilder makes use as far as possible, of the holes already existing on the side member vertical web in compliance with point 2.2.1.

According to the EC regulation, the external protection element can either consist of a single runner whose surface extends in the vertical direction or of several longitudinal sections with preset sizes and distances between them.

The side guards must be connected to their own supporting structures in order to allow quick removal or tilting should maintenance or repair work on assemblies or components located next to them be needed.

Operation of and access to the following parts must be ensured.

- Brake system equipment
- Fuel supply
- Suspension
- Spare wheel
- Engine exhaust

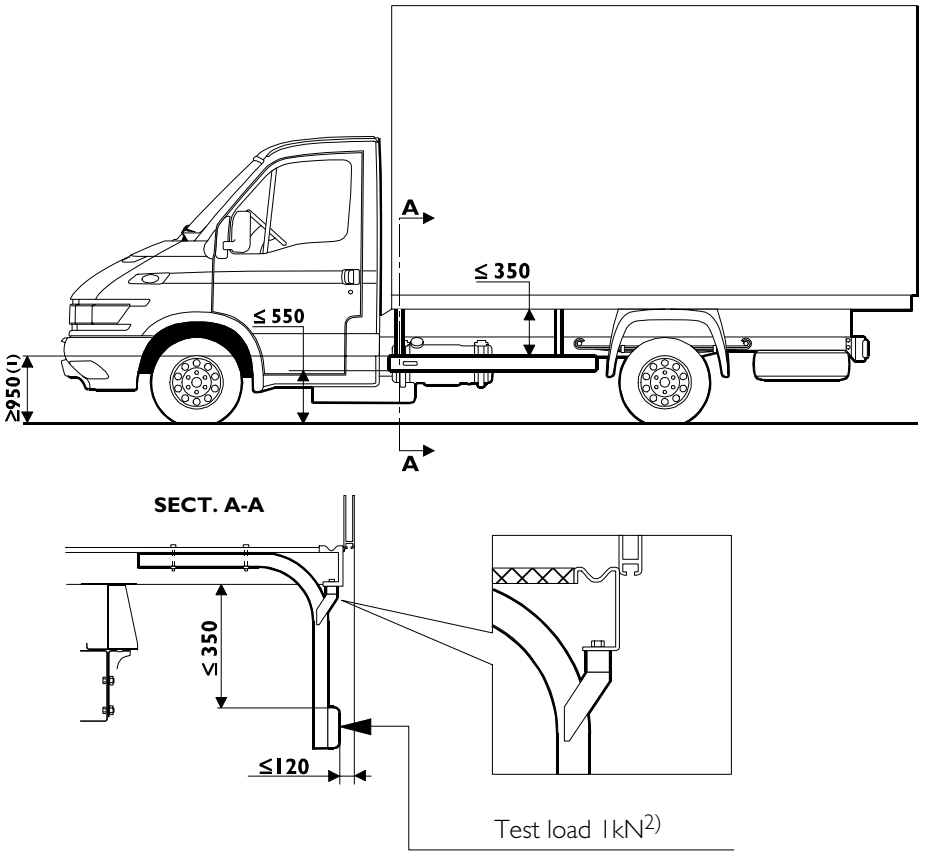
The guards must be made of the appropriate materials (e.g. FeE420).

Particular care must be taken when fitting to ensure the clearance from the ground and the distances to the various components required by the regulations.

Figure 2.42 shows a type of side guard designed in compliance with the relevant EC Directive to be fitted to fixed bodies.

The Bodybuilder will take care of the preparation and the arrangement of the side guard depending on the type of auxiliary subframe concerned, as it is not possible to provide instructions of a general character applying to all equipment versions.

Figure 2.42



NOTE:

N1 class vehicles are excluded.

1) Either the bottom part of the auxiliary frame is over 1,300 mm from the ground or the width of the auxiliary subframe is less than the external space occupied by the tyres.

2) Permitted sag values under test load:
≤ 30 mm on the rear, included in the last 250 mm of the device
≤ 150 mm on the remaining parts of the device

2.22 Chocks

Usually these are fitted directly at the factory. Should this not be the case, or if it is necessary to change their original position, the Bodybuilder must work out a new arrangement in compliance with local regulations. The new position must ensure reliability and safety as well as easy access for operation by the user.

3. BUILDING AND MOUNTING THE STRUCTURES

Index

The following detailed instructions supplement and integrate the regulations shown in the more general specifications.

3.1 Subframes and Bodies

3.1.1 Construction of the Subframe

The purpose of a subframe (auxiliary frame) is to ensure a uniform distribution of the load on the vehicle's chassis and to increase the strength and rigidity of the main frame in relation to the particular use of the vehicle.

The following points are to be borne in mind when constructing a subframe:

Material

Usually, provided the subframe is not to undergo great stress, the material used for its construction may be of a lower grade than that used for the vehicle chassis. It must have good welding characteristics and limits of no less than:

Tensile strength R ≥	370 N/mm^2	
Yield point $R_{0.2}$ ≥	240 N/mm^2	e.g. Fe360D
Stretching A_5 ≥	25%	

Should the stress limits require it (e.g. if cranes or tail lifts are to be fitted), or if very high sections are to be avoided, material with better mechanical characteristics may be used. In this case it should be considered that a lower inertia moment of the reinforcing beam implies high bending stresses on the chassis frame.

The characteristics of some materials considered in some applications hereinafter indicated are as follows:

Material	Fe510D
Tensile strength R ≥	520 N/mm^2
Yield point $R_{0.2}$ ≥	360 N/mm^2
Stretching A_5 ≥	21%

Aluminium Subframe

In the case of materials, having different characteristics compared to steel, such as aluminium, both the dimensions and the structures of the subframe will have, as a rule, to be adapted accordingly.

When the subframe's main function is mainly to distribute the load more evenly while leaving the major loadbearing to the frame, aluminium longitudinal runners can be used having the same dimensions as stated for the steel. Some typical examples are: fixed bodies,

vans, tanks with continuous and close spaced bearers or bearers mounted directly over the suspension hanger brackets. Exceptions are those cases where the high stresses on the vehicle's frame demand steel runners of a high dimension or shear-resistant connections.

When the subframe must contribute in terms of strength and stiffness (bodies having high concentrated loads, such as tippers, cranes, central axle trailers, etc.) aluminium is not recommended and has therefore to be authorised for each application.

It should be remembered that, when stating the minimum dimensions for the reinforcement runners, besides the admitted limit of stress for the aluminium, the different elastic modulus compared to steel (approx. 7.000 instead of 21.000 kg/mm^2) will also have to be considered. This will result in larger dimensions for the runners.

Similarly, if the connection between the frame and subframe allows the transmission of shearing stresses (plate connection), then when checking the stress of both ends of the single section, the relevant new neutral axis has to be estabilished according to the different elastic modulus of both materials.

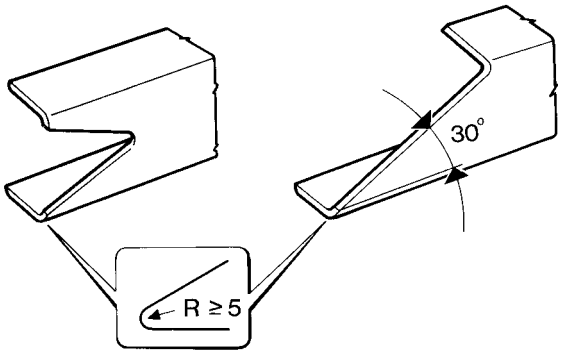
In the final analysis, if the subframe has to contribute to the frame's strength/stiffness, higher sectional dimensions for the runners will have to be used if aluminium is to be considered instead of steel.

Longitudinal Runner Profiles

The side member of the added structure must be continuous, extending as far as possible forward to the front of the vehicle to include, if possible, the area of the rear support of the front spring, and rest on the chassis of the vehicle but not on the brackets.

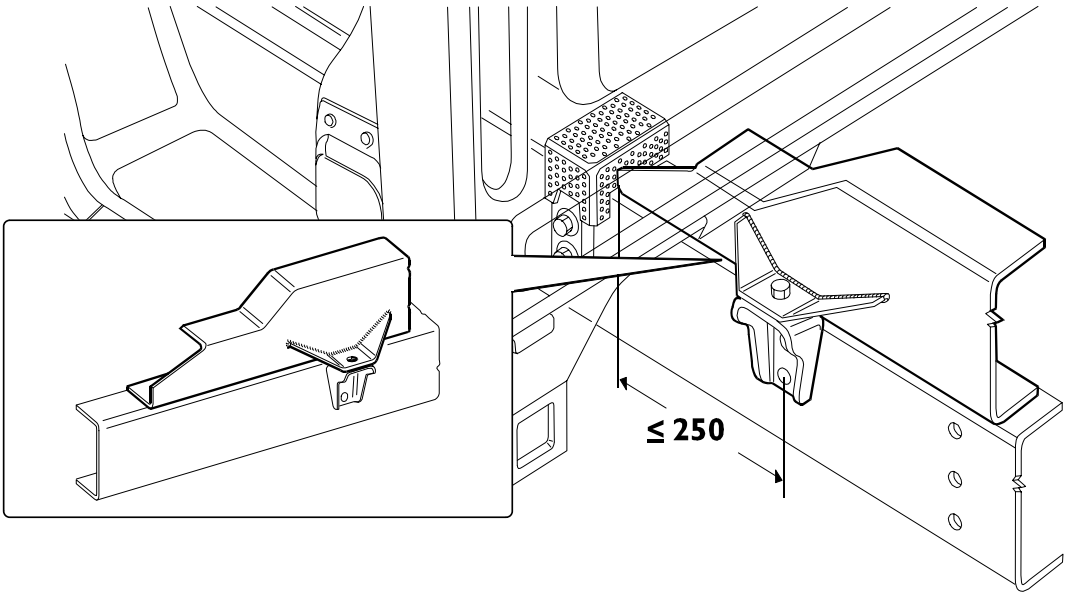
In order to achieve a gradual reduction in the resistant section, the front ends of the longitudinal runner must be tapered upwards at an angle of no more than 30°, or tapered in some other equivalent way (see fig. 3.1) ensuring that the front end in contact with the chassis is suitably connected, min radius 5 mm.

Figure 3.1



If the rear conformation of the cab (e.g., with crew cabs 6+1) does not allow the entire runner to pass through, this may be made as shown in Figure 3.2, with a fixing preferably no further than 250 mm from the front end of the subframe.

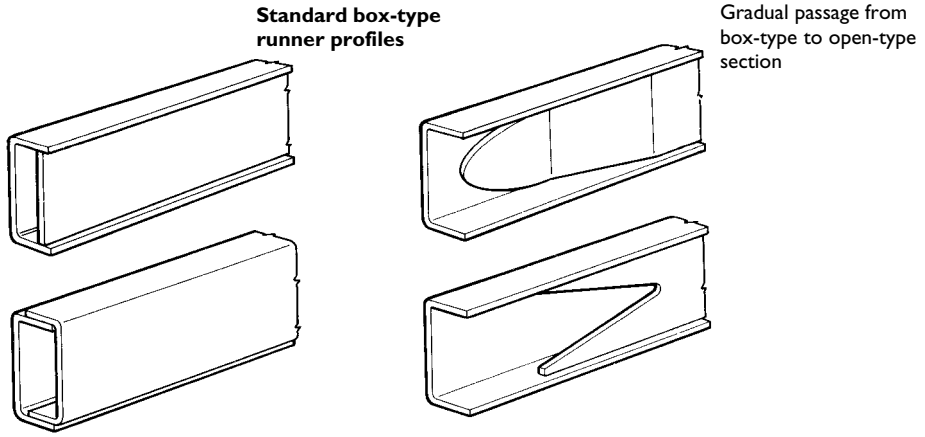
Figure 3.2



The shape of the section of the runner is determined with due consideration to the function of the subframe and to the type of structure that is above it. It is advisable to use open U-sections if the subframe is supposed to adapt itself elastically to the chassis of the vehicle, and to use box-type sections when added rigidity is called for.

Proper care must be taken to ensure a gradual passing from the box- type section to the open kind. Some examples on how to achieve this are shown in fig. 3.3.

Figure 3.3



There must be continuity between the longitudinal runners of the subframe and the vehicle. Where this is not possible, continuity may be restored by fitting cleat plate brackets.
If a rubber antifriction strip is inserted, specifications and thickness must be equal to those originally used by the Manufacturer (hardness 80 Shore, max. thickness 3 mm).
The application of antifriction material may prevent abrasive actions which can cause corrosion when using material with a different composition (e.g. aluminium and steel).

The specified dimensions for the side members of the various types of body are recommended minimum values that, as a rule, hold for vehicles with standard wheelbases and rear overhangs (see tables from 3.1 to 3.7). In all cases, it is possible to use similar sections whose moments of inertia and resistance are no lower. Such dimensions can be obtained from the technical literature supplied by the manufacturer of the runner profiles. It should be borne in mind that the moment of inertia, apart from being an important factor for the calculation of the share of bending moment to be applied, also represents the most adequate response to the degree of torsional stress required for the specific type of connecting section in use. Therefore, the moment of resistance is a determining factor as regards the stress exerted on the material.

Cross Members

An adequate number of cross members, which should be positioned if possible adjacent to the fastenings, are required to brace the two runners of the subframe.
The cross members may be of the open type (e.g. C-type) or, if greater rigidity is desired, of the closed type.

Suitable gusset plates must be employed at the points of the connection to confer sufficient strength to the connection (see fig. 3.4). In those cases, when greater rigidity is required for the connection, the work procedure may be carried out as illustrated in fig. 3.5

Figure 3.4

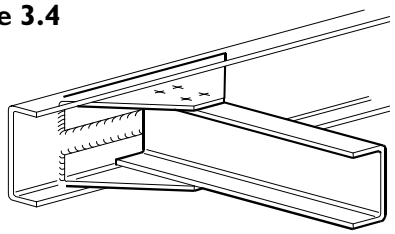
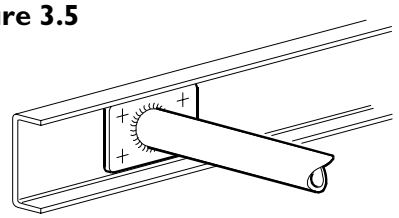


Figure 3.5



Stiffening the Subframe

In the case of certain bodies (e.g., tippers, overhead baskets, cranes on rear overhang, or bodies with a high centre of gravity), the subframe must be additionally stiffed at the rear end.

Depending on the degree of torsional stress, this must be done in one of the following manners:

- Joining the rear section of the longitudinal member by a box-frame construction.
- Box-frame construction, closed-section cross members (see fig. 3.6).
- Box-frame construction, crossties (see fig. 3.7)

As a general rule, the box-frame construction of the longitudinal runners should not be employed in the front end.

