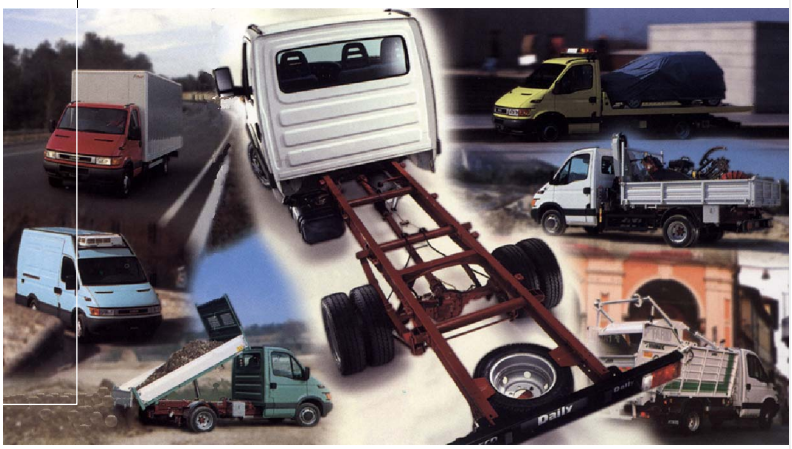
DAILY RANGE BODYBUILDERS AND VEHICLE FITTING INSTRUCTIONS

LIGHT RANGE



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Foreword

This manual contains instructions and data for fitting body structures / ancillaries and Vehicle modifications and is intended for skilled and qualified personnel.

The bodybuilder is responsible for the design and fitting and any modifications necessary for the installation. The bodybuilder must ensure full compliance with the requirements set out in this manual and with national and international regulations (Construction and Use, and EEC Standards).

Before starting any work make sure you are working form the latest Iveco Bodybuilders Instruction manual for the model. Make sure that all safety equipment e.g. eye protection, hard hat, shoe, gloves etc are used. Check that all mechanical equipment e.g. lifts and handling gear is in good working order land is used. Finally work on the vehicle in good conditions and ensure maximum safety at all times.

Any change, modification or fitting not covered by this manual and not expressly authorized in written by IVECO will relieve the latter of any responsibility and make, in particular, the vehicle guarantee null and void.

For installations / modifications and general information not covered by this manual contact IVECO.

On completion of the installation e.g. body, crane, wheelbase modification the vehicle and systems must be checked to ensure vehicle operation and safety is as designed by IVECO and has not been compromised. If a vehicle system needs to be set up i.e. engine control for PTO installation then contact your local IVECO Service Department.

IVECO shall not be responsible for any change, modification or fitting concerning the vehicle.

Due to continuing vehicle improvements and changes in regulations which cover or affect the vehicle, the information in this publication may not always be up to date.

If the bodybuilder has any queries regarding the information contained in this manual regarding the vehicle that is to be worked on he should contact IVECO before starting.

Symbols - Warnings

Danger to people: failure to fully comply with these precautions can involve' serious danger for personal safety.

Danger of serious damage to the vehicle
Partial or complete non observance of these precautions can cause serious damage to the vehicle and invalidate the IVECO warranty.

Warning / Precaution: failure to fully comply with these precautions can result in serious danger to personal safety and damage to the vehicle with the loss of the vehicle warranty

This indicates the correct use of materials in order to make the vehicle as environmentaily friendly as possible.

NOTE This indicates an additional explanation for a piece of information.

SECTION

1 GENERAL SPECIFICATIONS

Index

1.1 Aim of bodybuilders instructions

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.

1.2 IVECO approval for changes and fittings

Changes shall be made according to the criteria described in the following directives. The modifications below can only be made after approval from IVECO:

- wheelbase modifications, whereby the value of the newly obtained wheelbase does not fall within the minimum and maximum values available within the IVECO range for the same vehicle;
- work carried out on the braking system;
- work carried out on the suspension system;
- steering wheel modifications;
- suspension stabilizer bar modifications;
- modifications to the cab, cab supports, tilting locking devices;
- engine AIR intake and exhaust system modifications;
- engine cooling system modifications;
- power unit and driving component modifications;
- work carried out on front and rear axles;
- fitting additional axles;
- fitting decelerator brakes;
- fitting power take-offs;
- changing the tyre dimensions;
- coupling device (hooks, fifth wheels) modifications;
- electric/electronic unit modifications.

The other modifications of fittings covered by the following standards and made in compliance with the same do not require specific approval from IVECO. Any modification or fitting not covered by these standards shall, on the contrary, be authorized by IVECO in advance.

1.3 Liabilities

The authorizations issued by IVECO concern solely the technical/conceptual 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.**

1.4 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.

1.5 Request for approval

The requests for approval or support to carry out work or make modifications or fittings shall be forwarded to the IVECO marketing offices in charge.

To obtain the approval, the body builder shall provide adequate documents that illustrate the anticipated implementation, utilization and conditions of use on the vehicle. The drawings shall highlight any item differing from the instructions contained in this manual.

The body builder shall submit the modification and/or fitting to the competent authorities for approval.

1.6 IVECO technical documents available VIA computer

The following technical documents are available on the Internet at www.thbiveco.com:

- modification and fitting directives;
- technical cards;
- chassis cab diagrams;
- chassis diagrams;
- other specifications concerning the vehicle range.

Requests to access the site shall only be made to www.thbiveco.com.

1.7 Trademarks and Logos

Trademarks, nameplates and company name 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.

1.8 Legal Provisions

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 EC directives. Converted vehicles must also comply with these directives. The only permissible exception is granted where local type approval differs from EC homologation.

1.9 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.

1.10 Choice of material: 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.
Therefore:

- Everyone must be aware of the prohibitions on using harmful or potentially hazardous materials, such as ones containing asbestos, lead, halogen additives, fluorocarbons, cadmium, mercury, hexavalent chrome, 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.

In order to comply with EC directive 2000/53 (ELV), IVECO S.p.A. prohibits fitting parts containing lead, mercury, cadmium and hexavalent chrome to vehicles (except for the departures referred to in Attachment II of the above directive).

1.11 Vehicle delivery

Prior to delivering the vehicle, the body builder shall:

- verify that the work has been made correctly;
- perform vehicle and/or equipment set-up;
- check the operation and safety of the vehicle and/or equipment;
- prepare and deliver the necessary instructions for service and maintenance of the fitting and any additional units to the end customer;
- write the new data down on the special tags:
- confirm that the work carried out complies with the indications provided by the vehicle manufacturer and with the law regulations;
- provide a guarantee for the modifications made;
- if for any reason bolted components have to be temporarily removed from the vehicle when they are refitted new fixing hardware must be used. When riveted components are removed these must be refitted using flanged head bolts and nuts. Use grade 10.9 hardware for high stress components e.g. spring hanger brackets etc. the bolts must be checked for correct tightness after the vehicle has covered 500-100km;

Starter batteries must be service at regular intervals until the vehicle is handed over to the customer to prevent faults occurring such discharging, short circuiting or corrosion. IVECO reserves the right to declare void its own warranties for the battery where battery service procedures requested by IVECO network and by point 2.19.2 are not carried out.

1.12 Vehicle names

IVECO vehicle commercial names do not match with the approval name. Below are three examples of commercial names, with the meanings of the abbreviations used:

GVW (tx10)		**Class**	Engine rating (HP:10)		Version			Suspension	
2	**9**	**L**	**1**	**0**					
3	**5**	**S**	**1**	**2**	**D**			**/**	**P**
5	**0**	**C**	**1**	**1**	**C**	**N**	**G**	**/**	**P**

Class	**Rear wheels**	**GVW (t)**
L	single	2.8 – 3.3
S	single	3.5
C	twin	3.5 – 6.5

Version	
-	Truck
V	Van
D	Cab 6+1
CNG	Engine CNG

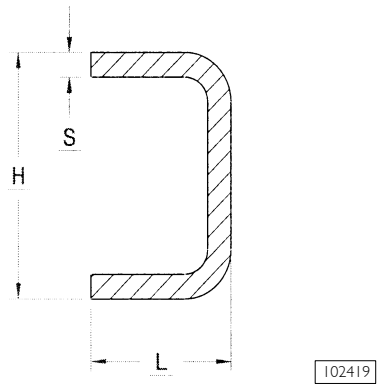
Suspension

-	mechanic
/P	pneumatic

1.13 Conventions

As regards dimensions H, L, S of the chassis and subframe section, refer to the figure below.

Figure 1.1



2 CHASSIS MODIFICATIONS

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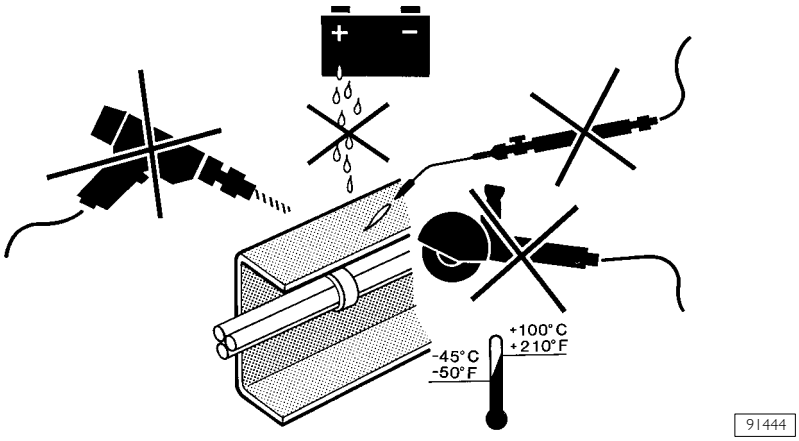
2.1 General instructions for chassis modifications

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 2.7, 2.8, and 2.9).
- **Holes in the flanges of the side members are not permitted** (except for the items described at points 2.10 and 3.4);
- 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 it is forbidden to reuse the same bolts. In this event and when rivets are replaced with bolts, the bolt torque must be checked after the vehicle has been driven approximately 500 - 1.000 kms.
- 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 2.7, 2.18 and 2.19).

Figure 2.1



2.2 Painting and protection against rust

2.2.1 Original components

Table 2.1 details the operations for protecting and painting the components of the original vehicle (See Table 2.1 for painted parts, Table 2.2 for non-painted or aluminium parts).

Table 2.1 - Protection classes

Class	Features of the part	Examples of the type of part
A	Parts in direct contact with atmospheric agents	Cab, rear view mirrors, cab fixing components
B	Parts in direct contact with atmospheric agents with mostly structural characteristics, directly visible	Chassis and related parts, including fixing components and parts under the hood
B1		Rear and front axles
C	Parts in direct contact with atmospheric agents, not directly visible	Engine and related parts
D	Parts not in direct contact with atmospheric agents	Pedals, seat frames, fixing components, internal cab pillars

Table 2.2 - Painted parts

Description of the cycle phase		Classes				
		A	**B (5)**	**B1**	**C**	**D**
Mechanical surface cleaning (including the removal of burrs / rust and cleaning of modified parts)	Sand blasting	-	yes •	-	yes •	yes •
	Brushing	si •				
	Sanding					
Pre-treatment	Degreasing	-	-	-	yes •	yes •
	Phosphate degreasing					
	Phosphating of the heavy iron		yes •			
	Phosphating of the zinc	yes				
Cataphoretic treatment	High thickness (30-40 μm)	yes (1)	yes (4) •	-	yes (6) •	yes •
	Low thickness (15-25 μm)	yes (2)				
	Acrylic to finish (>35 μm)	-				
Anti-rust	Bicomponent (30-40 μm)	-	yes (7)	-		
	Monocomponent (30-40 μm)		-	yes		
Chip-resistant base	Mono (130 °C) or Bicomponent (30-40 μm)	yes (2)	-	-	-	-
Paint	Mono (130 °C) or Bicomponent (30-40 μm)	yes	yes •	-	yes •	yes •
	Powders (50-60 μm)	yes (3)	yes			
	Monocomponent at low temperature (30-40 μm)	-	-	yes		

(1) = Cycle for two-coat preparation.
(2) = Cycle for three-coat preparation.
(3) = Alternative to the mono or bicomponent paint, only for cab parts (windscreen wipers, rear view mirrors, etc.)
(4) = Excluding parts that cannot be immersed in pre-treatment and paint baths, due to their geometry (air tanks), their large size (castings) or where this would compromise their functionality (mechanical parts).
(5) = For ferrous steel or pre-coated fuel tanks, refer to Table 2.2.
(6) = Only parts fitted on the engine.
(7) = Parts that cannot be treated cataphoretically (4).
• = Alternative products and cycles for the same class, as long as they are compatible with the part being treated.

Table 2.3 - Various unpainted and/or aluminium parts and components

Type of protection		Class			
		A	B – B1	C	D
Stainless steel		si	-	-	-
Dacromet		DAC 320/8/PL DAC 500/8/PL	DAC 320/5	-	-
Zinc treatment	Fe/Zn 12 III	-	-	yes	yes
	Fe/Zn 12 V	-	yes	-	-
	Fe/Zn 25 V	-		-	-
Aluminium	Anodizing	yes	yes	yes	yes
	Painting	yes			

2.2.2 Added or modified parts

All parts of the vehicle (cab, chassis, bodywork, etc.) which are added or subjected to modification must be protected from rust and corrosion.
There must be no unprotected areas on ferrous materials.
Table 2.3 (painted) and Table 2.4 (unpainted) show the minimum treatments required for modified or added components when it is not possible to provide the same protection as that used on IVECO original components. Different treatments are allowed on condition that the same level of protection against rust and corrosion is guaranteed.
Do not use powdered paints directly after greasing.
Parts in light alloy, brass and copper must not be protected.