Figure 3.6

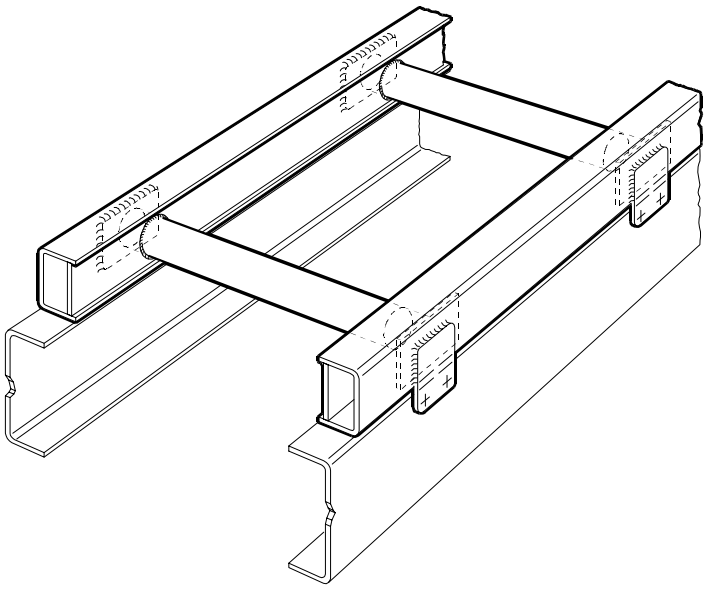
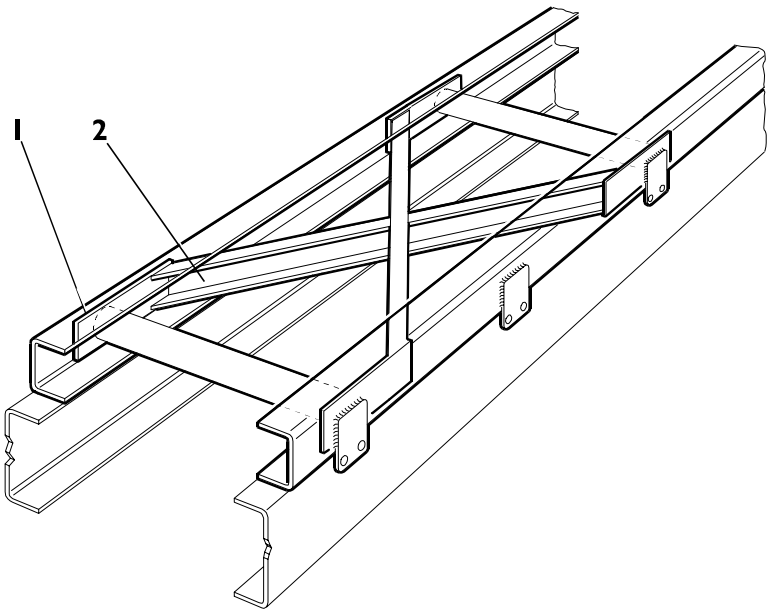


Figure 3.7



1 Subframe
2 Crossties

Self-supporting Bodies as Subframes

A subframe (longitudinal runners and cross members) need not be fitted if self-supporting bodies are to be installed (e.g. rigid box body, tankers), or if the base of the structure to be fitted already serves the purpose of subframe.

3.1.2 Connections

Choosing the Type of Body Mounting

The selection of the type of connection to be used - if not provided initially by the Manufacturer - is very important in terms of the subframe providing strength and stiffness, for the appropriate body type.

The subframe connection may be flexible (brackets or clamps) or it may be rigid, resistant to shearing stress (longitudinal or transverse plates); the choice must be made based on the type of body that is to be mounted (see points 3.2 to 3.13) analysing the stress forces which the additional equipment that is added transmits to the chassis both under static and dynamic conditions. The number, size and type of securing devices properly subdivided over the length of the subframe, must be such as to ensure a good connection between the chassis of the vehicle and the subframe.

The screws and clamps must be of a strength class no lower than 8.8, the nuts must be equipped with devices that prevents them from working loose. The first fixing nut must be located, if possible, at a distance of approx. 250-350 mm from the front end of the subframe.

Any connecting points previously existing on the frame of the vehicle must be used first.

The compliance with the aforementioned distance for the first mounting must be ensured in cases where the body applies concentrated loads behind the cab and requires additional stability (e.g. cranes, front end tipping gears etc.) in order to prevent overstressing the chassis frame. If necessary, additional fixings must be fitted.

When anchoring the body to the frame, no welding may be done on the frame of the vehicle, nor may holes be drilled on the flanges of the frame.

In order to improve the longitudinal or transverse securing of the connection, it is permissible to have holes on the flanges of the side members, but only at the rear end of the members, over a length of not more than 150 mm, provided that the anchorage of any cross members that may be present is not weakened (see Fig. 3.11). Alternatively, use the connection of Figure 3.12.

In all other cases, in addition to the instructions of point 2.5, it is absolutely prohibited to make holes in the flanges.

Body Mounting Characteristics

Flexible joints (see figs 3.8, 3.9 and 3.10) permit limited movement between the frame and the subframe, and permit the use of two parallel working strong sections. Each bears a part of the bending moment in proportion to its moment of inertia.

For the rigid type of joint (see fig. 3.11) between subframe and chassis, a single strong section is obtained, provided that the number and position of the joints are adequate to support the resulting shearing stresses.

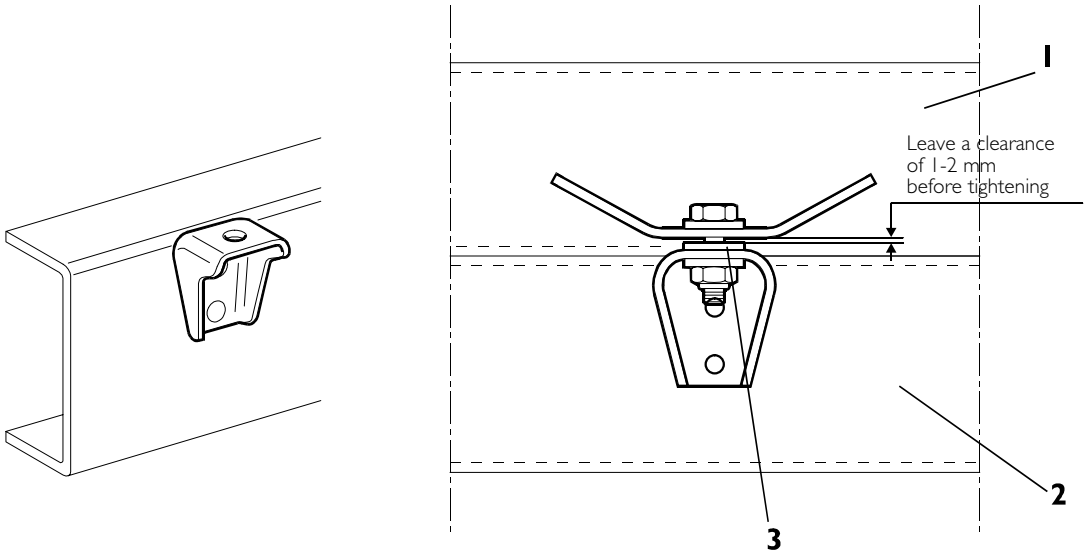
When using sheer resisting plates to secure the subframe to the sidemembers, a single strong section is formed which has a higher strength capacity when compared with the connections made using brackets or clamps. This has the following advantages:

- Lower height of the subframe profile under the same bending moment acting on the section.
- Higher bending moment under the same subframe profile dimensions.
- Further increase in the strength capacity, when the subframe is made up of high mechanical characteristic materials.

3.1.2.1 Connection with Brackets

These are the standard connections on the vehicles (see Fig. 3.8).

Figure 3.8



1 Subframe
2 Frame
3 Shims

In order to ensure a flexible joint there must be a gap of 1-2 mm between the brackets of the frame and those of the subframe before the securing bolts are tightened. Larger gaps are to be reduced by using suitable shims. Using bolts of proportional length improves the flexibility of the connection. The brackets should be fitted on the web of the side members of the vehicle with screws or bolts.

In order to guide and better contain the loads transversally, in transformations where this is necessary, the side guide for the body structure must be secured by other means (e.g., using guide plates connected only to the subframe or only to the vehicle chassis frame, see Fig. 3.10). When the front connection is of the elastic type (see Fig. 3.10), lengthwise securing must be ensured even in the conditions of maximum twisting of the chassis (e.g., off-road).

When the vehicle is already fitted with the brackets for fitting the body envisaged by IVECO, these brackets must be used to secure the structure. The brackets fitted to the subframe or to the body must have characteristics of strength not lower than those of the brackets originally fitted to the vehicle.

Connection with Greater Elasticity

When greater flexibility is required of the mounting (as for vehicles with high stiffness bodies to be used on winding or bumpy roads, special use vehicles, off-road vehicles etc.), a type of fastening as illustrated in fig. 3.9 should be used behind the cab.

Especially with bodies generating high bending and twisting moments (e.g. crane behind the cab), the subframe dimensions should be such to adequately sustain them.

Specifications of the flexible member must be adequate to body stiffness, to wheelbase and to the type of vehicle operation (bumpy road conditions).

When using rubber mountings, materials that give the same characteristic to that of the spring type must be used. Relevant instructions for visual checking and torque setting should be provided.

By way of example, for a van body, it is possible to use anchors with these specifications: M170, hardness 70 Shore and dimensions 45x45x18 mm.

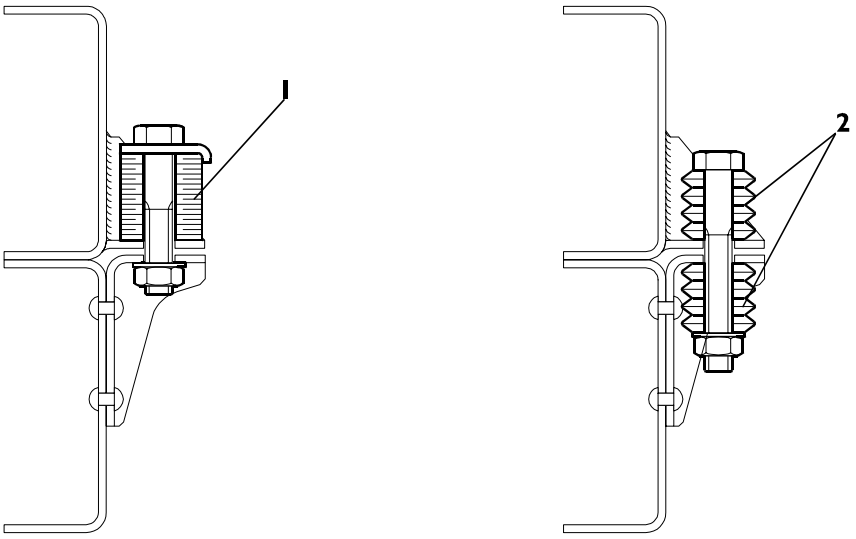
Utilize them on the first pair or on the 2+2 front brackets, with pre-tightening of 800 kg on the first bracket and possibly 1200 kg on the second one, with yielding of 5 and 7 mm respectively.

The whole connection capacity can if necessary be re-established using shearing resistant fastenings in the rear suspension area.

Similar arrangements may be made by using spring washers (Belleville).

In versions including vehicle lifting by means of hydraulic stabilizers (e.g., cranes, lifting platforms), limit flexible movement so as to ensure sufficient co-ordinated movement of the subframe and avoid excessive bending movements on the original chassis.

Figure 3.9



1 Elastic element

2 Elastic elements

3.1.2.2 Connection with U-bolts (clamps)

The most important mounting of this type is illustrated in fig. 3.10.

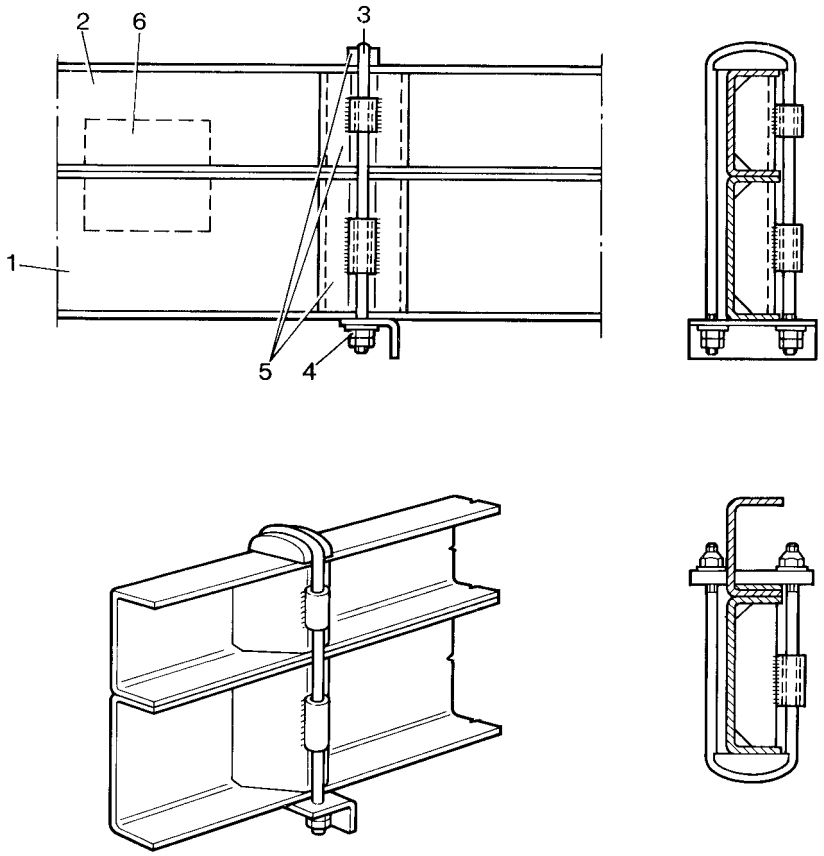
In this type of construction the bodybuilder must place a spacing piece, preferably made of metal, between the flanges of the two side members at the point where the U-bolts are located, in order to prevent the bending of the frames when the U-bolts are tightened.

In order to guide and to better contain transversally the structure that is attached to the vehicle's chassis, this type of joint must be complemented by the addition of plates that are attached to the subframe and chassis as shown in fig. 3.10.

Due to the nature of this type of mounting, its all-round use on the vehicle is not advisable. However, it is necessary - in order to keep the added structure from sliding, and to increase the rigidity - to provide positive attachment towards the rear with cleat plates to secure both longitudinally and transversally.

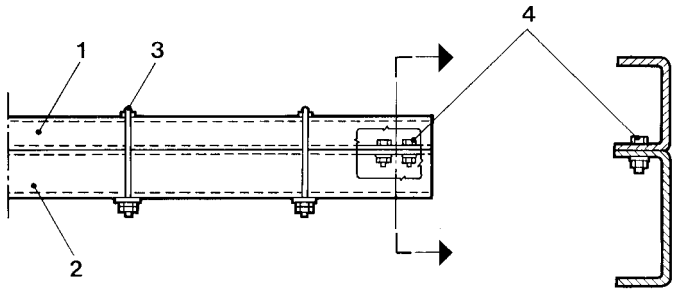
For this purpose it is also possible to use bolt-type connections at the rear end of the chassis as illustrated in fig. 3.11.

Figure 3.10



1 Frame
2 Subframe
3 U-bolts
4 Locking with lock nut
5 Spacers
6 Cleat plate (where necessary)

Figure 3.11



1 Subframe
2 Frame
3 U-bolts
4 Longitudinal transversal securing anchoring.

3.1.2.3 Connection made with Plates for Longitudinal and Transversal Securing Anchorage (Rigid type joint)

This type of anchorage shown in fig. 3.12 is achieved by means of a plate that is welded to the auxiliary frame and is secured to the chassis by means of bolts or rivets. This ensures regeneration following longitudinal and transverse thrust and provides maximum rigidity to the whole.

When this type of joint is used, the following must be observed:

- The plate must only be attached to the vertical web of the main sidemembers.
  Before fixing ensure that the subframe is mounted correctly on the top flange with no gaps between the two mating surfaces.
- Use of cleat plates must be confined to the central and rear sections of the frame.
- The number of plates, thickness and number of securing bolts must be adequate to transmit the section shearing and bending moments.
  These values can be determined accurately by calculating them, when all the necessary elements are available.

We believe them to be useful when the bodies cause high bending and twisting moments on the chassis and its strength has to be increased by means of a shear resistant connection between the chassis frame and subframe, or the subframe height has to be limited as far as possible (e.g., towing central axle trailers, crane on rear overhang, tail lifts, etc.). Observe the instructions given in the following table:

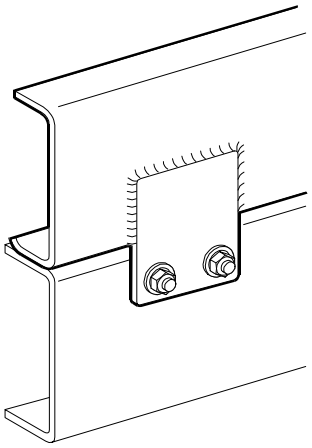
Frame/subframe section height ratio	**Max. distance between the centreline of the shearing resistant plates 1) (mm)**	**Models 3)**	**Min. characteristics of the plates**	
			Thickness (mm)	**Fixing hardware dimensions (at least 3 screws each plate) 2)**
>1,0	700	35C; 40C	4	M 12 (min. 2 screws per plate)
≤1,0	500	45C; 50C	4	M 12 (3 screws per plate)

1) The increase in the number of bolts per plate enables a proportional increase in the distance between the plates (twice the number of bolts enables a greater distance between the plates). In the areas of high stress (e.g., supports of the rear spring, or of the rear air springs) provision must be made to fit the plates as close together as possible.

2) In the case of limited thickness of both the plates and the subframe, the connection should be carried out by means of spacers, so that longer bolts can be used.

3) For the 29L and 35S models, installation of shear resistant plates will need to be assessed for each case.

Figure 3.12



3.1.2.4 Mixed Connection

On the basis of instructions given for the construction of the subframe (point 3.1.1.) and considerations included in the general section of point 3.1.2., the mounting between the vehicle frame and subframe can be of the mixed type, i.e. it may be obtained through a rational use of flexible connections (brackets, clamps) and rigid connections (plates for longitudinal and transversal anchorage).

As a guideline, it is advisable to have flexible connections on the front portion of the subframe (one or two on each side) while plate connections are recommended for the rear portion of the vehicle when a stiffer structure is required for the whole assembly (e.g., tippers, crane on rear overhang, etc.).

3.2 Fitting Box-bodies

On standard cab vehicles, intended exclusively for road use, box- bodies are usually fitted on a support structure comprising longitudinal runners and cross members. The minimum dimensions of the longitudinal runners are specified in table 3.1.

Table 3.1

MODELS	Minimum reinforcing runner	
	Section modulus Wx (cm^3)	Dimensions (mm)
29 L; 35S 1)	16	80x50x4
35C; 40 C; 45C; 50C	16	80x50x4

1) Make the body structure with its base so it can make an adequate torsion contribution to the chassis frame of the vehicle.

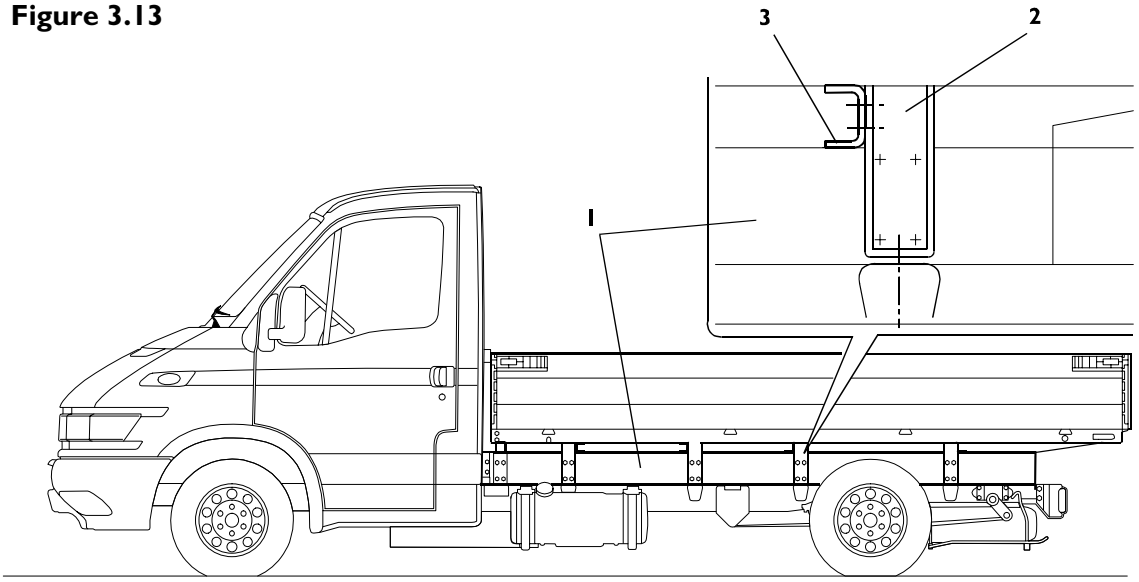
The attachment is carried out using the brackets arranged on the vertical web of the side members. If such brackets have not been provided by the Manufacturer, they must be installed according to the specifications given in point 3.1.2. In order to provide an adequate lengthwise securing when the brackets or clamps are used, it is good common practice to arrange a rigid joint (one on each side) on the rear overhang, using plates or bolts on the upper flange of the side member (see figs. 3.11 and 3.12).

Under no other circumstances may new holes be made in the flanges of the main side members.

In those instances in which the box-body uses supports that are raised above the subframe (such as cross members) it will be necessary to stiffen these supports in an appropriate manner in order to contain the lengthwise thrusts, as shown in fig. 3.13.

The front panel of the bodywork must be strong and sturdy enough to withstand the forces generated by the transported load, when braking sharply.

Figure 3.13



1 Subframe
2 Brackets
3 Securing anchorages

3.3 Building Vans

Dimensions and centres of gravity

Check the masses are correctly divided. In particular, bear in mind the guidelines concerning the height of the centre of gravity given in point 1.2.2, taking suitable precautions to ensure the load has the utmost stability during transport.

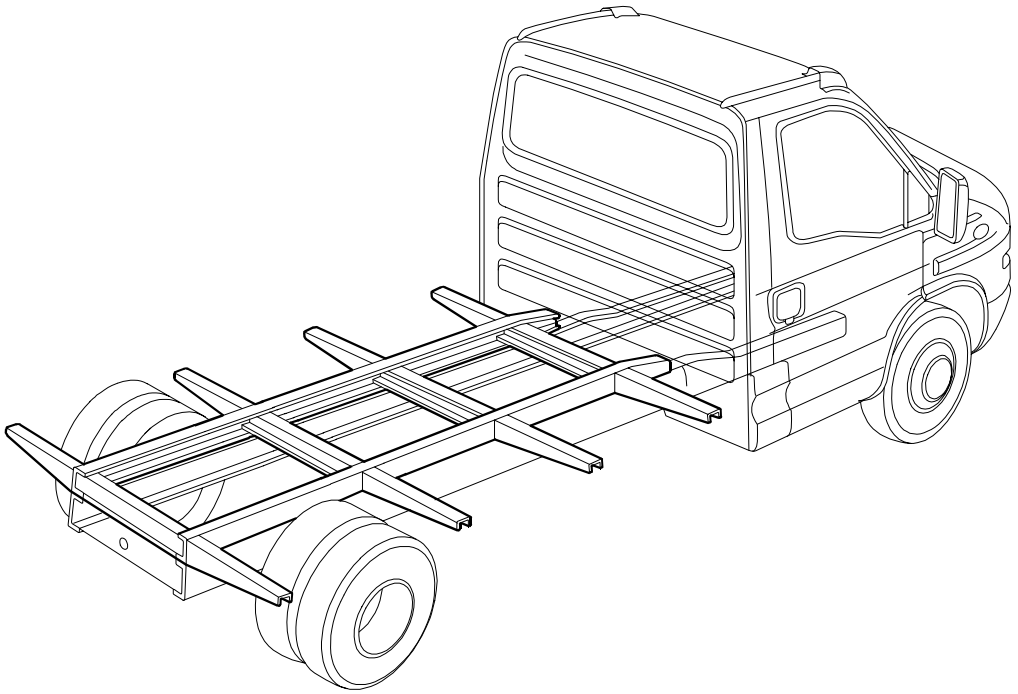
Base structure

For the connection to the vehicle chassis frame, it is possible to make a framework composed of longitudinal and transverse sections. The size of the longitudinal sections may be in the order of the dimensions given in Table 3.1.

Figure 3.14 shows an example where, in order to limit the height of the body, the longitudinal sections are integrated with cross members and brackets along their full length.

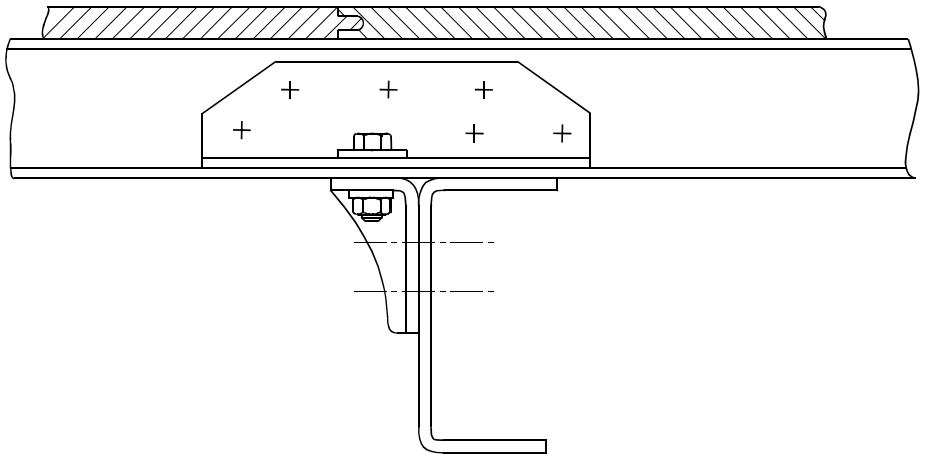
In this case, the rear spare wheel carriers must be inserted in the base of the structure.

Figure 3.14



When, in order to make the floor, cross members have been used at a distance apart of no more than 700 mm and suitably connected to form a sufficiently rigid structure (self-supporting), it may not be essential to use longitudinal sections (see Fig. 3.15).
To ensure the cross members the necessary stability and prevent the vehicle chassis frame stiffening too much towards the front, bear in mind the precautions given in the above paragraph 3.2.

Figure 3.15



Installing bodies, and more generally structures with a high torsion rigidity, requires using flexible connections towards the front of the structure, especially when the vehicle is used off road, to avoid the deformability of the main chassis frame getting reduced too much.

Front wall

It must be strong and sturdy enough to withstand the forces generated by the transported load, when braking sharply.

Vans integrated with the cab

In these cases the connection must be made so as not to transmit any stress to the vehicle's cab.

For the connections and when installing the reinforcement:

- Do no welding on the cab plate, use only mechanical fixing systems.
- The van structure, self-supporting, must need no support from the cab.
- Protect the parts of the cab involved in the transformation against oxidation and corrosion (see point 2.1.3).

3.4 Tipping Bodies

The use of tipping bodies, whether end or three-way, generally subjects the chassis to considerable stress. For this reason it is most important to select the right vehicle from among those intended for this use. Therefore we list here the specifications that must be adhered to for this type of construction. Table 3.2 gives the minimum dimensions of the main sections of the subframe with which these vehicles must be equipped.

Furthermore any government regulations concerning these vehicles must also be abided by.

When IVECO offers more rigid rear suspensions as optional equipment for certain models, their use is highly recommended for these applications.

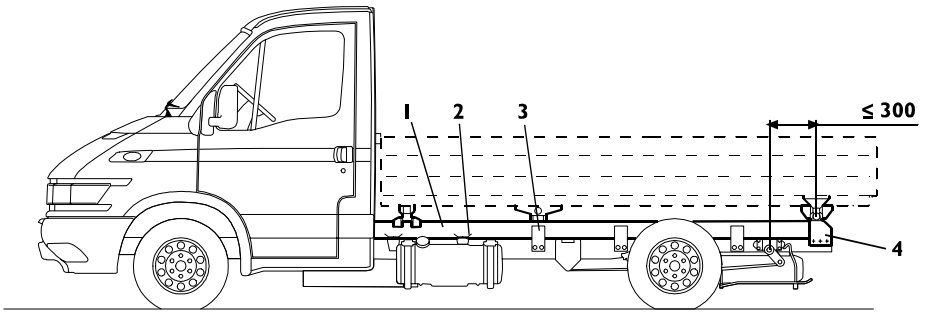
After fitting the body, the bodybuilders must ensure that the vehicle remains stable during tipping.

The following points must be kept in mind:

- The subframe must be suitable for the vehicle type and the specific operating conditions. It must have suitably dimensioned side and cross members and be stiffened at the rear (see Figs. 3.6 and 3.7). To secure it to the chassis, the standard brackets can be used for light-duty service, or replace the brackets at the centre and rear with shear resistant plates for heavy-duty service (see Fig. 3.12). This is to allow the added structure to contribute more to the rigidity of the whole.
- The rear tipping hinge must be mounted on the subframe, as near as possible to the rear support of the rear suspension. In order not to impair the stability of the vehicle during tilting operations and not to increase excessively the stress on the chassis, it is recommended to observe the distances given in Fig. 3.16 between the tipping hinge and the rear spring support. If this is not possible, to limit exceeding these distances as much as possible, it is necessary to use larger subframe sections than the ones normally used, with additional stiffening at the rear. In special cases requiring long bodies for larger volumes, it is advisable to lengthen the wheelbase instead of making longer overhangs.
- Great care must be given to the positioning of the lifting device both in terms of providing supports of adequate strength and in order to position the mountings precisely and conveniently. It is advisable in any case to place the device to the front of the centre of gravity of the body plus payload so as to reduce the extent of the localised load.
- The hinge of the lifting unit must be mounted on the added subframe. The useful volume of the body must conform, considering the maximum permissible mass on the axles, to the density of the material to transport.
  When low-density freight is transported, the useful volume may be increased within the limits established for the maximum height of the centre of gravity of the payload plus the fixtures.