Table 2.4 - Added or modified painted parts

Description of the cycle phase	Class
	A - B - D (1)
Mechanical surface cleaning (including the removal of burrs / rust and cleaning of modified parts)	Brushing/sanding/sand blasting
Pre-treatment	Degreasing
Anti-rust	Bicomponent (30-40μm) (2)
Paint	Bicomponent (30-40μm) (3)

(1) = Modifications to rear axles, front axles and engine (Classes B1 and C) are not allowed.
(2) = Preferably epoxy.
(3) = Preferably polyurethane.

Table 2.5 - Added or modified unpainted and/or aluminium parts

Type of protection	Class	
	A – B (1)	D
Stainless steel	si	-
Dacromet		-
Zinc treatment	-	si

(1) = Modifications to rear axles, front axles and engine (Classes B1 and C) are not allowed.

2.2.3 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.

With particular regard to the engine and its electric and electronic components, adequate precautions shall be taken to protect:

- on the whole engine and vehicle wiring, including earth contacts;
- on all connectors on sensor/actuator side and wiring side;
- on all sensors/actuators, on flywheel, on flywheel rev sensor bracket;
- on the whole diesel fuel system pipes (plastic and metallic);
- on complete diesel fuel filter base;
- on control unit and control unit base;
- on the whole soundproofing cover inner side (injectors, rail, pipes);
- on common rail pump including regulator;
- on vehicle electric pump;
- on tank;
- on front belt circuit and relevant pulleys;
- on power steering pump and relevant piping.

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 contact 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 (e.g. all electronic control units), must be removed.

2.3 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 side members of the vehicle be drilled unless in compliance with the indications given in point 2.10 and 3.4.

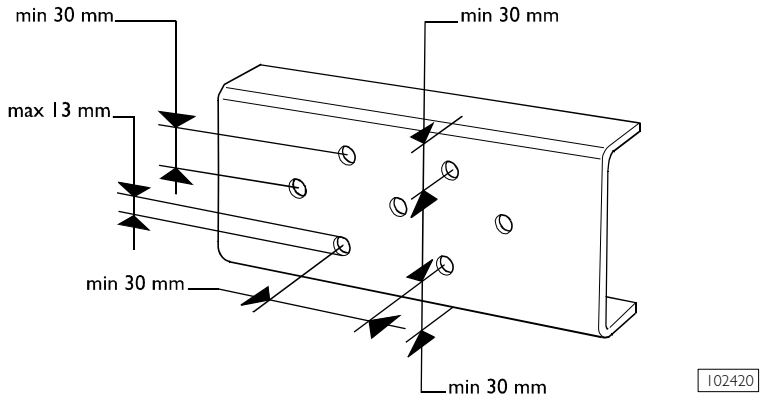
In those cases (installation of shelves, brackets etc.) where it is necessary to drill new holes, they must be drilled on the vertical web of the side member and must be carefully deburred and reamed.

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



2.4 Screws and nuts

In general, use fixings of the same type and class as those for similar fixings on the original vehicle (Table 2.6).
As a general rule, materials of class 8.8 are recommended.
Class 8.8 and 10.9 screws must have been hardened and tempered.
For applications of diameter ≤ 6mm, stainless steel parts are recommended.
Approved finishes are Dacromet and zinc coating, as detailed in Table 2.2.
A Dacromet finish is not recommended if the screws are to be subjected to welding.
If space allows, use flanged heads screws and nuts. Use self-locking nuts. Nuts must be tightened using a torque wrench set to the correct torque setting for the fixing.

Table 2.6 - Classes of resistance for screws

Class of resistance	Usage	Tensile strength (N/mm^2)	Yield point (N/mm^2)
4	Non-load bearing screws	400	320
5.8	Low resistance screws	500	400
8.8	Medium resistance screws (cross members, cleat plates, brackets)	800	640
10.9	High resistance screws (spring supports, stabilizer bars and shock absorbers)	1000	900

2.5 Characteristics of the material to be used when modifying the chassis

When modifying the chassis of the vehicle, and in applications which reinforce the side members directly, the material used must correspond in quality (Table 2.7) and thickness (Table 2.8) to that of the original chassis.
Should it not be possible to source materials of the thickness indicated, the next superior standard thickness may be used.

Table 2.7 - Material to be used to modify the chassis

Steel name		Tensile strength (N/mm^2)	Yield point (N/mm^2)	A5 elongation
IVECO	FeE420	530	420	21%
Europe	S420MC			
Germany	QStE420TM			
UK	50F45			

In order to change the wheelbase or chassis frame overhang, the following sections are avaible from IVECO Spare Parts:

Models	Dimensions (mm)	Lenght (mm)	Part No.
Daily	182x70x4	1000	1908968
Daily	122x70x4	1000	1908969

Table 2.8 - Daily, Dimensions of chassis section and thickness

Class	Type	Wheelbase [mm]	Rear overhang [mm]	H x L x S side-member section (wheelbase area) [mm]	H x L x S side-member section (Rear overhang) [mm]
29L - 35S	truck	3000	920	150 x 56 x 3	100 x 56 x 3
		3450	1355		
		3750	1665		
		3950 (camper van)	1825		
	van	3000 short overhang	840		
		3000 long overhang	1240		
		3300	1460		
		3950	1825		
35C - 50C	truck	3000 (1)	1240	182 x 70 x 4	122 x 70 x 4
		3450	1355		
		3750	1665		
		3950 (camper van)	1825		
		4100 (1)	1715		
		4350	1885		
		4750 (2)	2350		
35C-40C	van	3000 short overhang	840	180 x 69 x 3	120 x 69 x 3
		3000 long overhang	1240		
		3300	1460		
		3950	1825		
45C-50C	van	3000 short overhang	840	182 x 70 x 4	122 x 70 x 4
		3000 long overhang	1240		
		3300	1460		
		3950	1825		
60C-65C	truck	3450	1355	184 x 69 x 5	184 x 69 x 5
		3750	1665		
		4350	1885		
		4750	2350		
	van	3300	1460		
		3950	1825		

1 = only 35C - 40C
2 = only 45C - 50C

2.6 Stresses on the chassis

Do not exceed the following stress values under static conditions:

Table 2.9

Range	Permitted static stress on the chassis (N/mm^2), σ_{amm}	
	on road	Heavy duty (e.g. tipper)
Daily	120	80

When prescribed by national regulations, the bodybuilder must check that the stress limits are not exceeded. Welding activity will cause a deterioration in the characteristics of the material. Therefore, when checking the stresses in thermically-modified zones, consider a reduction of approx. 15% of the resistance characteristics.

2.7 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.

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).

Before any arc welding, in order to protect the electrical equipment and the ECUs, disconnect the wires from the battery (first the negative pole than the positive one), earth the welding equipment to the piece that is to be welded and disconnect the connectors from the ECUs. Extreme care must be taken when disconnecting and reconnecting ECU plugs to avoid pin damage.

Should close welding be required, remove the control unit from its position.

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

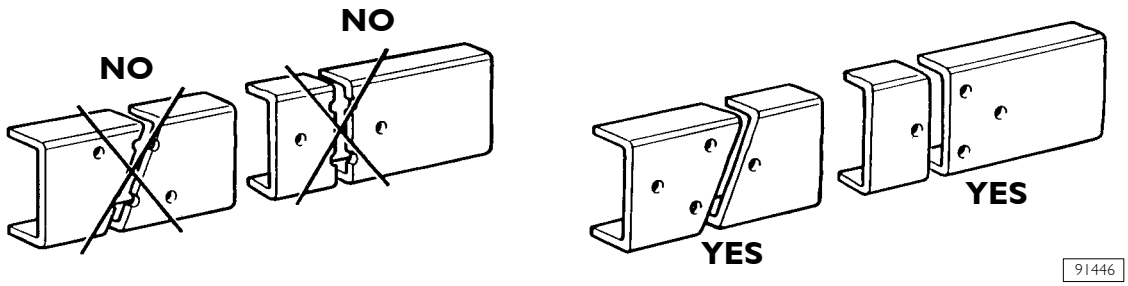
The surfaces of the leaf springs and air springs must be protected against weld splashes during welding. Do not allow the electrodes or conductors to come into contact with the spring.

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 2.2.1.).

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 existing holes 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 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

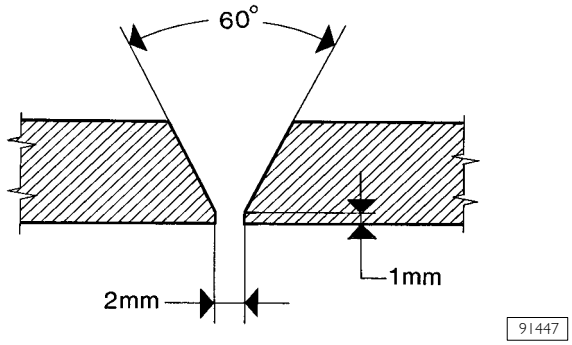
Avoid current overloading. Welding must be free from marginal cuts and waste material.

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.

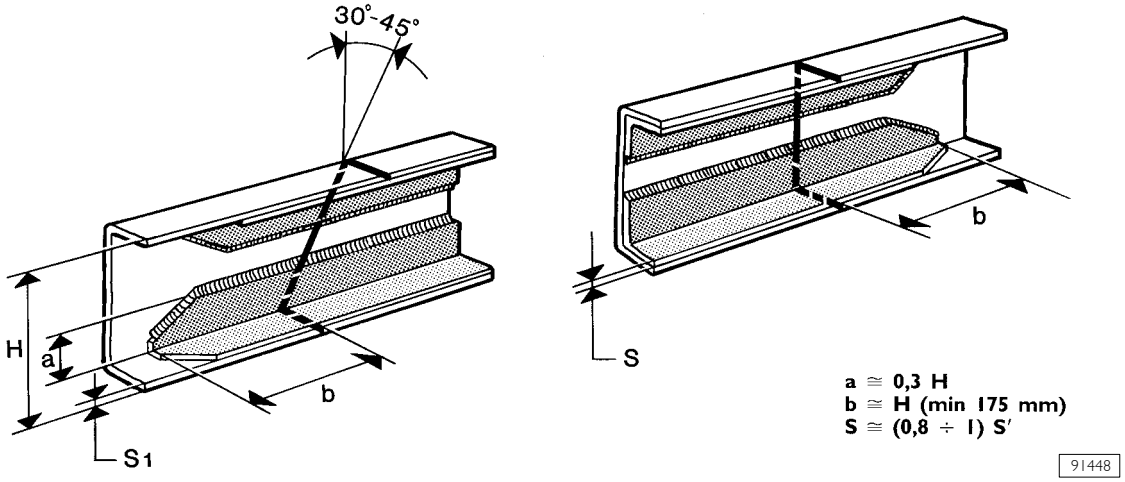
f) Remove excess material resulting from the welding operations by grinding.

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 must 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.

2.8 Modifying the Wheelbase

2.8.1 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.

Cutting the chassis must be done by following the instructions given in point 2.7. 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).

Use only the material given in point 2.5.

No modification of wheelbase is permitted on vehicles with ESP (optional 8123). See point 2.18.5.

2.8.2 Approval

The alteration of the wheelbase 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 (see table 2.8).
- 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.).

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.

Values shown in Table 2.10 and Table 2.11 are referred just to steering and braking system capacity and not to a possible lengthening or shortening of the wheelbase.

2.8.3 Consequences for steering

Generally, lengthening the wheelbase has a negative effect on the steering.
Whenever national regulations require it, the limits on the overall dimensions must be observed as well as the limits concerning the effort applied on the steering wheel and the relevant operation times (e.g. wrrent ECE standard or EC Directive).
The Table 2.10 gives the wheelbase lengthening limits for the various models, for vehicles with standard steering, the maximum permitted load on the front axle and approved tyres.

Table 2.10 - Steering, wheelbase lengthening limits

Model	Front suspension	Maximum wheelbase (mm)
29L, 35S	Transversal	4100
35C, 40C, 45C, 50C	Transversal (maximum admitted 1800kg)	4100
35C, 40C, 45C, 50C	Torsion bar (maximum admitted 1900kg)	4750
60C, 65C	Torsion bar	4750

If longer wheelbases are required for certain types of body, specific approval must requested from IVECO and measures must be taken to improve the steering characteristics, such as reduction of the maximum load limit on the front axle or the use of tyres and wheels with lower offset values.

2.8.4 Effect on braking

Generally, shortening the wheelbase has a negative effect on braking characteristics.
Table 2.11 gives the wheelbase alteration limits. Ask an authorised IVECO dealer for the conditions (brake cylinder, minimum tare settings see section, technically permitted masses, tyres, height of centre of gravity) under which these values are permissible.

Table 2.11 - Braking, wheelbase alteration limits

Model	Version	Wheelbase	
		Minimum (mm)	Maximum (mm)
29L, 35S	Truck, van	3000	3950
35C, 40C	Truck, van	3000	4100
45C, 50C	Van	3000	4750
45C, 50C	Truck	3450	4750
60C, 65C	Truck, van	3300	4750

If longer wheelbases are required for certain types of body, specific approval must be requested from IVECO and measures must be taken to improve the braking characteristics, such as the reduction of the maximum load limit on the front axle, changing the brake cylinders or using tyres and wheels with lower loaded radius values.

2.8.5 Recommended procedure

To ensure the success of the conversion proceed as follows:

- Arrange the vehicle so that the chassis is perfectly level, using the appropriate stands.
- Disconnect the propeller shafts, the braking system pipes, the wiring harness and any equipment that might prevent the work being carried out correctly.
- 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 the lengths 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 1500 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 2.7.
  efore 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 2.7.

Further indications

- Protect the surfaces from oxidation as described in point 2.2.
- Restore the electrical and braking systems as described in points 2.18 and 2.19.
- For work on the drive line follow the instructions given in point 2.8.9.

2.8.6 Chassis Stress Level

When lengthening a wheelbase, in addition to local reinforcement on thè side member joint the bodybuilder must provide sufficient reinforcements to achieve the section modules 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 thè load is evenly distributed and taking thè chassis to be a beam resting on thè spring hanger brackets.