- The bodybuilder must safeguard the functioning and safety of all the parts of the vehicle, in full compliance with current standards (e.g., positioning lights, underrun bar, etc.).

Figure 3.16



1 Subframe
2 Brackets
3 Plates
4 Butt strap

Table 3.2

MODELS	Minimum reinforcing runner	
	Section modulus W(cm^3)	Dimensions (mm)
35 C; 40C	19	80x60x4
45 C; 50C	36	100x60x6

3.5 Installation of Tanks and Containers for Bulk Materials

As a general rule, the installation of tanks and containers on our vehicles requires the use of an appropriate auxiliary frame.

Table 3.3 contains the guidelines for the dimensions of the longitudinal runners to be used for the auxiliary frame.

Table 3.3

MODELS	Minimum reinforcement profile	
	Section Modulus Wx (cm^3)	Dimensions (mm)
35C; 40C	16	80x50x4
45C; 50C	16	80x50x4

Tankers , or more generally, structures which are torsionally very rigid, must be fitted so that the vehicle chassis retains sufficient and gradual torsional flexibility, by avoiding areas of high stress.

When installing a tank we recommend using elastic joints between the body of the tank and the auxiliary frame in front and rigid supports that are capable of withstanding longitudinal and transverse forces in the rear.

As was mentioned in the case of other applications, the positioning of the mountings through which the forces are discharged is similar here. The rigid mounts go in a position corresponding to the rear suspension supports and the flexible mounts as near as possible to the rear support of the front suspension.

In order to define the elastic connection, the rigidity characteristics of the vehicle chassis as well as the area where the connections are to be installed and the type of use for which it is intended must be taken into account.

As a rule, for road use, it can be said that the first front elastic connection will allow for a gap of a few millimetres between the subframe and chassis frame during the chassis torsional stage.

Tanks may be mounted directly onto the vehicle chassis without fitting an auxiliary frame under the following conditions:

- The distance between saddles must be determined depending on the load to be discharged. In any case it must not exceed 80 cm.
- Saddles must be fitted so as to allow an even distribution of the loads over a considerably large surface. Suitable brackets must be provided between the saddles to limit the longitudinal and transverse thrusts.
- Other anchoring solutions will have to be authorised by the Manufacturer.
- Self-bearing tanks may be positioned directly on the chassis by means of suitable mountings located right behind the cab and in the rear axle area. Their number and distribution depend on the wheelbase: min. 2 for each side on vehicles with a short wheelbase.
  The anchoring devices must be sufficiently long (400 mm approx.) and be positioned next to the suspension mountings.
  To permit the necessary torsional movements of the chassis, elastic front anchorings should be employed where possible.
  Other solutions are possible depending on the type of construction.

The installation of two or more separate containers or tanks on the vehicle requires the use of an auxiliary frame that permits good distribution of the load and an adequate torsional rigidity for the chassis/subframe using connections resistant to shearing. A good solution is constituted by using a rigid connection which connects the containers together.

In order to adhere to the maximum admissible load limits on the axles, it is necessary to establish the maximum volume, the degree of filling of the container and the density of the freight. When separate tanks or individual containers with separate compartments are used, care must be taken to ensure that with every degree of filling the maximum permissible load on the axles is respected as well as the minimum ratio between the mass of the front axle and fully loaded vehicle mass (see point 1.2.1 and 1.2.3).

In consideration of the nature of this equipment, special attention must be paid to limiting the height of the centre of gravity as much as possible so as to ensure good handling (see point 1.2.2); we recommend the use of vehicles with stabilising bars.

It is necessary to provide special transverse and longitudinal bulkheads inside the tanks and containers for liquids in order to reduce the dynamic loads which the liquid transmits when the vehicle is in motion and the tanks are not filled to capacity which would adversely affect the handling and resistance of the vehicle.

Concerning the installation of containers for fuel or flammable liquids, all current government safety regulations must be abided by (see point 2.16).

3.6 Installation of Cranes

The selection of the crane must be made with due consideration to its characteristics (mass, maximum torque) in relation to the performance of the vehicle.

The positioning of the crane and of the payload must be done within the load limits permitted for the vehicle. Installation of the crane must be carried out in compliance with statutory requirements, national standards (e.g. CUNA, DIN) and international standards (e.g.ISO, CEN), depending on which of these is pertinent to the particular vehicle.

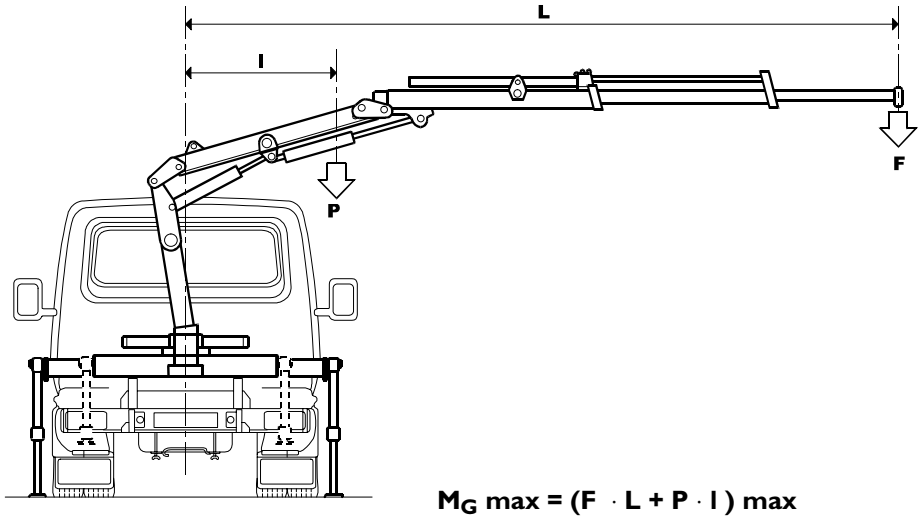
While the crane is operating, the stabilisers (hydraulic if possible) must be used and be in contact with the ground. As a general rule, the installation of a crane requires the use of a suitable subframe, whose construction must take into account all general specifications relating to it (point 3.1). Concerning the dimensions of the runners for the subframe, refer to tables 3.3, 3.4 and 3.5.

In those cases where no specific subframe is called for, it is still necessary to provide a suitable mounting on the chassis for the crane (section members with length at least 2.5 times the width of the base structure of the crane) in order to distribute the load and the stress developed when the crane is working.

If the vehicle (e.g. tipper) requires the use of its own subframe, it may also be used for the crane provided that its dimensions are adequate.

Special cases, whose M_G values fall within the areas designated with the letter "E" (or for higher values) must be checked individually each time.

Figure 3.17



$$M_G \text{ max} = (F \cdot L + P \cdot l) \text{ max}$$

The dimensions of the subframe refer to the total maximum static moment of the crane (M_G max.) which is calculated on the basis of the equation given in fig. 3.17.

The decision concerning the number of stabilisers and the type of subframe to be used, particularly in terms of torsional rigidity (box- type sections, cross members etc.) is determined by the maximum moment of the crane and its position for which the Manufacturer of the crane and installer are responsible.

The verification of the stability of the vehicle when the crane is operating must be done in compliance with the applicable government regulations.

3.6.1 Crane Behind the Driver's Cab

The mounting of the subframe onto the chassis frame will, as a rule, be performed by using the standard brackets (see fig. 3.18) to which are added, if necessary, other flexible anchorages (brackets or clamps) so that the flexibility and torsional characteristics of the chassis frame remain unchanged.

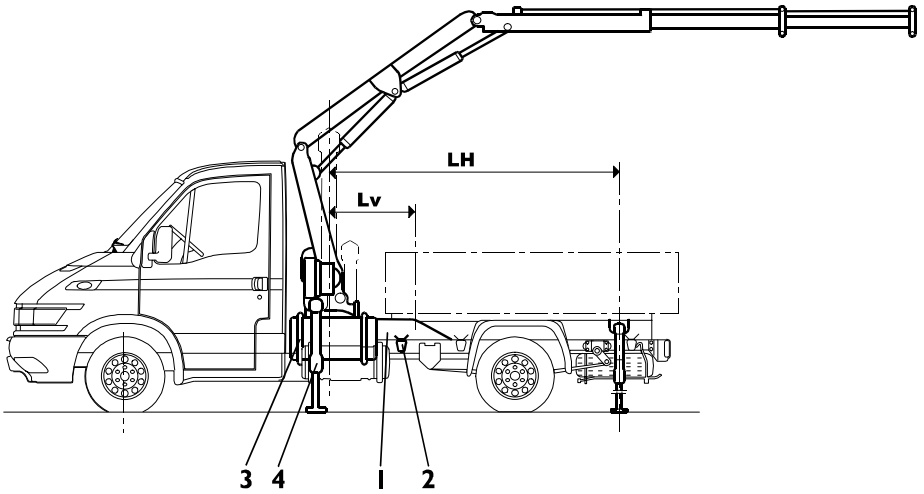
The dimensions and the subframe to be used for this type of installation are specified in table 3.3.

For on-road vehicles only, if the height of the subframe runner profile has to be reduced (e.g. to lower the total height of the vehicle) the mounting of the subframe may be carried out with shear resisting connections. For these applications, the minimum dimensions of the reinforcing runner are specified in Table 3.4.

The use of runners with a constant cross-section is recommended over the entire useful length of the vehicle. It is possible to decrease the cross-section of the runners (gradually) in areas where the bending moment induced by the crane is such as to permit a smaller runner.

The subframe for the crane, as shown in Fig. 3.18, may be integrated towards the rear with the subframe fitted for another body. The length "Lv" must in any case be no less than 35% of the wheelbase when the body runner has a smaller cross-section.

Figure 3.18



1 Subframe
2 Connections
3 Crane joints
4 Stabilisers

When installing cranes on crew cab vehicles (e.g., 6+1), extend the subframe appropriately under the cab (see Fig. 3.2), otherwise it may be necessary to limit crane rotation, depending on its capacity, so as not to exceed the bending moment allowance for the chassis.

Installation of cranes on off-road vehicles may require fitting elastic mountings between the chassis frame and subframe on the front and central areas (see fig. 3.11) so as not to excessively constrain the chassis torsional movement. Since in such cases the crane will be virtually connected to the subframe only, the size of the longitudinal runners must be adequate to resist the crane operation-generated movements.

The functioning of the equipment located behind the cab (e.g., fuel tank) must not be impaired. Relocating this equipment is permitted provided that the original type of connection is re-established.

The option of the fuel filling-pipe on the cab rear upright may be particularly useful in these cases (see point 2.15).

Normally, when the crane is placed behind the cab, it is necessary to move the platform body or equipment to the rear. In the specific case of tipping equipment, particular care must be given to the placement of the lifting device and of the rear tipping hinges which should be moved back as little as possible (see point 3.4).

Table 3.3
Cranes mounted behind the driver's cab
(subframe mounted with brackets or clamps)

MODELS		Crane capacity M_G max (kNm)						
(Chassis frame section in mm)	Yield point of subframe material (N/mm^2)	-20	20-30	30-40	40-50	50-60	60-70	70-80
		Minimum value of subframe Section Modulus Wx (cm^3)[1)]						
29 L; 35 S (180x70x3)	-	E						
35 C; 40 C (182x70x4)	360	21	36	57	89	E		
50 C (182x70x4)	360	21	36	57	89	105	E	

Table 3.4
Cranes mounted behind the driver's cab
(subframe mounting with shear resistant plates)

MODELS		Crane capacity M_G max (kNm)						
(Chassis frame section in mm)	Yield point of subframe material (N/mm^2)	-20	20-30	30-40	40-50	50-60	60-70	70-80
		Minimum value of subframe Section Modulus Wx (cm^3)[1)]						
35 C; 40 C (182x70x4)	360	19	21	31	57	E		
50 C (182x70x4)	360	19	21	31	57	89	E	

Table for selection of runner profiles (see Tables 3.3 and 3.4)

Section Modulus for each section Wx (cm^3)	Recommended section (or other with equal inertia and resistance moment) (mm) (channel profile C)	Section Modulus for each section Wx (cm^3)	Recommended section (or other with equal inertia and resistance moment) (mm) (channel profile b or C)
19	80x50x5	89	160x70x7
21	80x60x5	105	180x70x7
26	100x50x5		
31	100x60x5		
36	100x60x6		
46	120x60x6		
57	140x60x6		

Note:

Close the reinforcing runner in the crane mounting area.
E = To be checked from case to case (submit the technical documentation with the calculation made to determine stress and stability).
1) When the auxiliary frame requires a high moment of resistance the latter shall be established also for the crane.

3.6.2 Crane on Rear Overhang

It is advisable for this type of application to extend the subframe over the entire length of the vehicle that is available for the body up to the area behind the cab. The dimensions of the longitudinal runners to be used are given in Table 3.5.

In consideration of the particular distribution of the mass on the vehicle, wherein the load is concentrated on the rear overhang, and in order to ensure the rigidity that is necessary for good performance on the road and when the crane is in operation, the subframe must be strengthened and stiffened in relation to the capacity of the crane. Box-type construction sections (see point 3.1.1.) and brackets are to be employed in the area corresponding to the rear suspension and the rear overhang (Length Lv as per fig. 3.19). Care must also be taken to ensure that the transition from box-type to open section be well blended as illustrated in fig. 3.3.

In the area that is affected by the box-type section, the frame must be secured to the chassis of the vehicle by means of shear-resistant joints (i.e. an adequate number of plates spaced at most 400 mm from each other), whereas elastic anchorages are to be used in the front part. Due care must be taken to ensure that under any load conditions, the ratio of the mass on the front axle to the rear axle or axles, respects the limits set for the vehicle (see point 1.2.3).

As the required stiffness of the subframe depends on various factors (i.e. crane capacity, size of its supporting base, vehicle tare, chassis overhang) we cannot give information valid for all possible different conditions. For this reason the bodybuilder will have to assess the vehicle stability also by means of practical behavioural tests. If, as a consequence of such tests , the subframe stiffness proves insufficient, the bodybuilder will have to achieve this objective by means of alternative methods.

The rear overhang of the crane (length Lu, see fig 3.19) must be limited as much as possible in order to preserve the good driving characteristics of the vehicle and acceptable stress conditions. This value must not exceed 40% of the wheelbase.

Table 3.5
Cranes mounted on rear overhang
(subframe mounting with shear resistant plates)

MODELS		Crane capacity M_G max (kNm)						
(Chassis frame section in mm)	Yield point of subframe material (N/mm^2)	-20	20-30	30-40	40-50	50-60	60-70	70-80
		Minimum value of subframe Section Modulus Wx (cm^3)[1)]						
35 C; 40 C (122x70x4)	360	32	57	71	E			
50 C (122x70x4)	360	32	57	71	110	E		

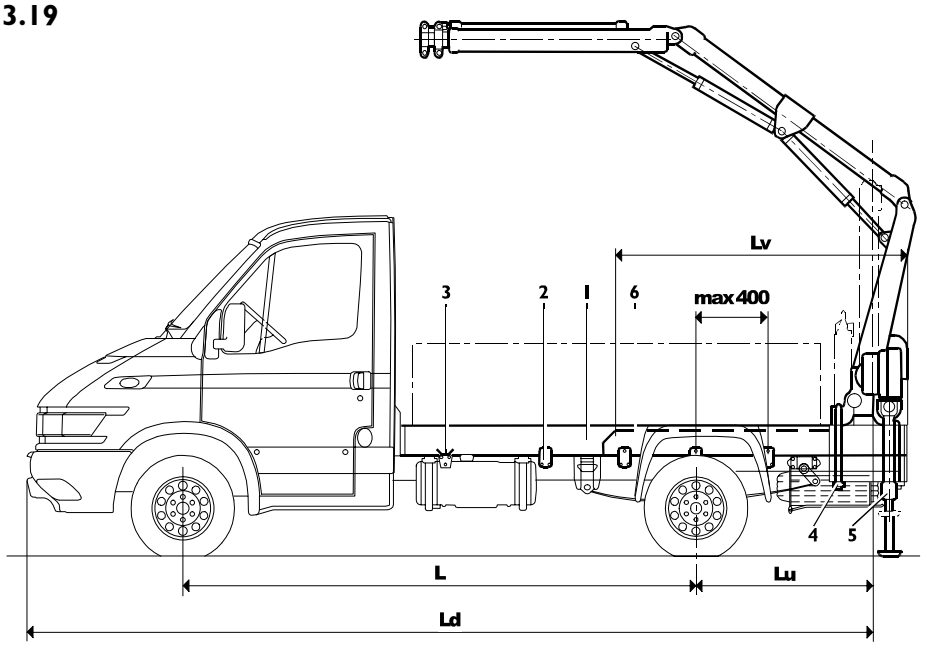
Table for selection of runner profiles (see Table 3.5)

Section Modulus for each section Wx (cm^3)	Recommended section (or other with equal inertia and resistance moment) (mm) (channel profile)	Section Modulus for each section Wx (cm^3)	Recommended section (or other with equal inertia and resistance moment) (mm) (channel profile)
23	80x50x5	110	160x70x7
32	100x50x5		
42	100x60x6		
57	120x60x6		
71	140x60x6		

Notes:

E = To be checked from case to case (submit the technical documentation with the calculation made to determine stress and stability).

Figure 3.19



1 Subframe
2 Plates
3 Brackets
4 Crane joints
5 Stabilisers
6 Connecting angle bar (alternative solution)

3.7 Installation of Tail Lifts

The dimensions of the reinforcing runners to be used when installing tail lifts can be assessed as follows:

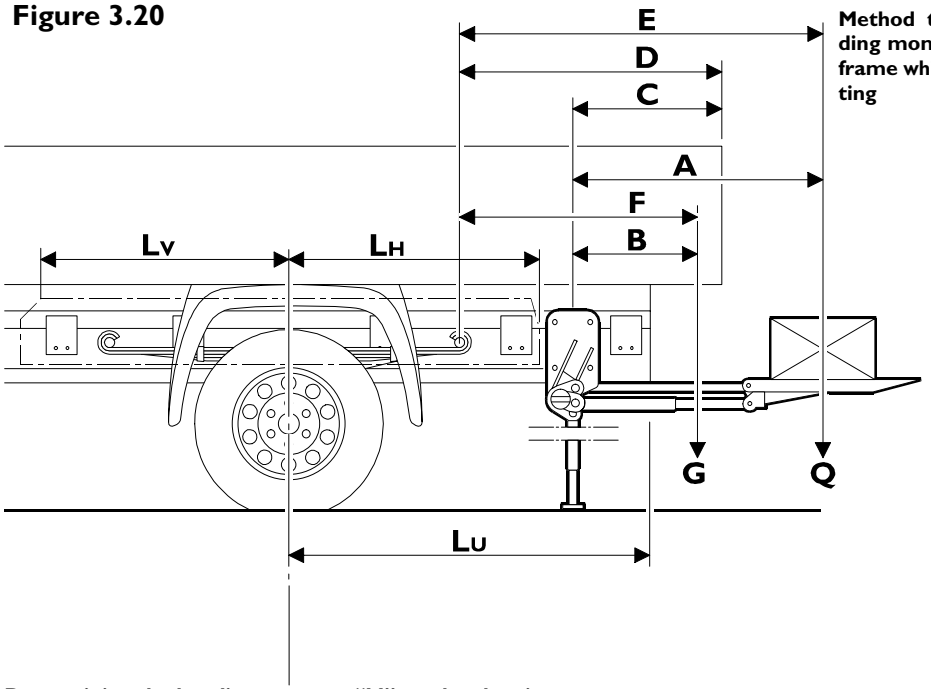
- By means of Table 3.6, with the standard rear overhangs and mean bending moments induced by tail lifts; depending on their capacity . In the table, the minimum capacity values are specified above which suitable stabilisers must be used.
- With different lengths of the rear overhang and with special tail lifts (e.g., of aluminium), the bending moments induced on the chassis frame can be defined with the information in Figure 3.20.

The bodybuilder or the manufacturer of the tail lift will take care to ascertain operational stability and safety.

In any event, particularly in those specific uses where there is no suitable auxiliary frame (as in the case with bodies for vans or box- type bodies built by means of cross members), the anchoring for the loading platform must be provided by a structure that enables the stress to be distributed over the chassis of the vehicle.

In addition, to provide the necessary strength and rigidity, the connection between the chassis and the subframe must be made, especially in overhangs of over 1200 mm, with shear resistant plates (no more than 400 mm apart) in the area of the rear overhang, as far as the front support of the rear suspension (see Fig. 3.20).

Figure 3.20



Method to assess the bending moment on the chassis frame while a tail lift is operating

Determining the bending moment "M" on the chassis

a. Tail lift stabiliser M = Q . A + G . B

b. Tail lift without stabiliser M = Q . E + G . F

E = D - C + A
F = D - C + B

Note:
"A, B, G e Q" : According to the data given by the Manufacturer of the tail lift.
"C" : Must be defined by the Bodybuilder taking into account the dimensions of the type of subframe and tail lift used
"D" : Depending on the type of subframe used.

The bodybuilder must consider each time the necessity of using stabilisers even in those cases where merely in terms of stress of the chassis their use may not appear to be necessary. When evaluating the need for stabilisers in relation to the capacity of the platform, the stability and attitude of the vehicle resulting from the deflection of the suspension during loading operations must also be considered.

The stabilisers that must be attached to the platform's supporting structure should preferably be hydraulically operated and must be employed during all loading procedures with the platform.

The stability of the vehicle must be verified in observance of government regulations in all operating phases of the platform.

To compensate for the elastic give of the chassis, which is inevitable when the tail lift is in operation, the bodybuilder may make use of reinforcement runner profiles of larger size in comparison to the one indicated in table 3.6.

The dimensions of the sections shown in Tab. 3.6 hold for standard rear overhangs. For longer overhangs you need to check whether it is necessary to fit larger sections or stabilizers (see Fig. 3.20).

The installation of tail lifts must be carried out with due regard for the maximum permissible weights on the rear axle or axles and of the minimum load established for the front axle (see point 1.2.3); if this should not be the case, the rear overhang will have to be reduced.

When electro-hydraulic tail lifts are installed, it is necessary to check that the capacity of the batteries and of the alternator is adequate (see point 2.14).

The bodybuilder will be responsible for any modification to the rear underrun guard or for installing a different type (see point 2.18) for preserving the visibility of the rear lights, for the overhang angles, and for the positioning of the tow hook as provided by the respective national ordinances.

Table 3.6
Installation of tail lifts (truck version)

MODELS		Tail lift capacity kN (kg)									
	Wheel-base (mm)	3 (300)		5 (500)		7,5 (750)		10 (1000)		12,5 (1250)		15 (1500)	
		Minimum value of subframe Section Modulus Wx (cm^3) as a function of the yield point of the material (N/mm^2)									
		240	360	240	360	240	360	240	360	240	360	240	360
29 L/35 S	-	E											
35C/40C 45C/50C	3000 ÷ 3450	16		21		26 + S		31 + S		E			
35C/40C 45C/50C	3750 ÷ 4100	21		21 + S		26 + S		31 + S		E			
45C/50C	4350 ÷ 4750	26		26 + S		31 + S		36 + S		E			

Table for selection of runner profiles (see Table 3.6)

Section Modulus for each section Wx (cm^3)	Recommended section (or other with equal inertia and resistance moment) (mm) (channel profile C)	Section Modulus for each section Wx (cm^3)	Recommended section (or other with equal inertia and resistance moment) (mm) (channel profile C)
16	80x50x4	46	120x60x6
19	80x50x5		
21	80x60x5		
31	100x60x5		
36	100x60x6		

Notes:
E = To be checked from case to case (submit the technical documentation with the calculation made to determine stress and stability).
S = Stabilizers must be installed.
On van versions it is possible to install lifts with a capacity of up to 3kN (300 kg), fitting local reinforcement on the chassis frame. For higher capacities, each case needs to be examined on its own.

3.8 Tractor for semi-trailers

No specific bodies for towing semi-trailers are made in our works.

However, it is possible to make the transformation, using the chassis-cab vehicle, with a specific authorization issued by IVECO.

This authorization will give the instructions the bodybuilder needs to follow, the permitted masses and operating requirements.

Here we give some guidelines of a general nature.

Fifth wheel mounting

The purpose of installing a suitable structure such as a subframe (see Fig. 3.21) is not only to distribute the load bearing on the fifth wheel, but also to ensure the chassis receives appropriate support for torsion and bending. Table 3.7 gives the minimum dimensions to use for the longitudinal reinforcing sections.

In addition, bear the following in mind for its construction:

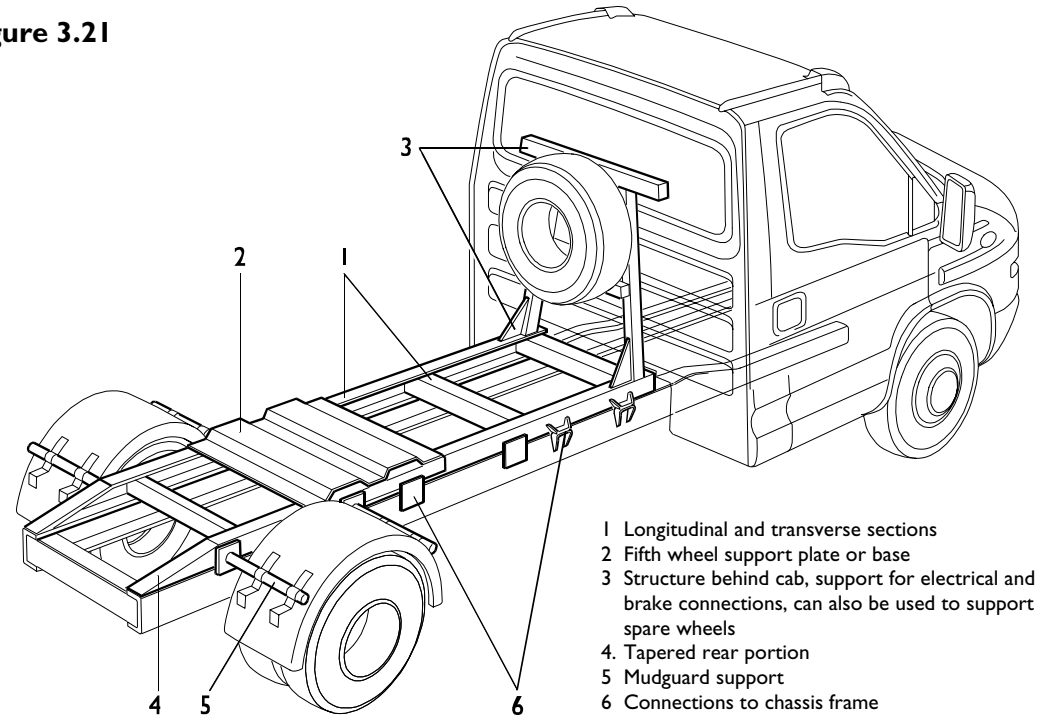
- The structure must be adequately dimensioned to handle the vertical and horizontal loads transmitted to it by the fifth wheel.
- Concerning the properties of the material of the structure, refer to point 3.1.1.
- The upper and lower surfaces of the structure must be even to ensure a good bearing on the chassis of the vehicle and of the base of the fifth wheel.
- The component parts of the structure, in those cases when it consists of several parts, must be joined to one another by welding and/or rivets so as to form a single unit.
- The anchoring of the structure to the tractor must be made with shear resistant plates in the central area and at the rear of the chassis and with brackets at the front.

For the joining, class 8.8 bolts (in sufficient number and diameter to withstand the longitudinal and transverse forces) must be used together with device to preclude their coming loose.

Table 3.7

MODELS	Wheelbase (mm)	Minimum reinforcement section	
		Section modulus Wx (cm^3)	Dimensions (mm)[7)]
35 C	3450	24	100x50x4
50 C / 35	3450	24	100x50x4

Figure 3.21



1 Longitudinal and transverse sections
2 Fifth wheel support plate or base
3 Structure behind cab, support for electrical and brake connections, can also be used to support spare wheels
4. Tapered rear portion
5 Mudguard support
6 Connections to chassis frame

Fifth wheel and its positioning

All fifth wheels with loading capacity, dimensions and performance, declared suitable by their respective manufacturers for the specific use, may be utilized on our vehicles.

In compliance with national and/or international standards, fifth wheels must comply with the requirements of the law and by type approved. For fixing them to the supporting structure, the number and size of bolts, and the position of longitudinal and transverse clamps, follow the fifth wheel manufacturer's instructions.
As the fifth wheel is an important part for the safety of the vehicle, it must not undergo any modification.

Brake system

The bodybuilder will need to make the specific system for braking the semi-trailer.

Because of the importance the braking system has for the active safety of the vehicle, it must be extremely well designed and made.

Components, pipes and fittings must be used of the same type as the ones utilized on the original vehicle.

The performance of the brake system (service, emergency and parking) must meet national standards or comply with relevant EC Directives, in accordance with the total weights made (e.g., class 02 or 03), in terms of deceleration, behaviour when hot, response times, etc.

It is also necessary to prepare the documentation on compatibility and road-holding curves (unless provided for otherwise).

IVECO, on request, can provide the technical documentation giving the specifications of the system and braking capacity of the original vehicle.