When extending above the longest originai wheelbase the reinforcements are dependent on the length of the extension, the type of body built and thè use to which the vehicle is to be put.

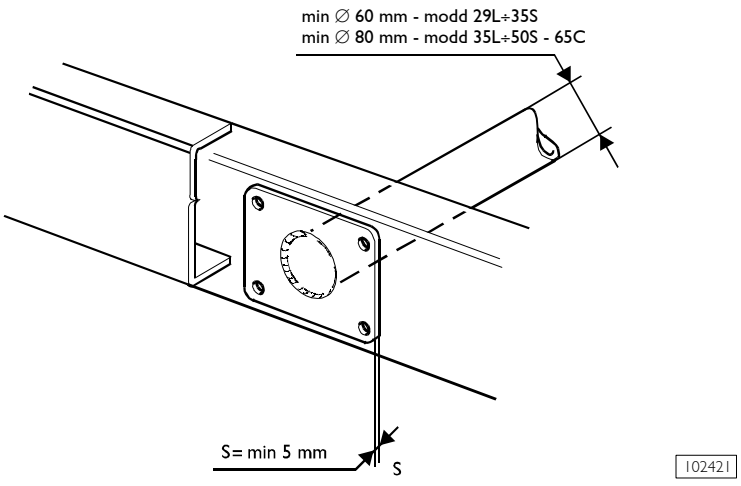
2.8.7 Cross Members

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 "heavy-duty" 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



2.8.8 Chassis reinforcement

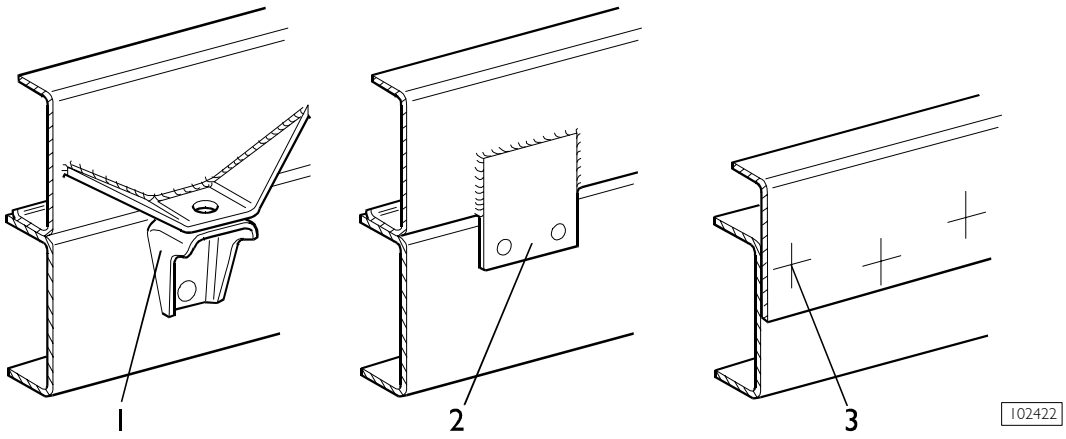
Fig. 2.7 shows some examples of possible solutions. The reinforcement must be continuous, covering the entire length of the vehicle's chassis as far as the cab. To join them to the side member, considering an angular profile, it is necessary to use bolts or rivets of class 8.8; their diameter and distribution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

If using a subframe type of reinforcement (see point 3.3), it is possible to use the body brackets fitted to the chassis (if any) for the connection, alternatively follow the instructions given in point 3.4 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 static stress on the vehicle chassis shown in Table 2.6, must not be exceeded. Use the material shown in Table 2.5.

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

2.8.9 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.

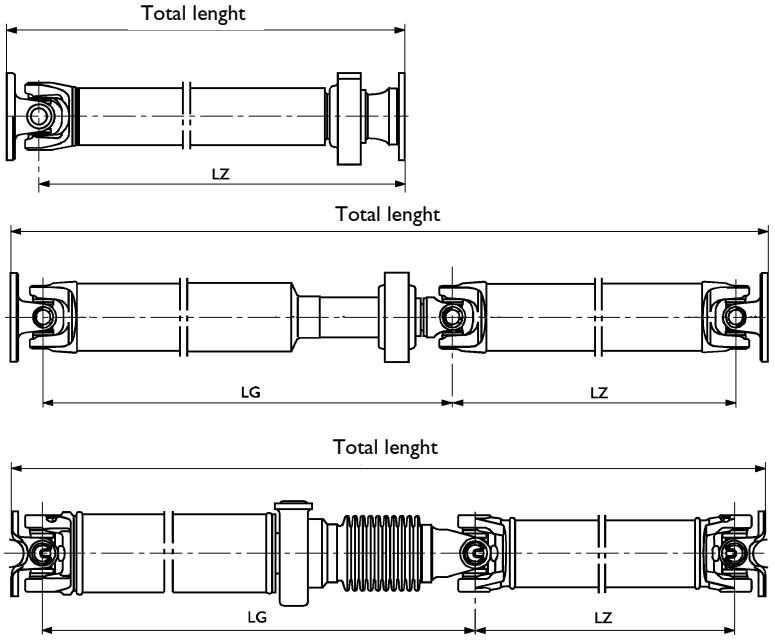
The technical instructions given in the drive line manufacturer's manuals can be used to make and install the segments.

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.

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 2.14.

For the propeller shaft length specified in Table 2.14. 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 2.14.

Figure 2.8



LZ Intermediate sections
LG Sliding sections

As far as sliding shafts are concerned, length LG is measured between the universal joint centers, with the sliding stub in its intermediate position.
Always check both branches LG and LZ.
The maximum working revs can be obtained using the formula below:

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

n_G = maximum number of transmission shaft revs (rpm)
n_{max} = maximum number of engine revs (rpm), see Table 2.12
i_G = gearbox ratio in the fastest gear, see Table 2.13

Table 2.12 - Maximum engine revs number

Engine	Engine code (1)	n_{max}
9	8140.63	3800
11	8140.43C	3600
9	8140.43R	3600
11	8140.43B	3600
13	8140.43S	3600
15	8140.43N	3600
10	F1AE0481A	3900
12	F1AE0481B	3900
14	F1AE0481M	3900
14	F1AE0481E	3900
14	F1CE0481A	3500
17	F1CE0481B	3500

(1) = See engine type on the engine plate

Table 2.13 - Gear ratio at the highest speed

Gearbox	i_G
5S200 5S270 5S300	0.8
6S300 61S300	1
6S380	0.8

Example of calculation of the maximum transmission length that can be achieved

Consider a 35C13 vehicle, with 200 gearbox. A drive shaft LZ with outer diameter of 76.2 mm is to be obtained.

From the data below

1. n_{max} = 3600 rpm
2. i_G = 0.8

you will obtain:

n^G = 3600 / (0.8) = 4500 rpm

This value is matched by a maximum obtainable length of 1400 mm.

The universal joints on the same shaft should not be rotated.

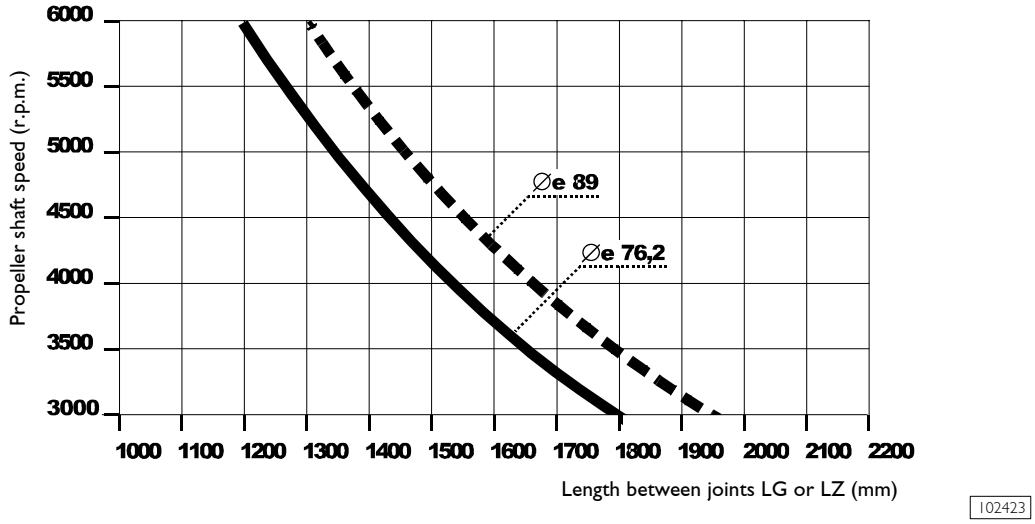
The greater thickness of the tube depends on the class, i.e. on the torque that the original shaft has to transmit and on the design of the driveline (torque, ratios of kinematic chain, power axle load).

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 2.14
Obtainable propeller shaft characteristics



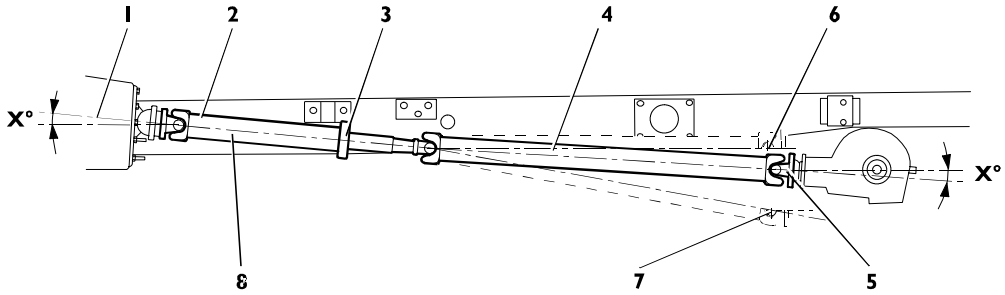
The maximum possible lengths given above refer to the original shafts; plan for shorter lengths (-10%) for segments obtained for transformation.

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, 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

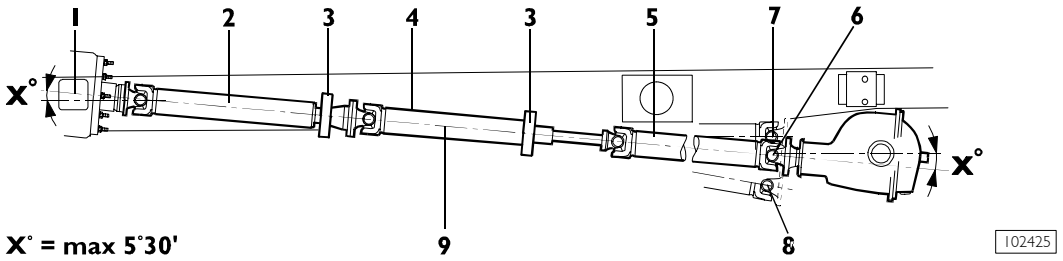


1 Engine, clutch, gearbox axis
2 Front shaft (sliding)
3 Shaft support
4 Rear shaft (fixed portion)
5 Inclination of rear axle case (static load)
6 Inclination of rear axle case (max. compression)
7 Inclination of rear axle case (max. extension)
8 Front shaft (sliding) and axle case axis must have the 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 inclination must be within 4° and 6° (nominal 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 between engine-gearbox axis, second intermediate shaft and rear axle, axle housing axis is mantained in vehicle static load conditions.

Figure 2.10

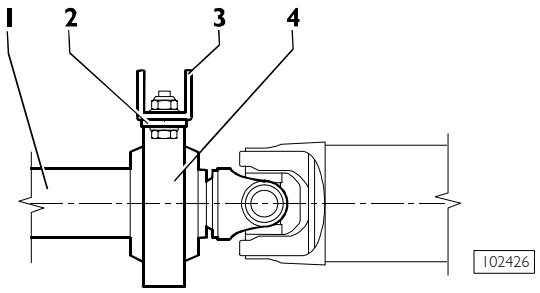


1 Engine, clutch, gearbox axis
2 Front shaft
3 Rear shaft support
4 Intermediate shaft (sliding)
5 Rear shaft (fixed portion)
6 Inclination of rear axle case (static load)
7 Inclination of rear axle case (max. compression)
8 Inclination of rear axle case (unladen)
9 Gearbox, sliding intermediate shaft 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.

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.

Since the transmission drive line 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.

2.9 Modifying the Rear Overhang

2.9.1 General specifications

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 3.2). 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.

2.9.2 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.

2.9.3 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.

2.9.4 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 2.7.

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. 2.5.