The manufacturers who equip the original components of the vehicles can supply air compressors with suitable capacities for braking the semi-trailer. To install them on the vehicle's engine, use the fixing screws of the auxiliary member supports on the right-hand side. The driving pulley, installed at the front of the crankshaft, must observe the guidelines given in Table 4.2.

Electrical system

Make the electrical system in compliance with the general requirements given in point 2.14.

Combining tractor and semi-trailer

Semi-trailers must not have such construction features (e.g., chassis frames too flexible, braking capacity not adequate, etc.) as to have a negative effect on the behaviour of the articulated truck on the road. In combining the tractor and semi-trailer, it is necessary to check all the relative movements, in the various operating conditions, ensuring the necessary margins of safety, in compliance with the requirements of the law and the highway code.

3.9 Road assistance vehicles

Installing breakdown equipment is generally done after choosing a specific subframe to ensure even load distribution and correct connections with the chassis of the component parts and assemblies to handle the vehicle to be picked up.

If the vehicle that has broken down is lifted and towed, observe the towing masses, vertical loads at the hook and the minimum ratio between the masses on the front and rear axle defined in the specific authorizations issued by IVECO.

The bodybuilders must use special plates/stickers to indicate the specific conditions for which transport is authorized (towing mass, load at hook, maximum speed, etc.).

3.10 Vehicles for Municipal, Fire-fighting and Special Services

Preparing municipal vehicles such as compactors, compressors or road sprinklers in many cases requires:

- Building a subframe which is particularly strong at the rear or elastic mountings at the front of the vehicle.
- Shortening the rear overhang of the chassis. When very short overhangs are required, the chassis may be shortened immediately behind the rear spring support (or after the anti-roll bar connection in the case of pneumatic suspension), keeping the cross member connection to the chassis intact.
- Placing the engine exhaust in a vertical position, behind the cab.
- Using rear suspensions that are more rigid or made with asymmetrical springs.
- Rearranging the rear lights.

3.11 Installation of Snow-removal Equipment on Front of Vehicle

The installation of snow removal equipment on the front of the vehicle, such as blades or plows, requires the use of suitable supporting structures and entails observance of the specifications contained in point 2.2.1 concerning the connection to the chassis.

Furthermore, all government requirements and regulations governing the application of this type of equipment must be observed.

Operation and possibility to use the original components located at vehicle front (e.g. towing hook, footboard to clean windscreen) must be safeguarded. Otherwise the company carrying out the modification must fit equivalent systems in compliance with the safety regulations and norms.

For most of our vehicles - if used for snow removal purposes at maximum speeds of 62 kph - an increase of the maximum permissible weight of the axle may be granted upon request.

The Manufacturer that carries out the installation must document and guarantee the observance of the requested new weight limit.

3.12 Winch Installation

The winch installation on the vehicle should be positioned on one of the following points:

- On frame front end (front installation)
- On vehicle frame, behind the cab
- Between vehicle frame side members, centred or displaced on one side.
- On the frame rear end.

The installation should be performed so as not to interfere with operation of units and components of the vehicle, with respect to max. load limits allowed on axles and following the company directions. Fixing of the winch unit and the relevant drive components should conform to directions reported at point 2.2.1 ensuring that the reinforced areas are not locally limited to the mounting area (see point 2.15) taking into consideration also the rope operations and in particular, its transverse component when the pulling action is running obliquely.

For the installation of the winch behind the cab a proper subframe will be designed to have dimensions and structure (stiffening cross member and braces) conforming to winch capacity.

The company has various winch installations available for some models. When specific requests are made for commercially available types of winch, we suggest choosing those equipped with hydraulic systems that can be operated through the hydraulic pumps already used for equipment previously installed on the vehicle (tiltable cargo body, crane etc.). Should mechanical winches be mounted, the drive transmission will conform to the indications given at points 4.1 and 4.2. For worm screw type winches, the power take-off system arrangement should take into account the low performance of such a drive system.

Electrical winches should be used for low power requirements and for short periods of use because of the limited capacities of battery and alternator. Follow strictly the safety rules, if any.

3.13 Special transformations

When making the special transformations indicated below, it is necessary to follow the general criteria described above.

As stated in paragraph 1.4, the vehicles manufactured at our works meet the requirements of current standards. The bodybuilders will need to observe and ensure compliance with the precautions of the law for the work carried out, especially as regards bodies for transporting people.

Chassis cowls

They are prepared specifically for installing special bodies such as retail outlet vans, motor homes, etc.

Observe the guidelines and precautions given in the technical literature (chassis diagram) that IVECO provides.

Motor homes

In particular, it will be necessary to ensure the limits on the masses on the single axles and on the total mass are observed, bearing in mind the number of persons and a sufficient margin for the load that can be transported, such as:

- luggage, curtains, sports equipment;
- water tank capacity, toilet facilities;
- gas bottles, etc.

Make sure the payload can be located in the specific compartments with the necessary margins, providing suitable guidelines for users so loading will be done correctly.

For any work on the chassis frame (e.g., changing the rear overhang), see the instructions given in point 2.4.

Special attention must be paid when making compartments for installing gas bottles, which must be done in compliance with current regulations, taking all the necessary safety precautions.

4. POWER TAKE-OFFS

Index

4.1 General Specifications

For the control of the auxiliary groups like tippers, cranes, compressors, municipal vehicles etc. various types of power take-off can be used to supply the necessary drive. Depending on the type of use and the performance level required, the application may be applied to:

- the gearbox
- transmission
- the front of the engine

The characteristics and performances are given in the paragraphs which follow and in the relevant documentation which will be supplied upon request.

For the definition of the power necessary for the apparatus to be controlled, particularly when the values requested are high, the absorbed power should also be considered during the drive transmission phase (5-10% for the mechanical transmissions, belts and gears, and greater values for the hydraulic controls).

The choice of transmission ratio for the power take-off should be made so that the absorption of power occurs in a flexible engine operating range: low r.p.m. (below 1,000 r .p.m.) must be avoided to prevent irregular running .

The power taken in relation to the number of revolutions of the power take-off at the required torque =

$$P(CV) = \frac{M \cdot n}{7023} \qquad P(kW) = \frac{M \cdot n}{9550}$$

P = Useable power
M = Torque permitted for the power take-off (Nm)
n = power take-off r.p.m.

Type of use

Both occasional and continuous use should be considered.

For occasional use periods of under 30 minutes are considered.

The values for continuous use are those used for long periods. Whenever this is comparable to that of a stationary engine, the suitability of reducing the scheduled values on the basis of the conditions of use (engine cooling, gearbox etc.) should be evaluated.

The scheduled take-off values are also applicable for uses which do not involve large variations of torque either in frequency or magnitude.

To avoid overloading, in some cases (e.g. hydraulic pumps, compressors) it may be necessary to include the application of devices like clutches or safety valves.

Transmissions

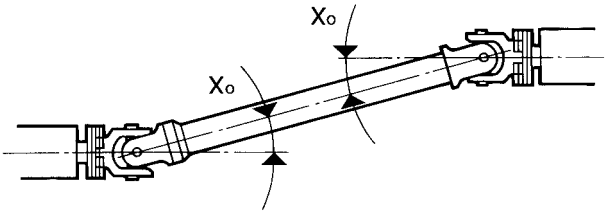
The kinematic forces of the transmission from the power take-off to the relevant apparatus should be carefully considered (angles, r.p.m., moment) during the design phase and the dynamic behaviour during operation in compliance with the transmission Manufacturer's instructions should be respected. The dimensions should take into consideration the forces which might occur under maximum power and torque conditions.

To obtain a uniformity of kinetic forces angles of equal value, maximum of 7°, should be obtained at the extremities (Fig. 4.1) . Solution Z is preferred to solution W due to the lower loads on the bearings of the power take-off and the equipment being driven. When it is necessary to obtain different spatial inclinations (φ), the variations in r.p.m. should be compensated for with the arrangement of the forks shown in Fig. 4.2.

For transmissions employing multiple sections, the instructions given at point 2.3.2 should be followed.

Figure 4.1

Solution Z



Solution W

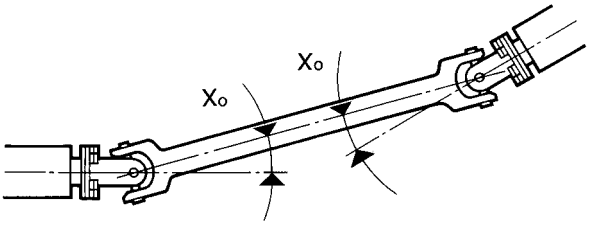
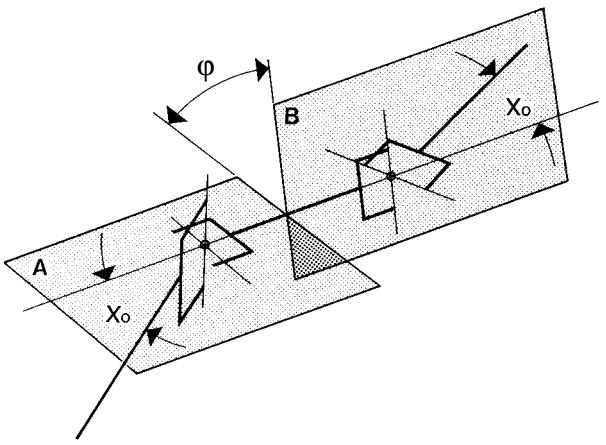


Figure 4.2



4.2 Power Take-off from Gearbox

4.2.1 General Specifications

Depending on the type of gearbox, power can be taken from the layshaft through the flanges or splining located on the rear, side or lower part of the gearbox.

The technical characteristics necessary are given in the documentation supplied upon request for the various gearboxes.

The types of power take-off and the torque values obtained with the ratio between the number of output revolutions and engine r.p.m. are shown in Table 4.1.

The values refer to the conditions indicated in the table.

Higher values for occasional use must be agreed upon as each occasion arises depending on the type of use.

Check the vehicle to ascertain whether it is possible to fit a power take-off suitable to its size.

The power take-off applied to the gearbox must only be used when the vehicle is stationary and engaged and disengaged when the clutch is disengaged to avoid excessive stress on the synchronizers during gear change. Consequently, when the power-take off is, exceptionally, used with the vehicle in motion, the gear must not be changed.

Direct Application of Pumps

When the application of pumps or other equipment (e.g., to control tipping equipment or cranes) is carried out directly from the power take-off, without the use of intermediate shafts and after checking that the size of the pump permits margins of safety with chassis and engine unit (cross members, propeller shaft, etc.), the static and dynamic torques exerted by the mass of the pump and by the power take-off should be checked for compatibility with the resistance of the walls of the gearbox. The moment due to the additional masses must be no greater than 23 Nm.

In cases where the gearbox is applied in a single unit with the engine, the value of the additional masses must be verified with regard to the inertial effects so as to avoid the induction of resonance conditions in the engine unit within the field of operational engine r.p.m.

Warning

- When employing power take-offs the torque values established in Table 4.1 should be respected.
- For extended use the temperature of the gearbox oil should be checked. The oil temperature should not exceed 120°C and the temperature of the water should not exceed 100°C.
- When in use the specifications (working periods, pauses etc.) specific to the power take-off in question should be respected.

Table 4.1

Gearbox power take-off data

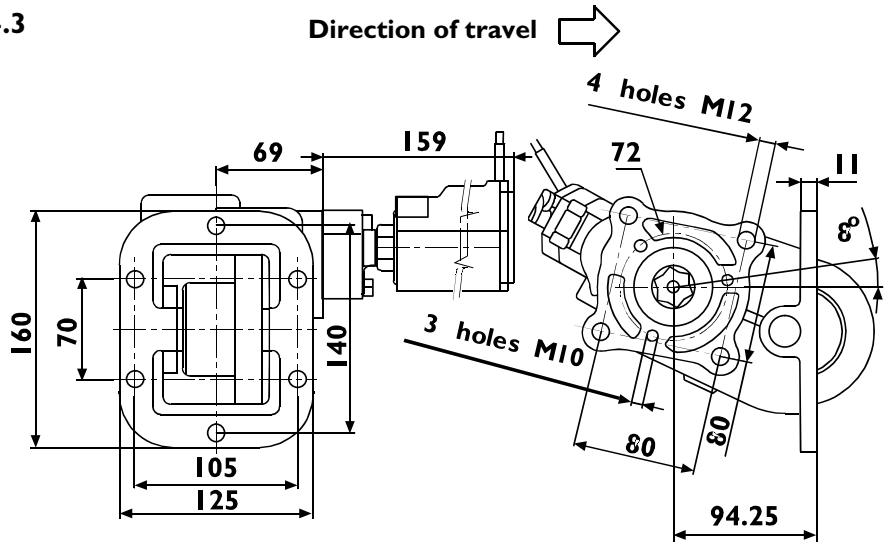
ZF Gearboxes

GEARBOX					POWER TAKE-OFF [2]			
Type	**Drive take-off side[1]**	**Transmission ratio** $i = \frac{\text{output rpm}}{\text{engine rpm}}$	**Flange type**	**Max. torque available in continuous operation Nm**	**Type**	**Transmission ratio** $i = \frac{\text{PTO output rpm}}{\text{engine rpm}}$	**Max. torque available in continuous operation Nm**	**Direction of rotation.[3]**
5 S 200	S	0,684	SAE6	175	20Z1	1	120	D
6 S 300	S	0,541	SAE6	303	20Z2	0,91	180	D

1) PTO position: S = left.
2) The types are by Hydrocar: request the documentation for the specific bodies. The max. torque available refers to a speed of 1500 r.p.m. at the output of the PTO (min. 800 r.p.m.): for higher speeds (max. 3000 r.p.m.), decrease the available torque in proportion.
3) Looking at the PTO output: D = right (opposite to engine).