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

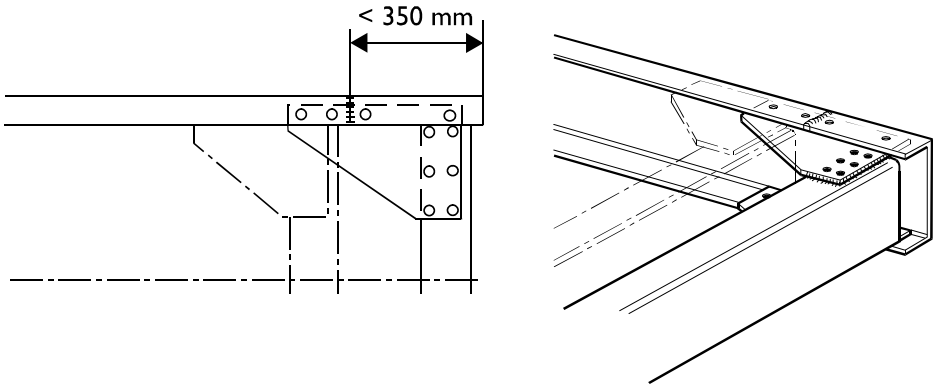


Figura 2.12a

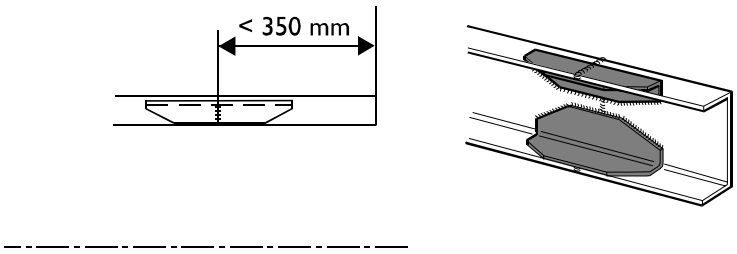
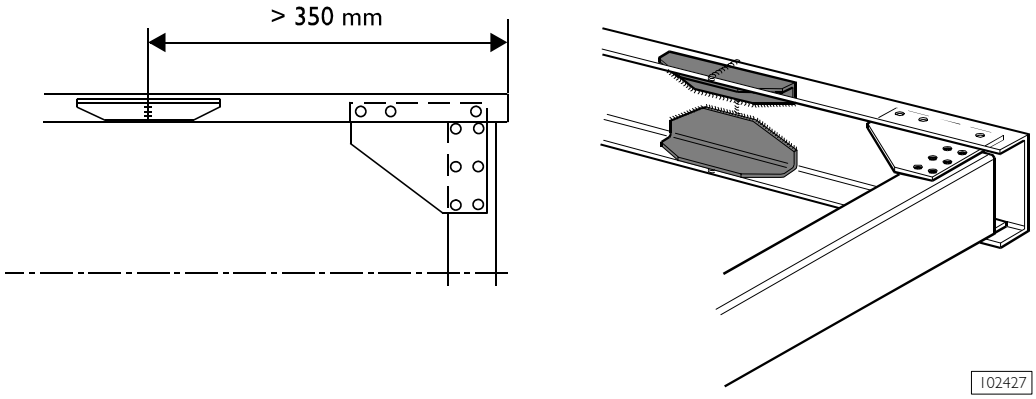


Figure 2.13



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.

2.10 Installing a Towing Device

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.

Choosing a Hook

The hook must be chosen based on the following characteristic values:

- for towing gear which is not suitable for transmitting vertical loads, the D value is defined by the following formula:

$$D = g \cdot \frac{T \cdot R}{(T + R)} = (kN)$$

- for towing gear for trailers with a centre axle, the Dc, S and V values are defined by the following formula:

$$Dc = g \cdot \frac{(T + S) \cdot C}{(T + S) + C} (kN)$$

$$V = \sigma \cdot \frac{X^2}{l^2} \cdot C (kN)$$

D = representative value of the class of jaw (kN). This is defined as the technical reference force for the horizontal force between the towing vehicle and the trailer;
g = acceleration due to gravity (m/s^2);
T = maximum weight (in tonnes) of the towing vehicle;
T+S = maximum weight (in tonnes) of the towing vehicle + the vertical load of a trailer with a centre axle;
R = maximum weight (in tonnes) of the trailer;
S = value of the static vertical load (in tonnes) which, in static conditions, is transmitted to the point of attachment. S must be $\leq 0,1 \cdot R$;
C = sum of the maximum axle loads (in tonnes) of the trailer with a centre axle at maximum load. It is equal to the maximum weight of the trailer with a centre axle less the static vertical load (C = R - S);
V = value V of the intensity of the theoretical dynamic vertical force;
a = for the equivalent acceleration at the point of attachment, as a function of the rear suspension of the towing unit, use the following values:
- a = 1.8 m/s^2 for air suspension;
- a = 2.4 m/s^2 for other suspension types;

X = length of the load surfaces (m);
l = theoretical length of the drawbar (distance between the centre of the drawbar towing eye and the centre line of the trailer axle (m));
$X^2/l^2 \geq 1$ if the result is less than 1, use the value 1.

Example for calculating the class of towing gear for trailers with a centre axle

Daily 65C15 with maximum mass 6250 kg vehicle pulling a trailer with a centre axle of 3500kg with S=250 kg a loading surface length of 5 m and a theoretical drawbar length of 4 m.

Therefore, from the data

1. S = 0.25 t
2. C = R – S = 3.5 - 0.25 = 3.25 t
3. (T + S) = 6.25 + 0.25 = 6.5 t
4. $X^2 / l^2 = 25 / 16 = 1,5$

we obtain:

D_c = 9.81 x (6.5 x 3.25) / (6.5 x 3.25) = 21.3 kN, e V = 1.8 x 1.5 x 3.25 = 8.8 kN

The following table shows the approved hooks for vehicles. Check, by referring to the approval documents, the conditions under which these devices are permitted.

Table 2.15 - Approved hooks avaible from the production

Maker	Type	Class	D (kN)	D_c (kN)	S (kN)	EC approval no.
Orlandi	GS500	A50-X	22.5	-	250	e11*94/20*0533*00
Orlandi	GA381	S	22.5	-	250	e11*94/20*1613*01

The following table shows S maximum admitted value for original towing cross member when towing a central axle trailer.

Model	Maximum S (kN)
29L, 35S	100
35C, 40C	120
45C, 50C, 60C, 65C	250

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.

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.

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.

Ball hooks

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.

The automatic hook for the truck version can also be fitted to the same crossmemberss provided for the ball hook.

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

If not already fitted by IVECO, it can be retro fitted following the instructions given in point 2.19.11.

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.

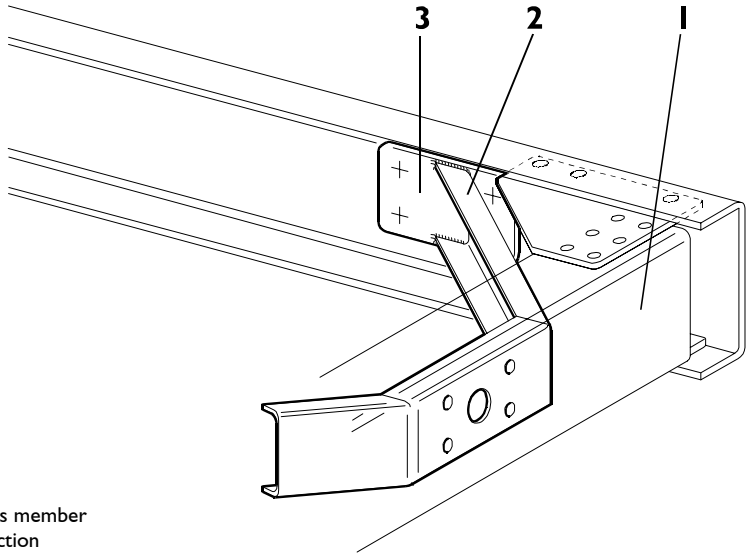
Such authorisation will include the conditions that must be complied with and, where necessary, specifications concerning modifications and work to be carried out on the vehicle.

These include possible reinforcements to the standard cross member (see Fig. 2.14), the instructions for installing a reinforced cross member when available, and changes to be made on the brake system.

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

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

Figure 2.14 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

102428

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 weight on the front axle is observed, as indicated in point 3.2.3.

Rating plates

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

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

2.11 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 on one side and one semielliptic spring on the other side 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 2.18).

No modification of suspensions is permitted on vehicles with ESP (optional 8123). See point 2.18.5.

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.

2.12 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 IVECO authorisation.

Any work done must not alter the existing vacuum values of the intake or the exhaust back pressure shown in the Table 2.16.

Table 2.16 - Maximum back-pressure permitted at rated speed and full load

Engine	Engine code	Exhaust back-pressure (kPa)	Minimum-maximum intake depression (kPa)
9	8140.63	20	1.5 - 6.7
11	8140.43C	20	1.5 - 8.5
9	8140.43R	16.5	1.5 - 8.5
11	8140.43B	16.5	1.5 - 8.5
13	8140.43S	16.5	1.5 - 8.5
15	8140.43N	16.5	1.5 - 8.5
10	F1AE0481A	11	1.6 - 8.5
12	F1AE0481B	12	1.6 - 8.5
14	F1AE0481M	12	1.6 - 8.5
14	F1AE0481E	12	1.6 - 8.5
14	F1CE0481A	15	1.5 - 8.5
17	F1CE0481B	15	1.6 - 8.5

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 and free of sharp edges or welding burrs inside the tube.

Sufficient clearance should be maintained (min. 150 mm) between the exhaust pipe and the electrical system, plastic hoses, the spare wheel, the plastic fuel tank (min. 100 mm), 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 carried out on the exhaust system of the vehicle will require the vehicle to 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 and in any case not less than the original one. 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.

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.

2.13 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. 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.

2.14 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 2.19). 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 2.13), 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 combustion gas circulation inside the vehicle) 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.

2.15 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 2.19). 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.
- 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 2.16.3).
- For specific applications with compressors not supplied by IVECO (e.g. fridge box), contact the IVECO local office.

2.16 Cab and bodywork modifications

2.16.1 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 3.2).

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 2.2).

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.

2.16.2 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 2.2).

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.

2.16.3 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.

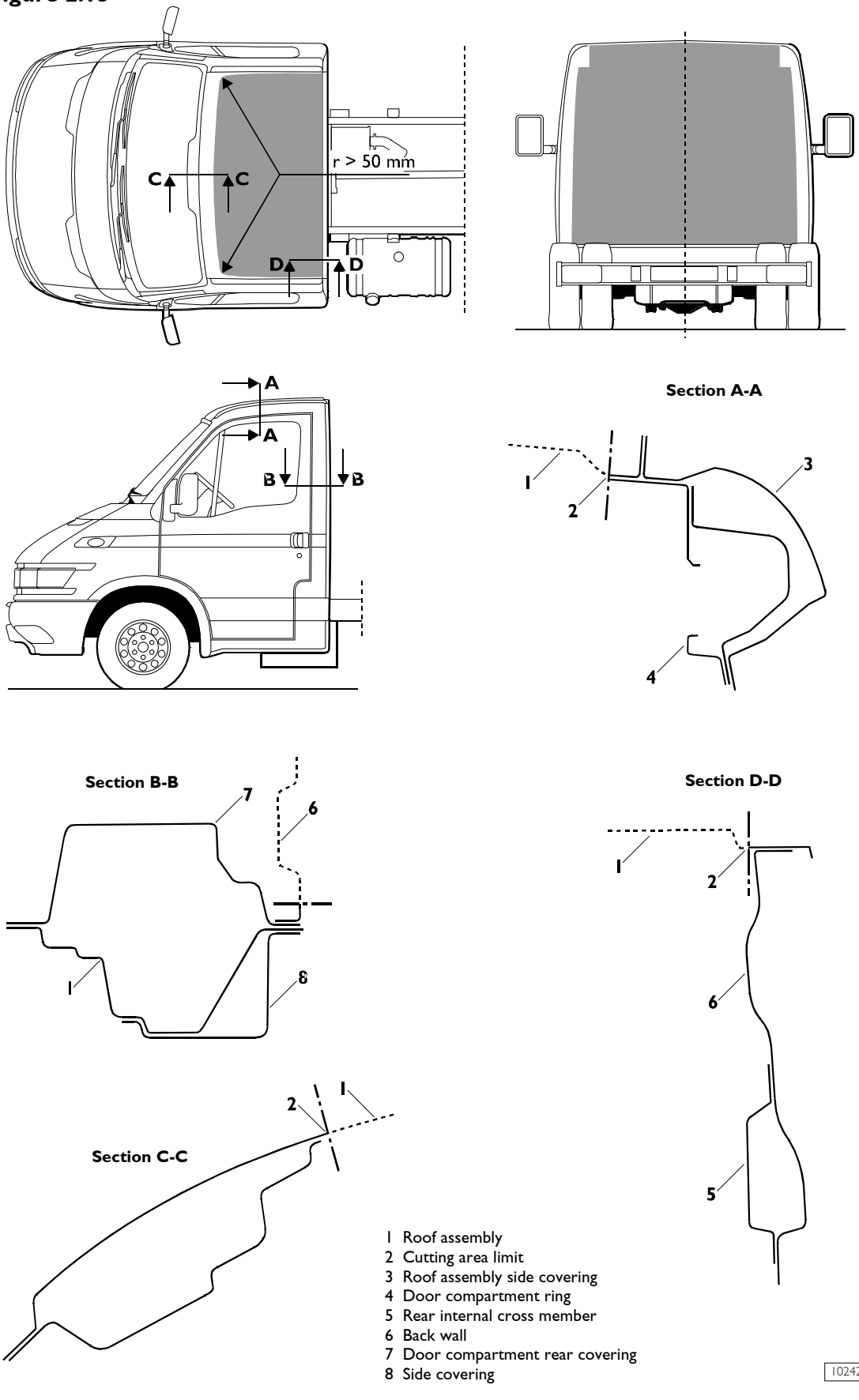
Whenever national regulations require it, these installations will be inspected by the responsible agencies.

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 2.15, 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.
- Make the connection with the new structure by following the general guidelines given above.

Figure 2.15



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

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2.16.4 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 overall value of 150 kg must not be exceeded.
- The permitted mass for each fixing element must not exceed 25 kg.

Figure 2.16

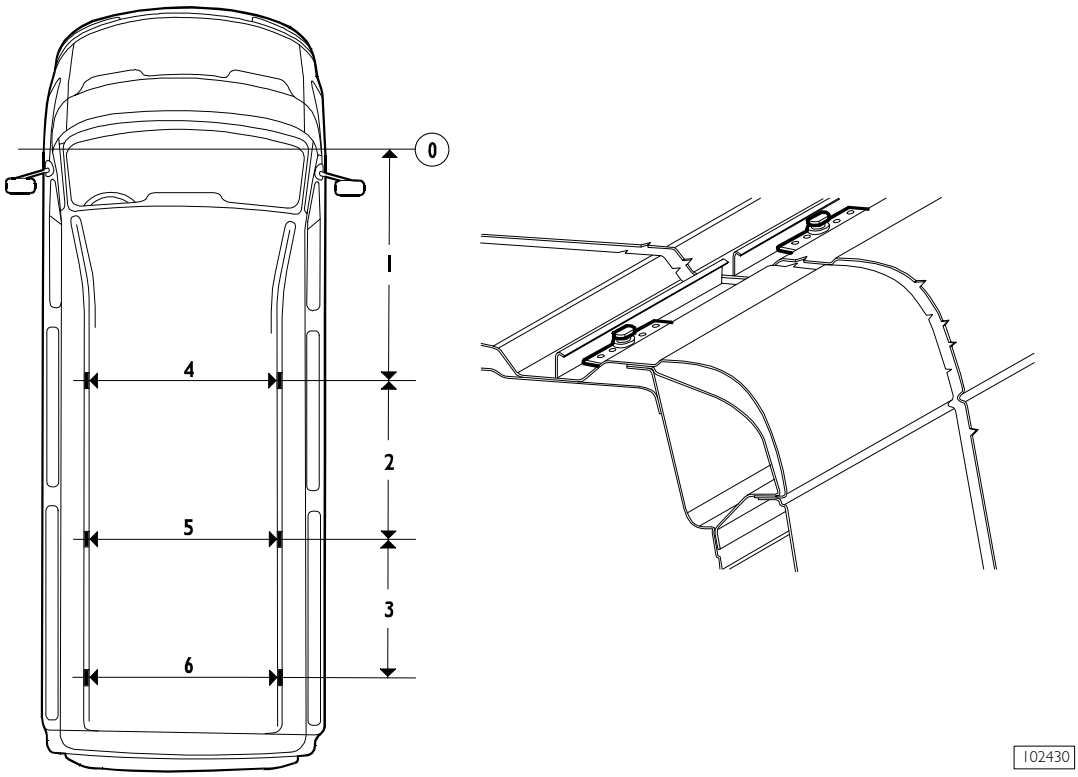


Table 2.17

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.

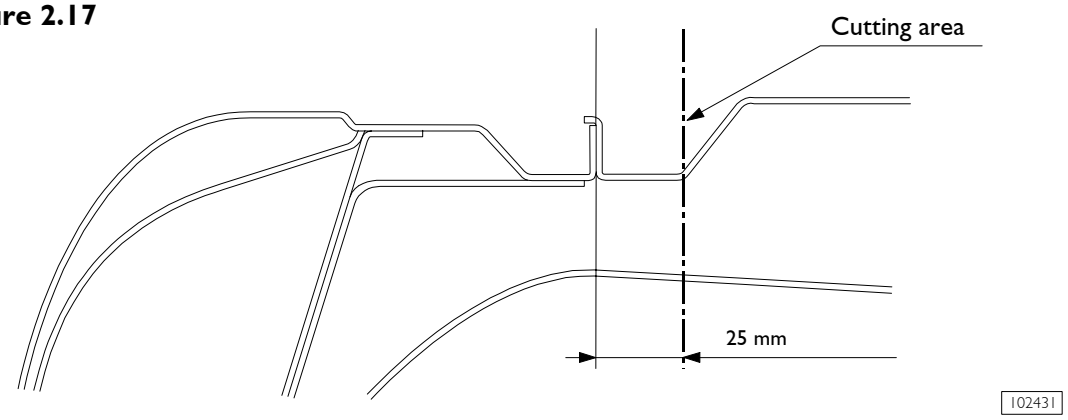
For vehicles that have already been manufactured, the modification is possible by proceeding as follows, taking the necessary precautions.

- Purchase from IVECO Parts the following components:

Component	Part number	Quantity
Translucent roof	500360077	1
Roof support cross member	500360079	2
Roof support	500360089	2

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

Figure 2.17



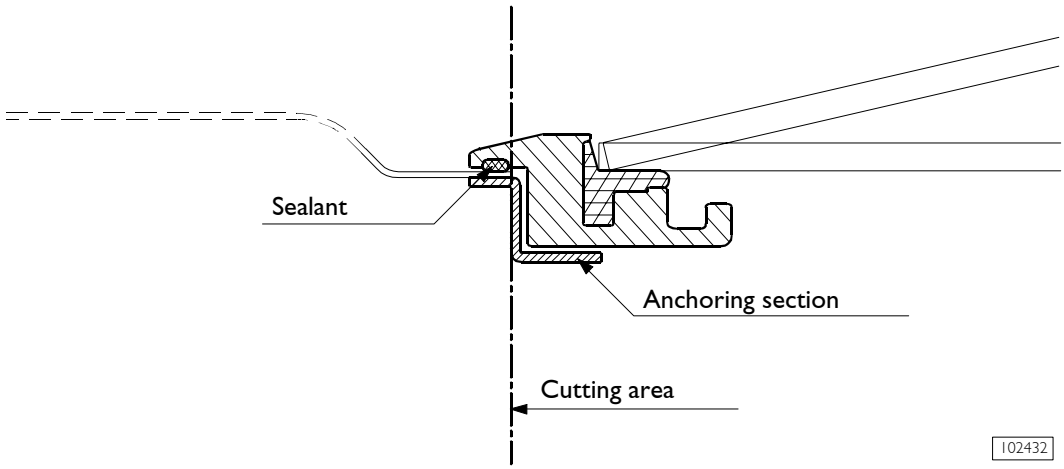
- Leave approximately 25 mm of the original roof joint area (see Figure 2.17);
- weld (using the most convenient, efficient and safest method) the four roof support crossmembers to the remaining part of the roof using the 25 mm that was left for this purpose when the roof was cut;
- glue the translucent roof (500360077), by placing it down from above, on the roof support crossmembers in place using suitable gluing compounds (e.g. Betafili, Gurit, Essex, etc.) taking care to ensure the complete joint is waterproof (see Figure 2.17).

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. 2.18 shows an example of installation.

Figure 2.18



c. Modifying the roof panel height

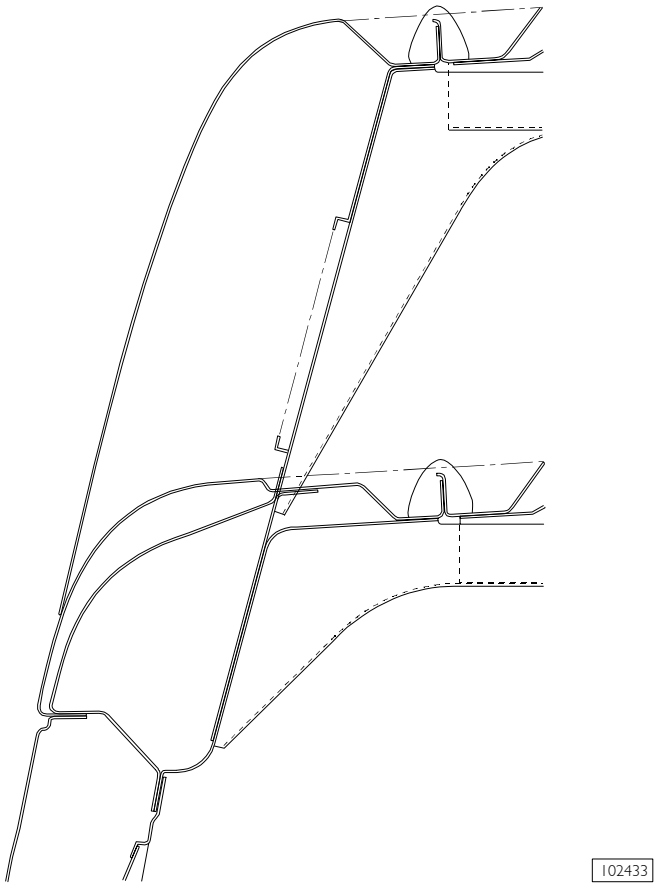
There are three internal heights of the roof assembly available on request:

- 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. 2.19 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 2.19



d. Making side windows

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

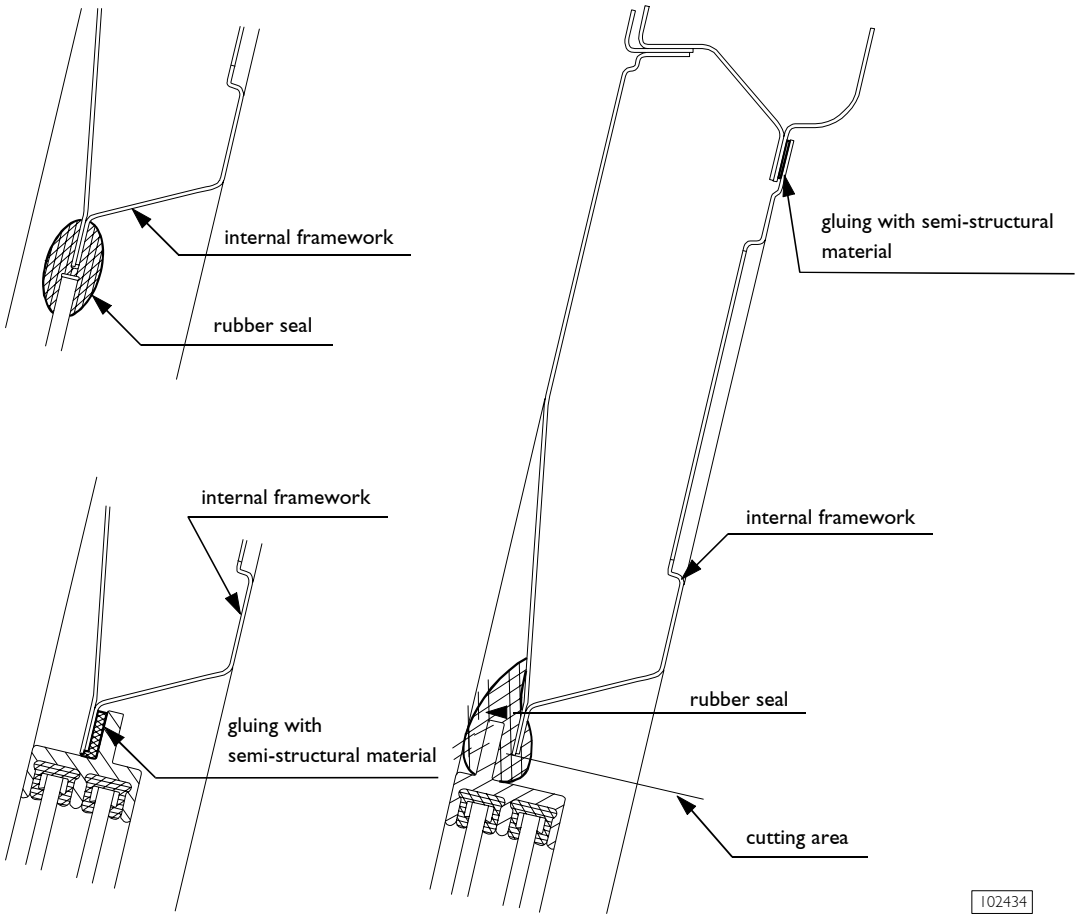
Cut the sheet as shown in Figure 2.20, taking care to keep a circumferential profile with a minimum width of:

- 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. 2.20) 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 2.20



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.

2.16.5 Occupant protection

The airbags, seat belt anchorage points (the positioning of the belt retractors and pre-tensioning devices), seat anchorages, as outlined 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 legal requirements.

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 sensors and its wiring;
- installation of components close to the opening on the dashboard.

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

Note

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

Anchoring safety belts

Work done in the areas of the seat belt anchorage points may affect their compliance with CE certification.

Check for compliance with any legal requirements.

Seats

The seats have been anchored to the floor structure in compliance with legal requirements 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 regulations.

2.17 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.

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.

2.18 Modifications to the Braking System

2.18.1 General Specifications

The braking system and its components are very important to traffic safety and vehicle dependability.
No modifications are permitted 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.

2.18.2 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:

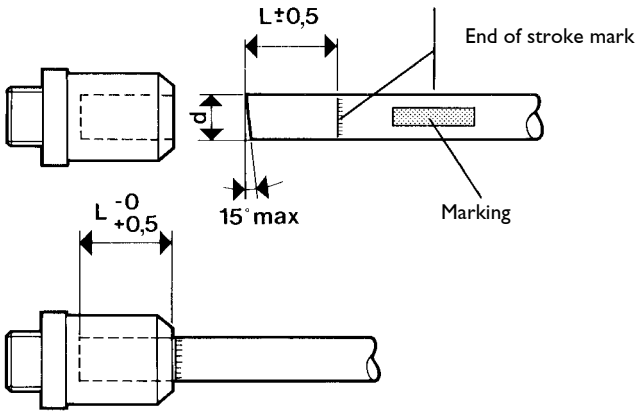
- Material and dimensions : Standard DIN 73378 e 74324 (max. operating pressure 11 bars)
- Radii of curvature (referred to the pipe centreline) : min. 6 · ⌀ est

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. 2.21) 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 2.21



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.

Table 2.18

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.