4.2.2 Vehicles with Hydrocar PTO type 20Z1 and Z2 (IVECO options no. 6364 and 6365) (Hydrocar code P20Z1/2 E28201)

Figure 4.3



Available solutions:

a) Direct pump connection

Available in versions with outputs:

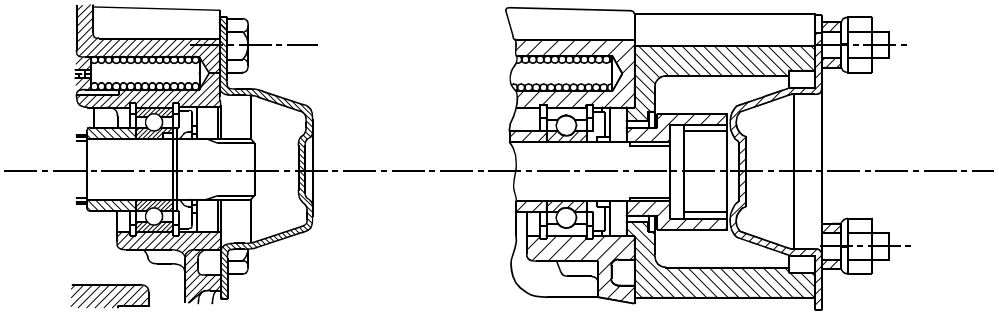
a) standard version 21 ISO 14: For direct pump connection 3 holes 21 shaft ISO 14.

b) optional version SE with adapter: For pumps with connection 4 holes SE - ISO 7653

Figure 4.4

Standard version (IVECO supply)

Opt. version with Hydrocar adapter for piston pumps (code XIK)

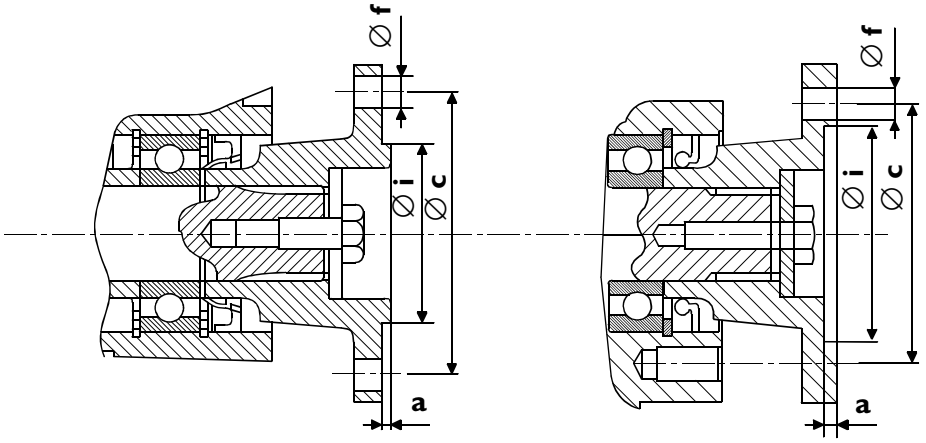


b) Connection with flange

Available in versions with output:

- DIN 00 flange 4 holes diameter 90 mm (available from Hydrocar)
- Spicer 1120 flange 4 holes (not equidistant) (available from Hydrocar)

Figure 4.5 **DIN type** **Spicer type**



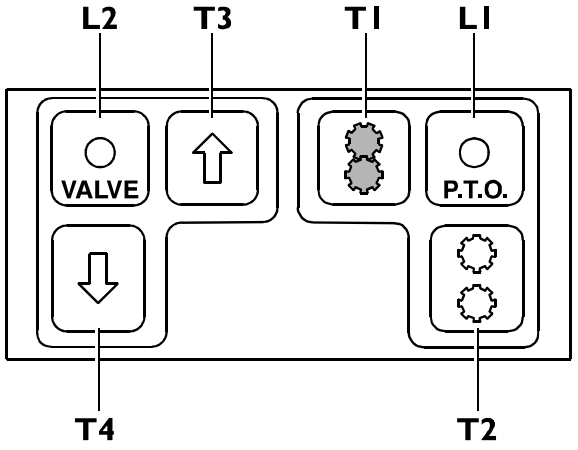
Type	Dimensions (mm)			
	Ø i	Ø c	Ø f	a
DIN 00	47	90	8,5	2,3
Spicer 1120	57,16	69,87	8,5	3

Control type

With the PTO option the vehicles are equipped with an electric power take-off control (Hydrocar type KES series 2), installed on the dashboard to the left of the steering wheel.

It is a specific electric control device to engage the power take-offs. It is composed of a linear actuator, an electronic push-button panel and a set of electric cables.

Figure 4.6 PTO control on dashboard



The PTO control push-button panel makes it possible to control the functions of engaging and disengaging the power take-off from inside the cab of the vehicle.

It is composed of a box containing the control unit of the device and a front panel where there are the control buttons and indicator lights.

For the electric cables there are three connectors, located in the rear wall, so the push-button panel can be completely freed from the rest of the system.

The control console is composed of two distinct sections called P.T.O. and VALVE.

The P.T.O. section governs power take-off engagement and disengagement with two push-buttons and an indicator light.

The VALVE section governs tipper operation (only for vehicles with this function) with an indicator light and two push-buttons that interact with the hydraulic control valve annexed to the lifting system.

In the case of vehicles that are not to be used as tippers, the VALVE section is non-operative.

The front panel is permanently backlit (the lighting can only be seen at night) so the power supply must be kept linked with the engine ignition key in order to prevent running down the battery when the vehicle is stationary.

P.T.O. Section

The push-button (T1) controls power take-off engagement. This function is permanent even after letting go of the push-button. The steady red LED (L1) signals PTO engagement.

The push-button (T2) controls power take-off disengagement. This function is permanent even after letting go of the push-button. The red LED (L1) goes out upon disengagement.

VALVE Section

The push-button (T3) governs lifting the tipper body. This action is temporary and is cancelled on releasing the push-button.

The steady red LED (L2) signals tipper body lifting.

The push-button (T4) governs lowering the tipper body. This action is temporary and is cancelled on releasing the push-button.

See the additional possible functions and safety features in the specific Hydrocar literature.

Electrical protection

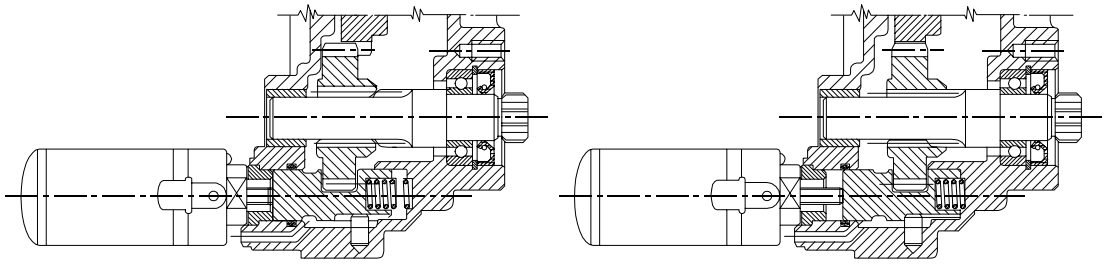
The control unit, aided by an external 10A fuse, is protected against the following:

- electromagnetic sensitivity (EC 95/54 standard);
- electromagnetic emissions (EC 95/54 standard);
- electrostatic charges;
- load dump;
- power gaps;
- polarity reversal;
- current overload (if current draw exceeds the threshold the control unit, irrespective of the fuse, is self-limiting).

PTO engagement device

Composed of a Hydrocar electric actuator type KES 13, it is installed directly on the PTO.

Figure 4.7



The linear actuator provides the movement on the control rod that engages and disengages the power take-off.

It is secured to the power take-off by the butt, screwing it onto the PTO casing.

Electrical protection

The KES actuator is protected against the following:

- electromagnetic sensitivity (EC 95/54 standard);
- electromagnetic emissions (EC 95/54 standard).

4.2.3 Vehicles manufactured with no PTO

For vehicles manufactured without the PTO option, follow these instructions in order to install it:

a. Vehicles with standard electrical outfit

On request, Hydrocar will supply the full PTO kit, control push-button panel, electric cables, with the technical specifications for installation on the vehicle.
Follow these specifications for correct installation.

The most significant phases comprise:

- Draw current in the fuse-holder area directly from the three-way connector from pin 2 (+15) key positive (see point 2.14.3 paragraph c). Use a relay to draw off more than 4A, otherwise draw from the battery terminal, utilizing a fuse in both these cases.
- Position the cables supplied with the kit as shown in Figure 4.8, removing the top portion covering the dashboard (odometer, various instruments).
- Install the push-button panel in the specific area reserved for it on the dashboard, on the left-hand side of the steering wheel for left-hand drive (on the right of the steering wheel for right-hand drive vehicles), with the adapter front panel for fixing.

Note:

For the cable to pass from inside the cab (push-button panel) into the engine bay, use the 30 mm hole punched in the air duct (engine bay) with its outlet in the cab on the right-hand side under the dashboard, which is accessed through its specific door.

Use suitable grommets, making sure you seal the area between the cable and grommet appropriately in order to prevent fumes and dust getting into the cab.

For the cable to pass inside the dashboard, remove the top of the dashboard by taking out the relevant screws.

Switch on clutch pedal (enabling PTO engagement/disengagement)

This needs to be installed by the bodybuilder.

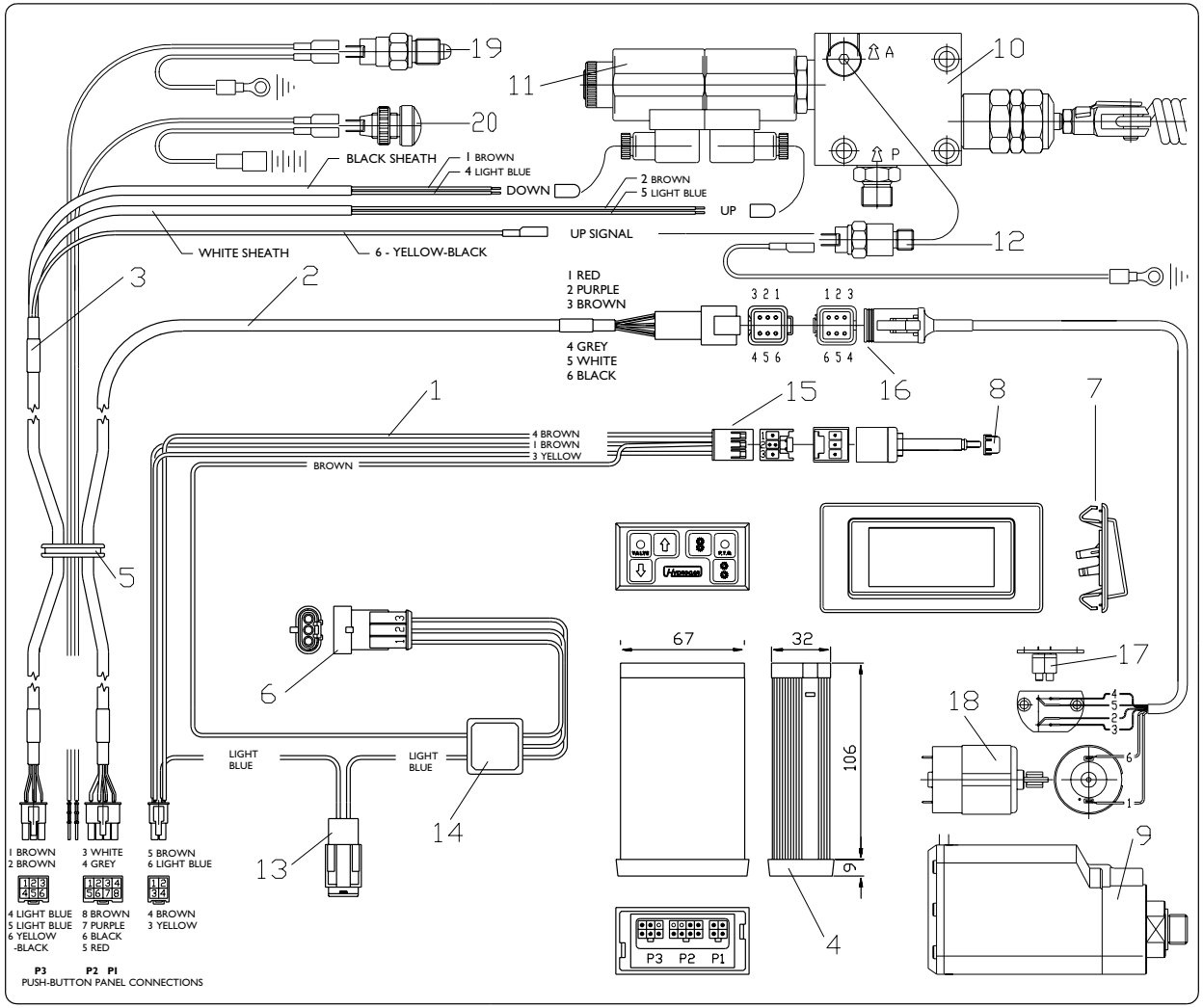
The Hydrocar kit comprises an on/off switch.

It is installed by using the hole on the clutch pedal, inserting the component by turning it through 90° and fully pressing the clutch pedal (for self-adjusting its travel). Then take the coloured cap off the top of the contacts.

Pressing the pedal once enables PTO engagement, twice disengages it.
Except for the 8140.43S engine (Common Rail), where the present switch enables only engagement, not disengagement (after making a specific circuit); Hydrocar supplies a specific kit that enables also the function of disengaging the PTO.

Cable positioning diagram (Hydrocar kit)

KES COMPOSITION DIAGRAM FOR DAILY VERS. PTO-SOLENOID VALVES



LEGEND

01 - POWER CABLE

02 - ACTUATOR CABLE

03 - SOLENOID VALVE CABLE

04 - ELECTRONIC PUSH-BUTTON PANEL

05 - CABLE BULKHEAD CONNECTOR

06 - MALE CONNECTOR

07 - IVECO S 2000 COVER

08 - PEDAL SWITCH KIT

09 - ACTUATOR 12V / ACTUATOR 24V
KES 13 (12V) 194KES13000
KES 17 (12V) 194KES17000
KES 18 (24V) 194KES18000
KES 19 (24V) 194KES19000

10 - HYDRAULIC CONTROL VALVE

11 - SOLENOID VALVE 12-24V

12 - PRESSURE SWITCH

13 - FUSE-HOLDER AND 10A FUSE

14 - RELAY

15 - SWITCH CONNECTOR

16 - ACTUATOR CONNECTOR

17 - MICRO-SWITCH

18 - ELECTRIC MOTOR

19 - PTO ENGAGEMENT INDICATOR

20 - PTO ENGAGEMENT INDICATOR LIGHT

Figure 4.8

b. Vehicles fitted with ABS/ABD/EBD, ECAS, Air-Conditioner, Door-Locking, Differential Locking devices, etc.

The vehicles are fitted with the electrical system (including the indicator light) to control PTO and body tipping.

Connect the cables in the engine bay, close to the windscreen washer tub (6-pole light blue connector for PTO, 6-pole grey connector for tipper, 3-pole light blue connector for PTO), to the PTO on the gearbox, taking the precautions of paragraph 2.14.4.

Install the push-button panel in the cab, connecting it to its seat with the frame (IVECO part nr. 50037 8843ED).

c. Version with mechanical control

Hydrocar supplies the PTO P20Z1/2 type M33 201 with mechanical control (Bowden), to be installed in the cab on the right of the driver's seat.