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

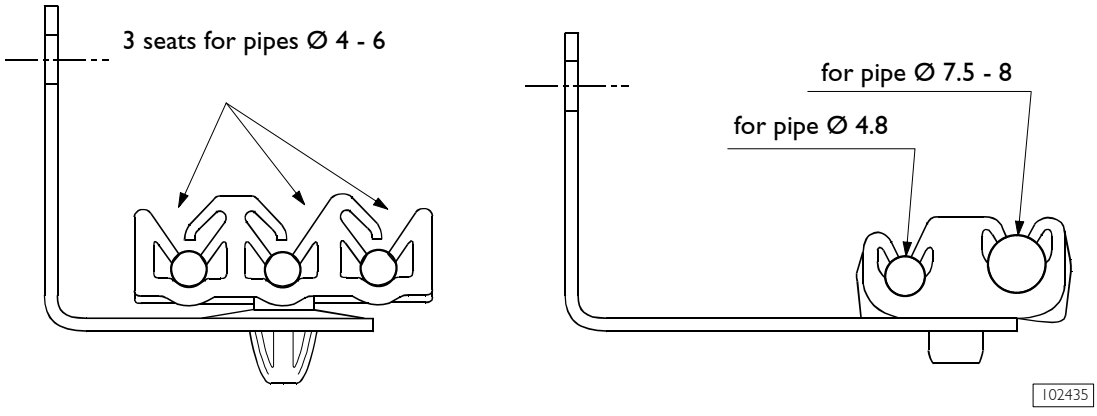
2.18.3 Installing pipes on the vehicle

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

Figure 2.22



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 below. The efficiency of the braking system must then be checked.

Manually bleeding air from the hydraulic brake system

There is one bleed screw on each brake caliper.
Carefully repeat the following operations on each of the calipers (the following sequence must be used rear right, rear left, front left, front right):

- check the brake fluid level in the reservoir on the power brake, top up to the maximum level;
- clean the brake area surrounding the bleed screw;
- remove the rubber cap protecting the bleed screw;
- using a transparent flexible tube fix one end over the bleed screw and immerse the other end in a container part filled with brake fluid;
- loosen the bleed screw by one turn and press the brake pedal down to the floor:
- with the pedal held down on the floor tighten the bleed screw and then release the pedal;
- repeat the above two steps until all the air has been removed from the calliper;
- make sure the brake reservoir does not become empty while bleeding the callipers as this will allow air into the brake system;
- repeat the above for the other callipers where necessary.

The fluid discharged from the hydraulic circuit during the bleed operation must not be used again.
Top up using only the fluid of the prescribed type, contained in original, sealed containers that should only be opened when using the fluid.

Bleeding air from the hydraulic brake system using "MODUS" on vehicles equipped with ABS/ABD/EBD system

On vehicles equipped with ABS/ABD/EBD systems, the traditional, manual bleeding operation described above may not be sufficient. The presence of air causes the brake pedal stroke to be longer, with possible anomalous actuation of the system.
The manual operations must be carried out, which will be driven by the program included into "MODUS".
This program makes it possible to perform full drain (primary circuit and secondary circuit of the modulator) under item "System filling/emptying".
In fact, an operator actuates cyclic operation of the modulator solenoid valves and the pump.
At the same time, by operating the brake pedal and acting on the drain screw of the caliper pointed out according to the manual procedure, the air bubbles still found in the concerned portion of the system can be blown out.
Then, you should follow the instructions that appear each time on the screen, taking care not to exceed the solenoid valve and pump actuation time, so as to avoid component overheating.
In such an instance, the system will be deactivated, and you will have to wait for the established time in order to be able to start the operation again.

In the event that the modulator is replaced (the modulator is supplied by the Spare Parts Department already filled with the brake fluid in every of its parts), you only need to follow the manual drain procedure, taking care not to empty it up and not cause its pump and solenoid valve to cycle prior to full charging.

The ABS, ABD, EBD modulating devices, placed on the chassis in the engine compartment, shall not be moved.

When modifying the wheelbase, the electric cables between the rear axle sensors and the control unit shall be adapted by using new cables or extensions with proper connectors. The brake piping downstream the modulator shall be adapted too.

Warning

Great care shall be taken, when carrying out the work, to observe correct connection of the piping for every single wheel.

Carry out, every after intervention, the necessary checks and tests for correct operation, at the Authorized Workshops equipped with the specific equipment.

2.18.4 Instructions for adjusting the braking load proportioning valve

Load proportioning valve version

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

- version for dual circuit (crossed) for vehicles with single rear wheels (mod. 29L and 35S);
- version for single circuit for vehicles with twin rear wheels.

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. 2.23).

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.

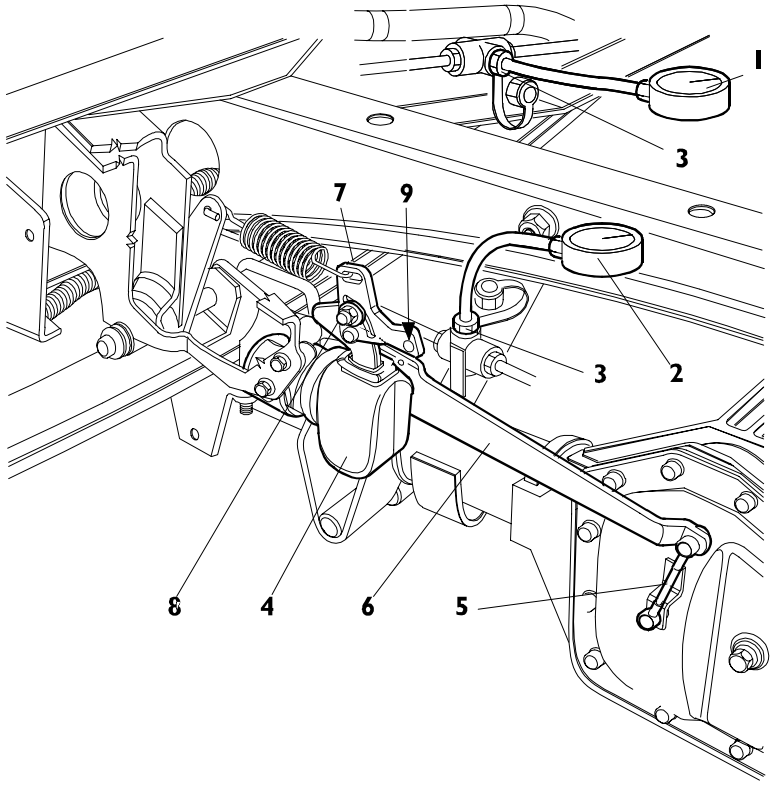
- Connect the pressure gauges 1 and 2 to the pressure test points upstream and downstream from the braking load proportioning valve with the test fittings 3.
- Loosen the joining screw 8 of the proportioning valve adjustment lever 7.
- On hole 9, apply the specific adjustment load for each model and 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:

Table 2.19

Models	Rear leaf spring Type (part no.)	Load on adjustment lever (kg)	Reference load on ground on rear axle (kg)
29 L - 35S	single blade (504054606 -...)	1,5	1500
35 C	semi-elliptic (504048792 -...)	3,5	1500

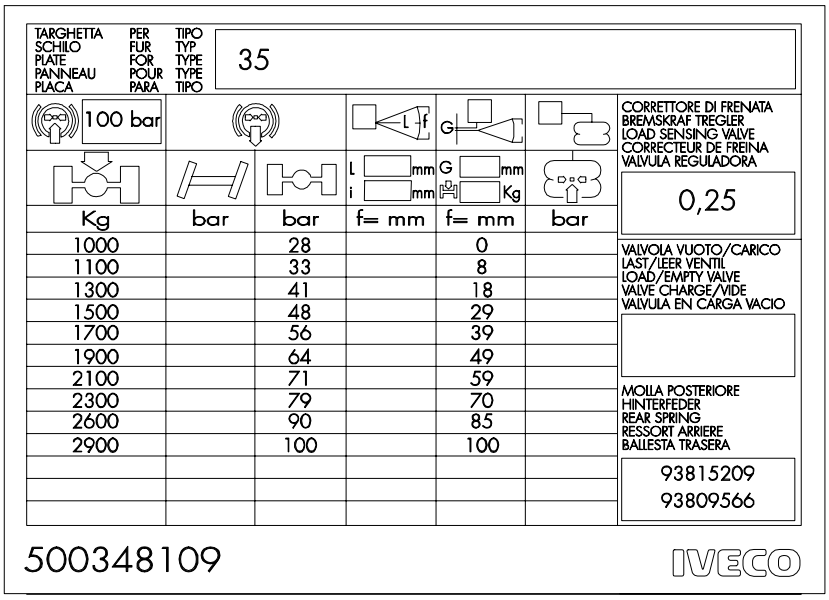
- Tighten the joining screw 8 to the required torque of 16 – 19 Nm.
- Operate the brake pedal to reach the control pressure of 100 bars in the circuit upstream from the load proportioning valve.
- Check that the output pressure corresponds to the value given on the rating plate, corresponding to the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

Figure 2.23 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 2.23a An example of a tag for a brake corrector of a 35C vehicle.



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 vehicle is equipped with the ABS system, no adjustment need be made.

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 2.18.4, 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.

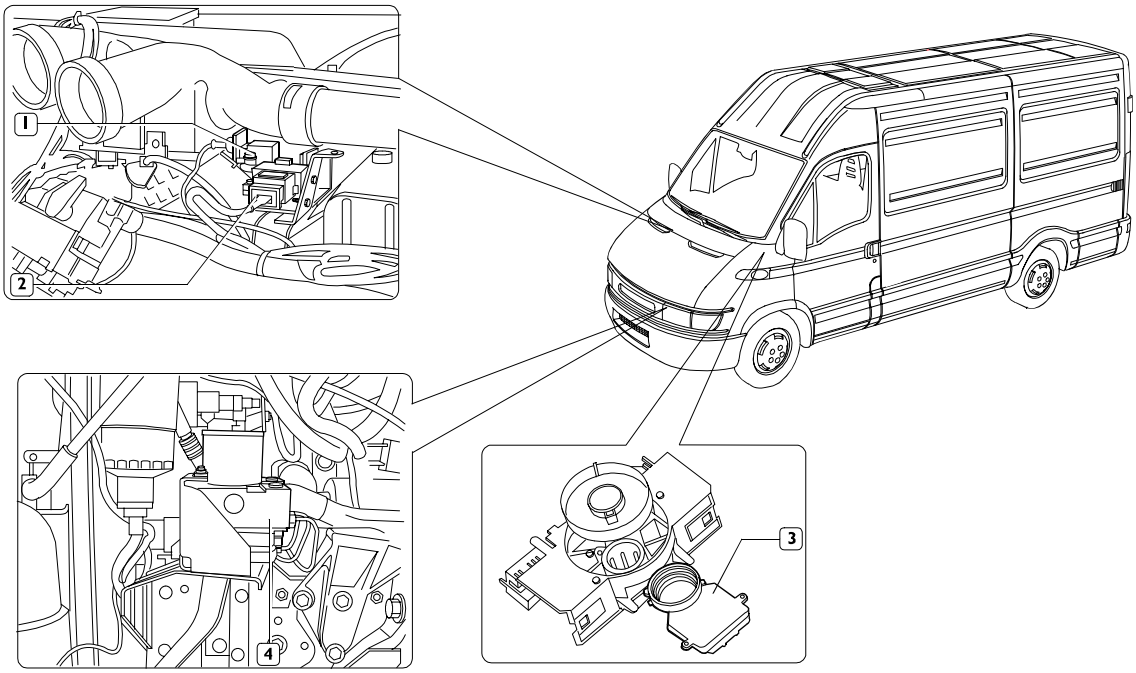
Changing the data on the rating plate of the load apportioning valve requires it to be replaced with another one giving the new data.

2.18.5 ESP (Electronic Stability Program)

On vehicles with ESP (optional 8123) no suspension or pitch modifications are allowed. Installing, positioning and fixing points of the yaw rate sensor and also of the steering angle sensor (Figure 2.24) must not be modified. Tires not manufactured in production cannot be used. Vehicles with ESP cannot be changed from trucks into tractors.

Modifications carried out without keeping in mind the above mentioned prescriptions may cause improper system enabling and therefore driving troubles may occur.

Figure 2.24



1. Longitudinal sensor - 2. Yaw rate sensor - 3. Steering angle sensor - 4. ECU/Modulating value.

2.19 Electrical system

2.19.1 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.

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

Note

For more detailed information on the vehicle's electrical system, please refer to the specific Workshop Manuals.

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

Work on the system (e.g. removing wiring harness, making additional circuits, replacing equipment, changing fuses, etc.) that is not done in conformity with IVECO instructions or is 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 damage (e.g. short-circuiting with the risk of fire and destruction of the vehicle) that is not covered by warranty.

It is absolutely prohibited to make any changes or connections to CAN line, which cannot be tampered with, under any circumstances. Any fault diagnosis or maintenance work can only be done by authorized personnel with IVECO approved equipment.

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 problem with keys and ancilliaries disconnected.

Restore the original conditions of the wiring (routing, guards, and binding, preventing the cable at all costs from coming into contact with metal surfaces of the structure that may impair its integrity).

2.19.2 Battery service procedure

1) Charge check
   Frequency: for the first time, after 15 days from storage; subsequently monthly; at last before the vehicle is handed over to the customer.
   Test conditions: the battery must not have been charged during the preceding 10 hours; neither by a charger, nor by the alternator (by a running engine).
   If these conditions cannot be complied with, the battery must be stabilized as follows before taking any measurements: switch on the dipped beam and heater fan (highest position) for 60 seconds about. Switch off all current consumers and close the doors. Wait for at least 3 minutes.
   With a digital voltmeter measure the rest voltage between the terminals of each battery.
   Test values and procedures:
- Battery voltage: less than 12.1V: Replace battery.
- Battery voltage: between 12.1V and 12,5V: the battery must be charged for at least 8 hours; no quick charger should be used. After every charge session the battery rest voltage must be stabilized before measuring the rest voltage as described above.
- Battery voltage: higher than 12,5V: the battery is in good condition, no charger is required

2) Check the electrolyte level in every cell. If necessary, top up with distilled water.
3) Visual inspection of the battery exterior: Check the battery for damage and leaks.
   Replace the battery if any damage is found.
4) Minimize discharging if the battery is unused for a long period.

   Stationary overnight and through the weekend:
- Tachograph: turn both control knobs to the rest position, fit the tachograph disc and close.
- Main circuit switch: Off

   Stationary for more than two weeks:
- Main circuit switch: Off
- Disconnect the battery earth lead

2.19.3 Modifying the electrical system

Alternator battery, electrical/electronic components

In order to protect the vehicle components, take the following precautions at all times.
Never disconnect the batteries from the system or open the main current switch (opt 2532) when the engine is running.

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.
Control units equipped with metal sheathes have to be earthed through a screw or bolt unless otherwise specified.

Do not tow-start the vehicle.
Do not start the engine without connecting the batteries permanently.

Should it be necessary to quick charge the batteries, disconnect them from the vehicle circuit. Starting will have to be carried out only with the external battery trolley, according the following procedure.

- To avoid damage to engines when starting it is important that the fuel tank contains sufficient fuel. Attempting to start an engine with insufficient fuel could result in serious damage to the fuel injection system.
- Observe all standard safety procedures (including wearing safety goggles).
- Use a back-up battery with similar specification to those on the vehicle.
- Switch off all the electrical devices on the dead vehicle that are not strictly required.
- Connect a jump lead from the positive terminal of the back-up battery to the vehicle's battery positive terminal.
- Connect another jump lead from the negative terminal of the back-up battery to one of the earth point on the vehicle. This point should be at least 300mm away from the vehicle's battery to avoid risk of battery gases exploding.
- Switch on the ignition and wait for all engine related warning lights to go out. Start the engine of the vehicle. Do not crank for more than 10 seconds. Do not depress the accelerator while starting the engine.
- Allow the started vehicle engine to idle.
- Switch on electrical loads on the started vehicle - e.g. headlights, heater fan. This will prevent any current/voltage surge when the back-up battery is disconnected which could damage ECUs.
- Remove the negative jump lead from the started vehicle's chassis earth point and then from the back-up battery.
- Remove the positive jump lead from the back-up battery and then from the started vehicle's battery.
- Switch off the electrical loads, one at a time, on the started vehicle.

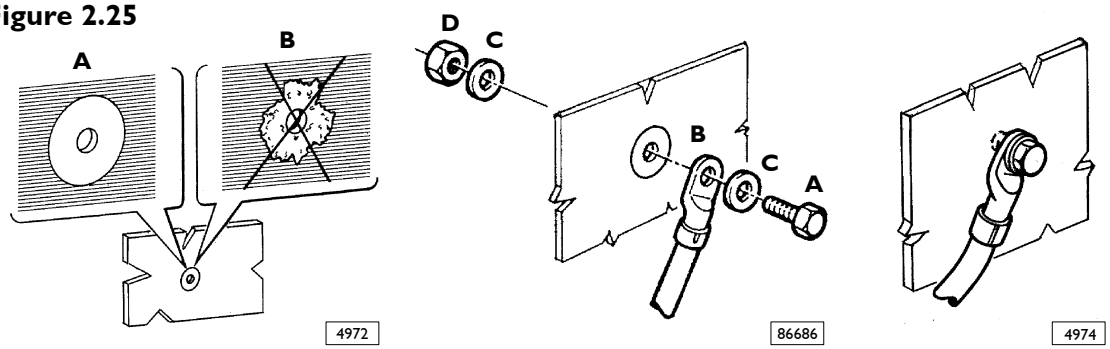
At the earliest opportunity the battery should be properly recharged off the vehicle using the correct recharging procedure - slow charge at low amperage.
Do not use a high voltage battery charger/booster to start the engine. If in doubt refer to Iveco Dealer. Any damage to ECUs caused by not following this procedures will not be covered by the vehicle warranty.

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:

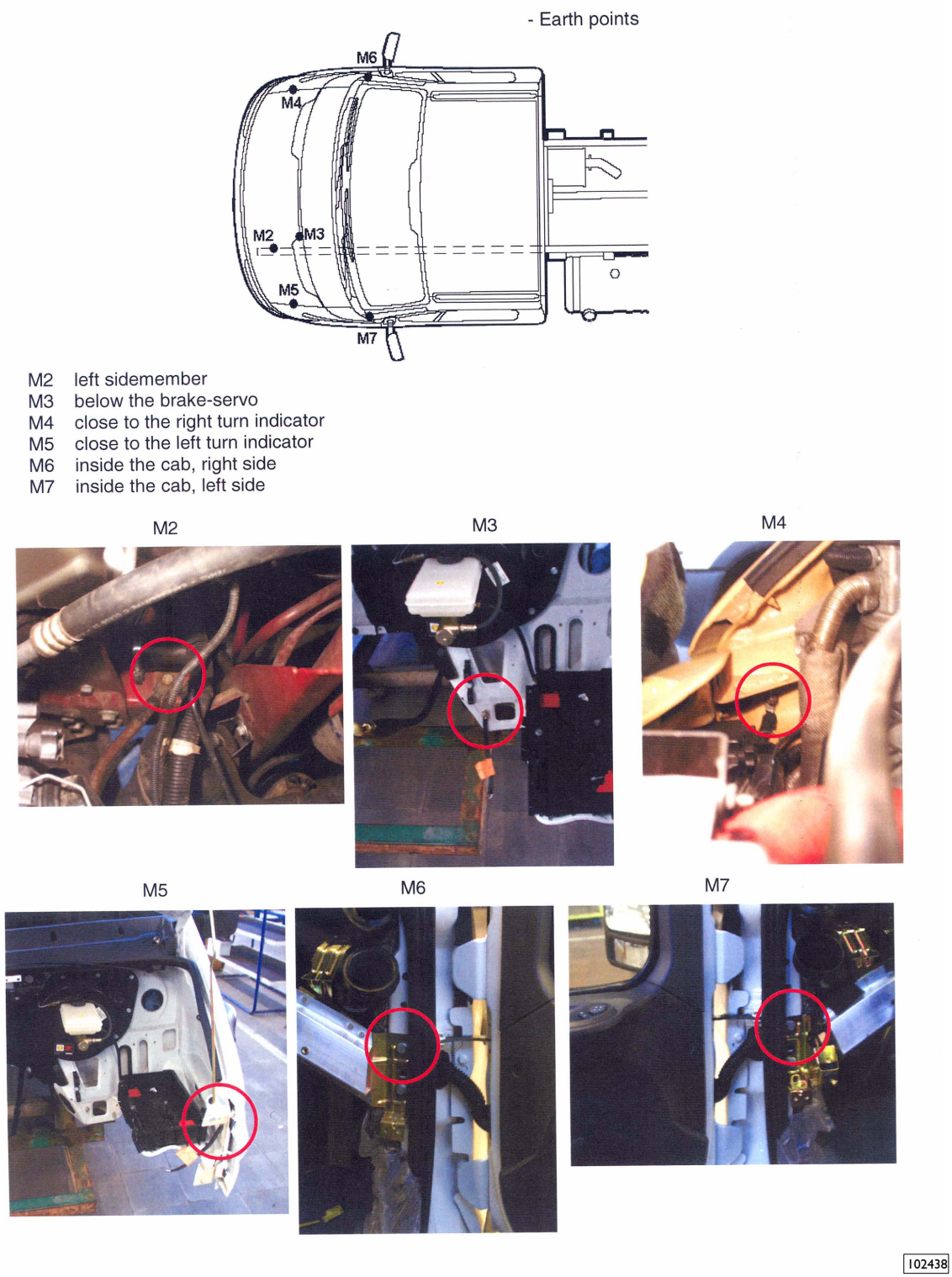
- Remove the paint, either by filing and/or using a suitable chemical product, on both the chassis side and terminal side, ensuring that the anaphoretic paint is completely removed from the chassis and a support surface is created with no indentations or ridges;
- Apply appropriate high conductivity paint 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 standardised (engine and chassis earth connection) points for the earth connections for control switches (e.g. sensors or low absorption devices).

Figure 2.25



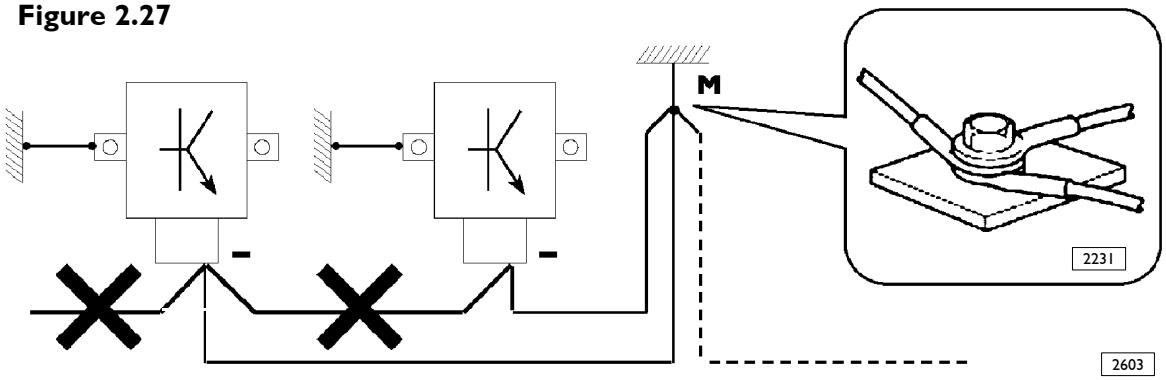
1 - EARTH CONNECTIONS: A. EFFICIENT EARTH POINT - B. INEFFICIENT EARTH POINT
2 - WIRE ATTACHMENT: A. SCREW - B. WIRE TERMINAL - C. WASHER - D. NUT
3 - WIRE CONNECTED TO EARTH

Figure 2.26


- Earth points
M6
M4
M2
M3
M5
M7
M2 left sidemember
M3 below the brake-servo
M4 close to the right turn indicator
M5 close to the left turn indicator
M6 inside the cab, right side
M7 inside the cab, left side
M2
M3
M4
M5
M6
M7
102438

The negative wires connected to the system earth points must be as short as possible and interconnected with a "star" connection.

Figure 2.27



2.19.4 Additional circuits

These must be separated from the vehicle's main circuit and protected with a fuse.

Additional electric wires must be connected to the original electrical system with the same type of sealed connectors as the original ones. They must be protected with sheaths (not PVC) or ducted in corrugated pipes fixed with fasteners, shielded from impact and heat sources.

The wires must be at minimum distances of:

- 150 mm from major heat sources (turbine, engine, exhaust manifold, ...)
- 50 mm from containers of chemical agents (batteries, etc...)
- 20 mm rom moving parts

Take great care to prevent the wires rubbing against other components, especially against sharp edges on the bodywork.

Wherever possible, wire routes must be secured with fasteners and dedicated clips, set close together (about 350 mm apart) to prevent sagging, making it possible (and obligatory) to route them in the same way after repairs/ fitting work.

When the wires pass through holes or along the edges of panels, etc. they must be shielded with protective conduits (in addition to the corrugated piping). It is forbidden to drill through the chassis for wire passages.

The corrugated piping must protect the whole wire completely and connected to the rubber grommets on the terminals (with heat-shrink fasteners or tape). The clips on the corrugated pipe (when cut lengthwise) must not deform the pipe and the wires must not stray out of the piping or come into contact with sharp pipe edges.
All (+) terminals for wires must be protected with rubber grommets, (hermetically sealed in zones exposed to atmospheric agents or where water collects).
The wires must be attached to the terminals (both positive and negative) in such a way as to prevent slackening. Tighten with a torque wrench where possible and using radial crimpers for multiple connections (to be avoided where possible).
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.

Use fuses and wires of suitable cross-section, depending on current levels, as shown in the table. The fuse must be installed as close as possible to the current drawing point.

Table 2.20

Max continuous current [1] (A)	Wire cross-section (mm^2)
4	0.5
10	1
20	2.5
25	4
35	6
50	10
70	16
90	25
120	35
150	50

[1] For use periods longer than 30 seconds.

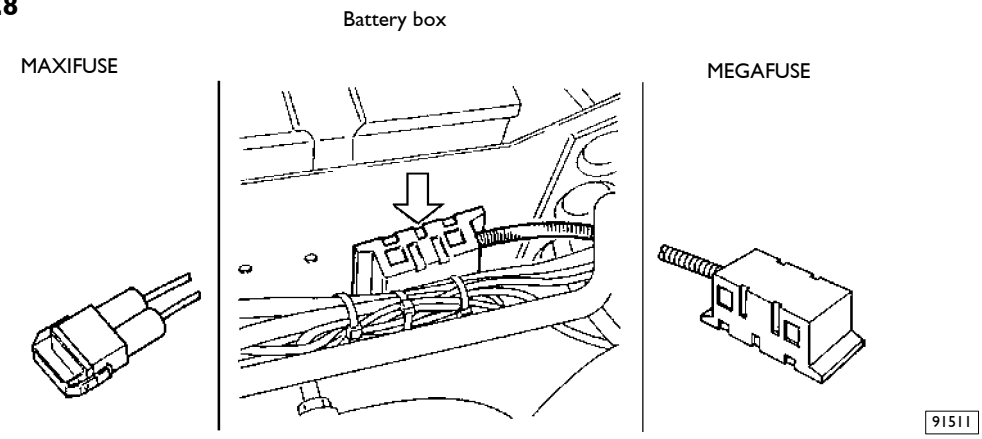
Use fuses that can be loaded at least 70-80% of ther maximum capacity.

Maxifuse and Megafuse fuses

A set of five fuse holder kits is available from any IVECO Parts Dept., to protect high power supplies.

These fuses should be positioned as close as possible to the supply terminal on the battery according to the space available on the vehicle.

Figure 2.28



Capacity	IVECO Ref. No.	Cable section
Kit 40A	4104 0110 KZ	$10mm^2$
Kit 60A	4104 0111 KZ	$10mm^2$

Capacity	IVECO Ref. No.	Cable section
Kit 100A	4104 0112 KZ	$25mm^2$
Kit 125A	4104 0113 KZ	$35mm^2$
Kit 150A	4104 0114 KZ	$50mm^2$

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.