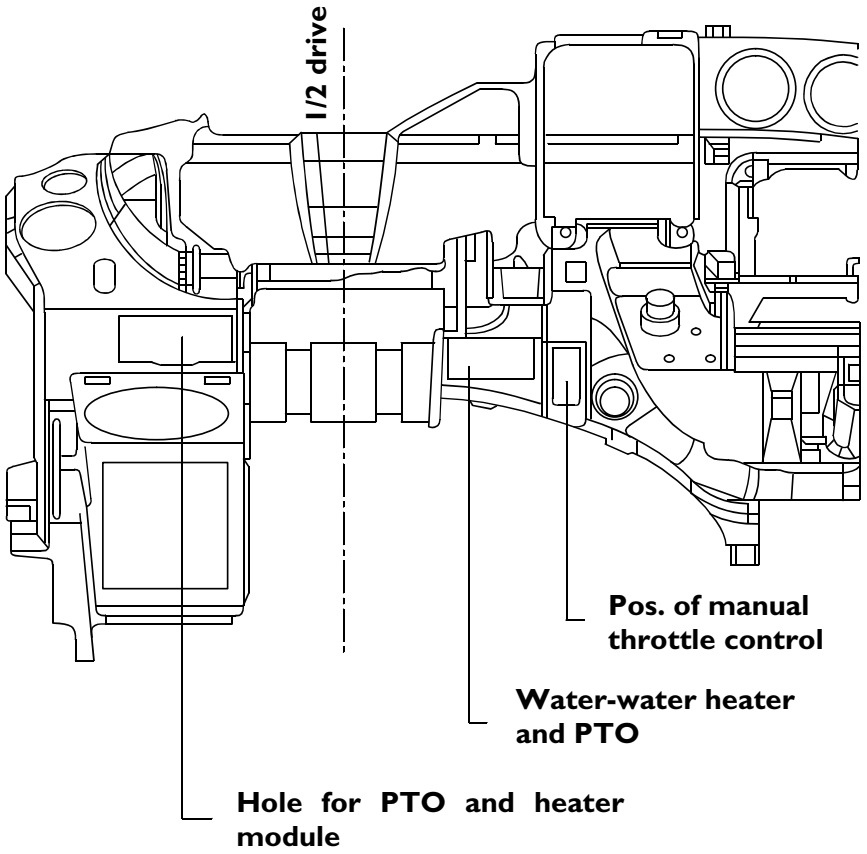
d. Alternative solutions

Other PTO solutions are also possible.

The guidelines given above are one example. Observe the general guidelines in this manual for the various phases of the work.

To position the control, besides the one indicated on the left of the steering wheel, it is alternatively possible to use the punched bay, closed with a plug, on the right of the steering wheel (if not already used for other purposes, such as the water/water heater option), see Fig. 4.9.

Figure 4.9



4.3 Power Take-off from Drive line

The authorisation for the application of a power take-off on the drive line downstream of the gearbox is issued after examination of the complete documentation presented to the Company.

The various power and torque values will be evaluated as each occasion arises on the basis of the conditions of use.

In general the following should be noted:

- The drive take-off may be operated only when the vehicle is stationary.
- The power take-off r.p.m. is dependent on the gear selected.
- The power take-off must be located immediately downstream of the gearbox. For vehicles with the drive line in two or more sections, the power take-off may also be fitted at the flexible support included between the first and second sections (respect the indications given in point 2.3.2).
- The angles of the drive line on the horizontal plane and vertical plane must be kept as close as possible to the original values.
- Masses and rigidity added to the drive line must not provoke a loss of balance or abnormal vibrations or damage the transmission drive line (from engine to axle) either during vehicle movement or during operation with the motor running.
- The power take-off must be fixed to the chassis with its own suspension.
- **As the transmission is an important part for the safety of the vehicle, modification to it must only be carried out by specialist companies approved by the supplier of the transmission.**

4.4 Power Take-off from Engine

In general the use of these power take-offs is planned for apparatus requiring a continuous power supply.

Albero motore

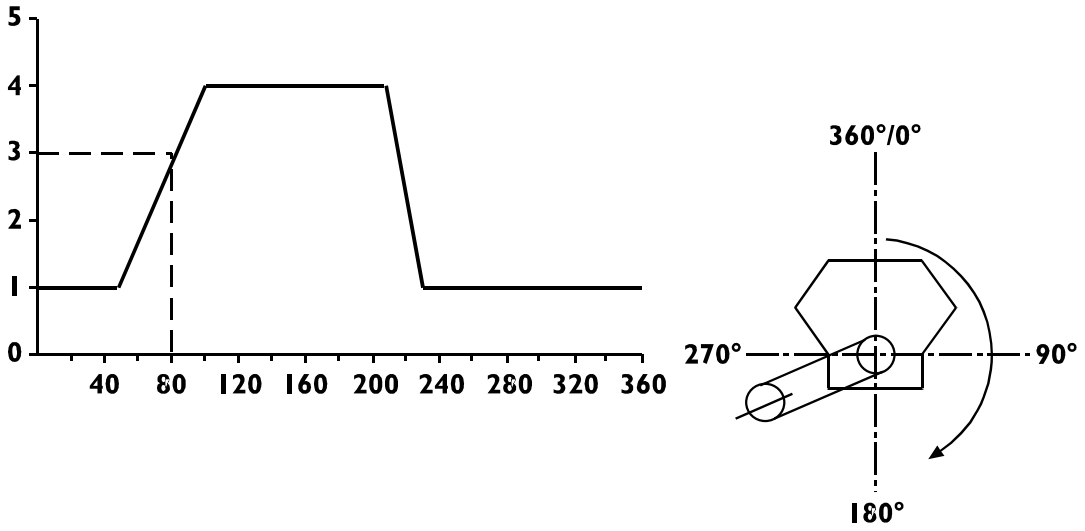
The drive take-off from the front part of the crankshaft is obtained, for limited power values to be drawn off (e.g., air-conditioning, compressors, etc.), by belt drives.

Table 4.2 shows the values to be referred to for the take-off.

Table 4.2
Power take-off from front of engine

Engine type (power)	R.p.m. corresp. to full power	Max. speed with no load	Max. admitted take-off values [1]		
			Max. torque available	Max. moment of inertia	Max. bending moment
(kW/Cv)	(r.p.m.)	(r.p.m.)	(Nm) [2]	(kgm^2) [3]	(Nm) [4]
8140.63 (63/87) 8140.43 (78/105) 8140.43S (92/125)	3800 3600 3600	4500 4250 4250	80	0,005	70

1) For special uses we can examine the possibility of admitting higher values upon presentation of specific documentation on the type of construction.
2) The power drawn off depends on the curve of the torque and the r.p.m. (see point 4.1).
3) These values may be obtained from the specific technical literature.
4) The values given can be increased depending on the angular position of the assembly to be controlled, using the diagram shown below.



Example:

- Angular position of the assembly: ∞ = 80°
- Increment factor: 3
- Admitted bending moment in table: Mf = 70 Nm.
- Mf ∞ = 70 Nm · 3 = 210 Nm.

4.5 Engine r.p.m. adjustment for drive take-off

For the application of the power take-offs, depending on the additional assembly and the type of use, it may in certain cases be necessary to utilize injector pump governors equipped with specific characteristics.

8140.63 engine (67 kW / 87 HP at 3800 r.p.m.)

This engine is equipped with a mechanical pump fitted with a min. and max. regulator.

The adjustment of the engine speed to supply the power take-off is made, according to the power required (e.g., tippers), directly by the driver who adjusts the fuel flow rate with the throttle pedal.

8140.43 engine (78 kW / 105 HP at 3600 r.p.m.)

A mechanical pump is installed on the engine with a governor at all speeds. Using an additional manual throttle makes it possible to adjust the engine speed irrespective of the power required.

Using the engine governor graphs below, it is possible to establish the desired speed under load by setting the r.p.m. with no load.

The change in adjusted speed depends on the r.p.m. used by the engine and the power drain.

The following diagram shows that the change decreases as the engine speed increases and it increases in proportion to the value of the power drawn off.

This version is particularly suited to operate assemblies that need the operator outside the vehicle (e.g., cranes).

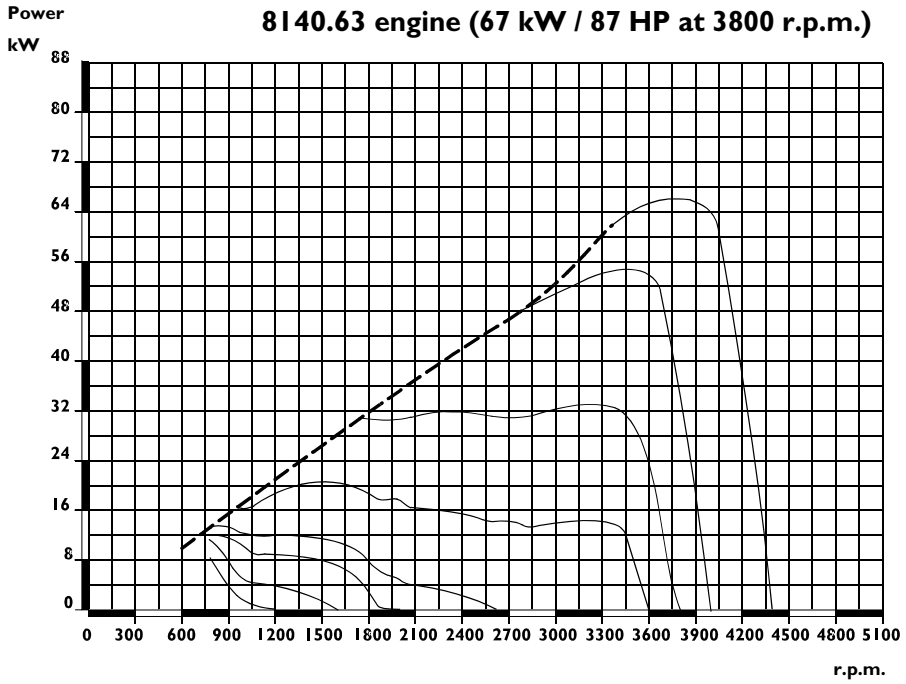
In cases where the characteristics of the added assembly (e.g., pumps, compressors, etc.) require keeping under a certain speed (permitted r.p.m.), it is necessary for the governor to be equipped with a device that, operated mechanically or pneumatically with the engagement of the power take-off, limits the maximum r.p.m. during the take-off phase.

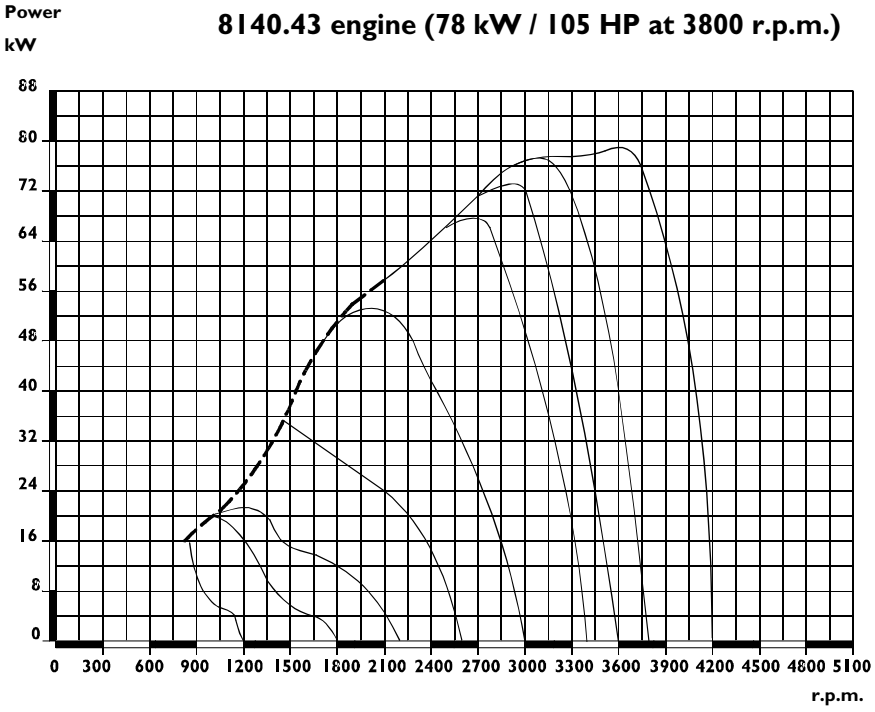
8140.43 engine (92 kW / 125 HP at 3600 r.p.m.)

Since this engine is equipped with a pump with an electronic supply (EDC), the r.p.m. can be adjusted with the Cruise-Control function (option), with an engine speed of between 800 and 1500 r.p.m.
Without the Cruise-Control function, the PTO speed adjustment is made with the:

- throttle pedal,
- or a specific kit supplied by IVECO.

Figure 4.10





Example:

Engine	8140.43
Power to be taken off	10 kW
Requested r.p.m. (with power take-off)	1100 r.p.m.
R.p.m. to adjust (no load)	1300 r.p.m.
Change	18.2%

5. SPECIFIC INFORMATION AND INSTRUCTIONS

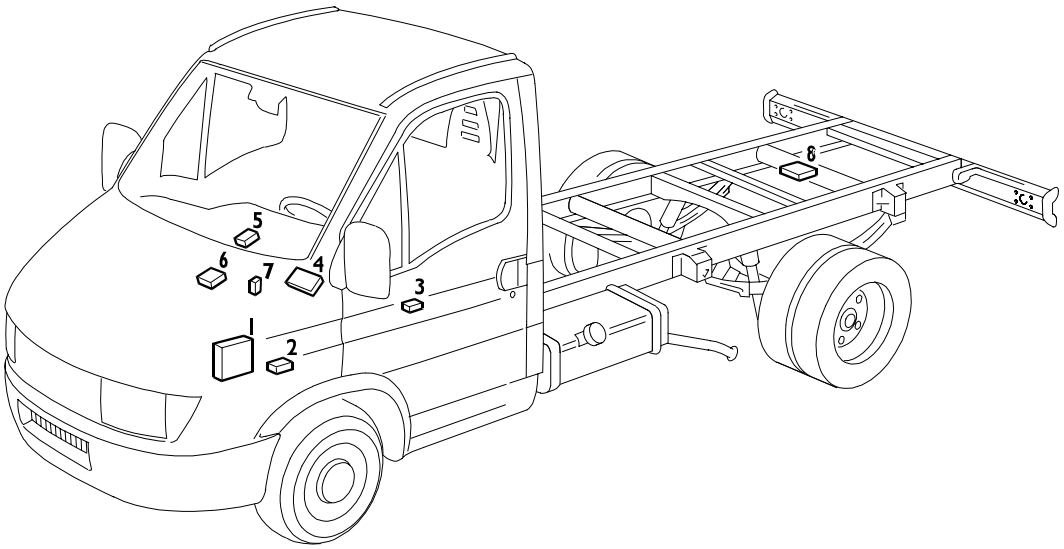
Index

5.1 General information

This section provides some instructions that are additional to and integrate those of a general nature given in the previous sections.

5.2 Positioning electronic control units on vehicles

Figure 5.1



1 EDC/pre-heating
2 ABS
3 Airbag
4 Anti-theft device
5 Central locking
6 Air-conditioner
7 Power take-off engagement
8 Air suspensions

5.3 Chassis frame side members: Sections available from IVECO Spare Parts

In order to change the wheelbase or chassis frame overhang, the following sections are available from IVECO Spare Parts:

Models	Dimensions (mm)	Length (mm)	Part No.
Daily	182x70x4	1000	1908968
Daily	122x70x4	1000	1908969