Plug connections and terminals must be shielded and resistant to atmospheric agents, using the same type of components as on the original vehicle.

2.19.5 Installing additional equipment

When fitting additional equipment, where necessary, diodes must be fitted to provide protection against any induction current peaks.
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 2.19.3). 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:

The level of electromagnetic immunity of the electronic devices equipping the vehicle, at a distance of 1 metre from the transmitting aerial must be:

- 50V/m immunity for secondary devices, for frequencies ranging from 20 MHz to 1 GHz
- 100V/m immunity for primary devices, for frequencies ranging from 20 MHz to 1 GHz.

The maximum admissible variation in transient voltage for units powered with 12 V is $\pm$40V, as measured at the terminals of the artificial network (L.I.S.N.) during bench tests; otherwise, if the measurements are made on the vehicle, the variation must be determined at the most accessible point in the proximity of the device generating the disturbance.

Max. levels of radiated and conducted emissions.

Table 2.21

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
- Compressors for refrigerator systems.

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.

2.19.6 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.

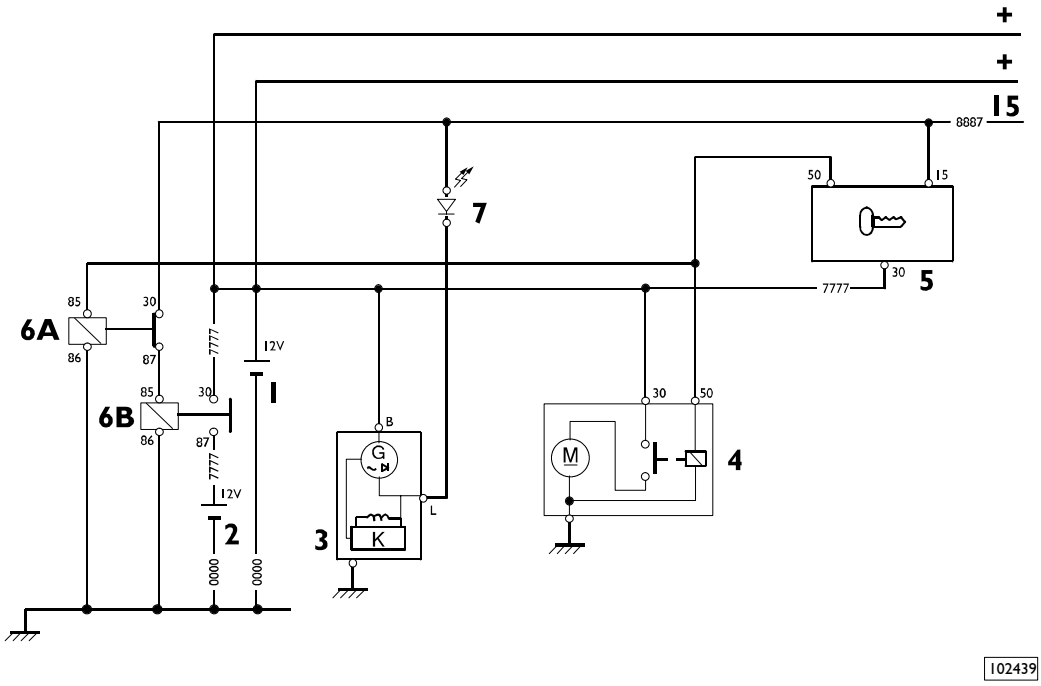
Additional Batteries and Alternators

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.

Installing additional batteries

Figure 2.29



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.

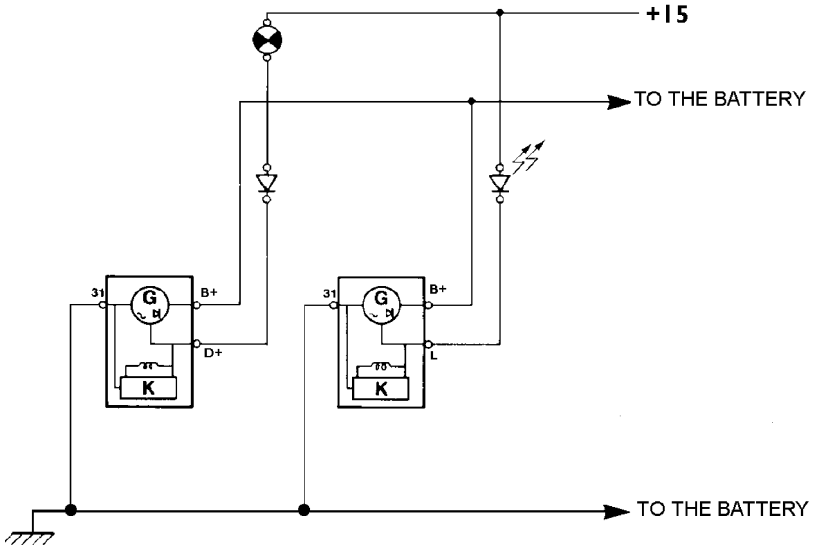
When using electric motors which are activated only while the vehicle engine is running, instead of supplementary batteries, it could be sufficient to use a larger power alternator or a supplementary one.

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. Moreover, each alternator requires a warning light or a LED to signal the alternator is charging.

In case of a supplementary alternator, it shall have the same electric characteristic of the one fitted in production and cables with sufficient section (20 mm^2 about) shall be used.

Figure 2.30

Installing an additional alternator



2.19.7 Drawing off power

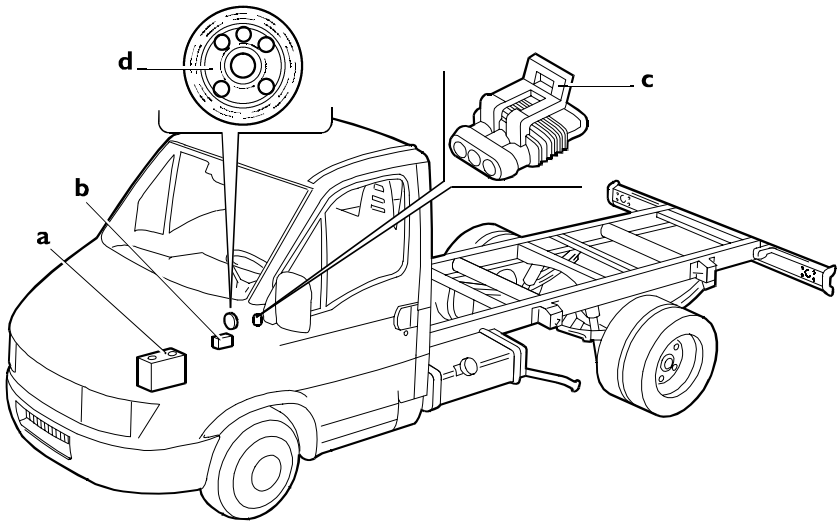
The information about the points from which power draw-off is possible (see Fig. 2.31), the available current and the precautions to be observed are as follows:

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 2.19.4.

Figure 2.31

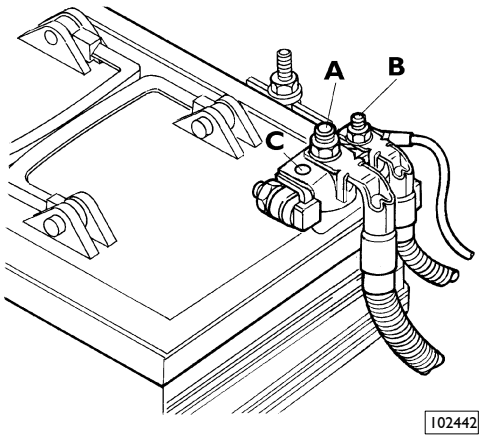


a. From the battery (engine bay) - b. From the junction box (engine bay) - c. From the three-way connector (in the cab) - d. Bulkhead connector (cables passing between engine bay and cab).

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

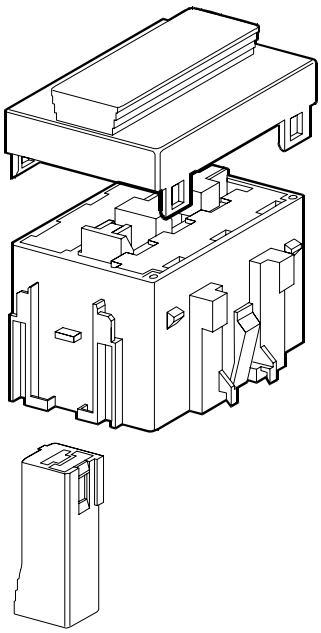
With engine off: 10A for 1 hour
20A for 1/2 hour

With engine running: Another 5-15A may be drawn off, depending on the engine speed.

If the terminal C is engaged, it's still possible to draw off power.
In that case, do not draw off a current higher than the maximum admitted valve for terminal C.

b) From the 6 way junction box (+30)

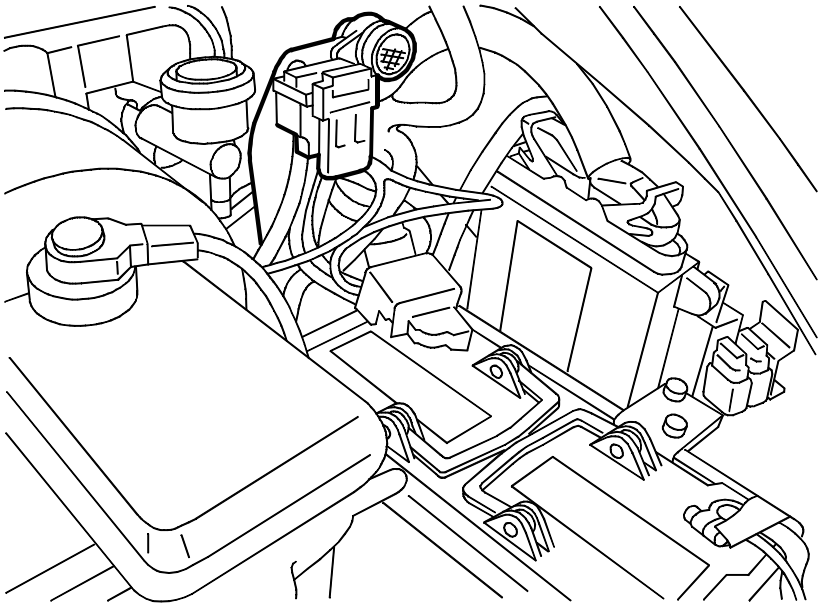
Figure 2.33



8630

Located in the engine compartment near the vacuum brake.

Figure 2.34



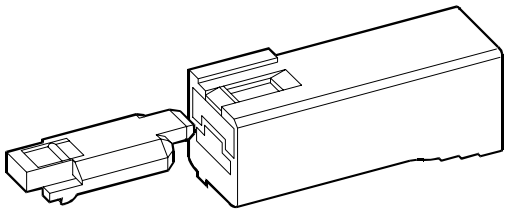
73722

At the bottom of the connector are 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.

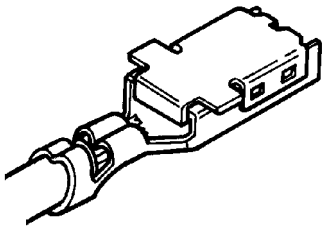
Female connector **Part number 12309787**

Figure 2.35a



Female cable terminal **Part number 19205894**

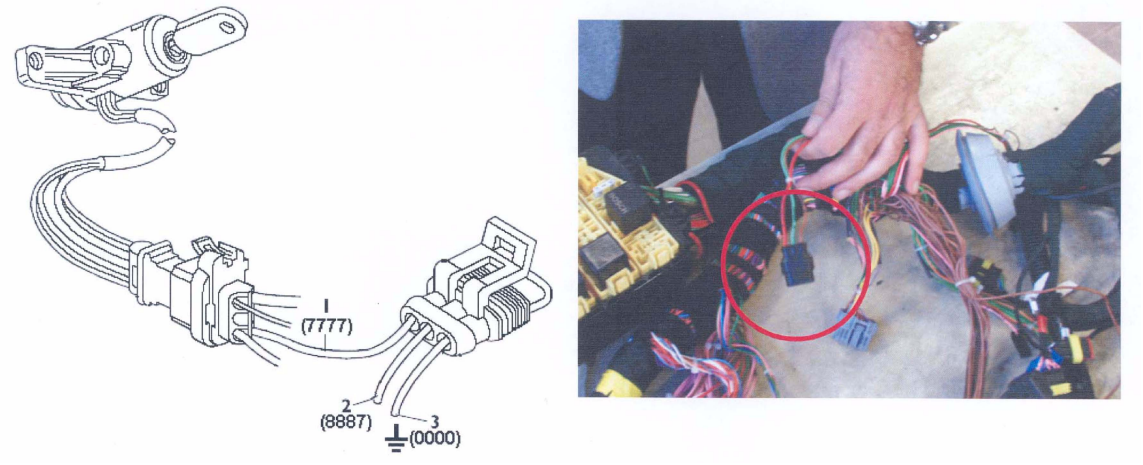
Figure 2.35b



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 2.36



102445

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

Pins 1 and 2 must be protected with suitable fuses. Max. total current value that can be supplied (pins 1+2) is 10A.

Connector parts required:

Table 2.22

Component	Part number	Quantity
Male connector:	98435341	1
Half shell:	98447231	1
Cable terminal:	98435370	-
Rubber gasket:	4861936	3

d) Taking cables in and out of the cab

To enable bodybluiders to take cables into and out of the cab there is a rubber grommet in the bulkhead closed to the brake-servo. This grommet has five, 10mm diameter, positions trough wich the cables should pass (see Fig. 2.37).

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

Figure 2.37

102446

2.19.8 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.

Use cables of adequate thermal class, depending on their position and intended use.

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.

2.19.9 Extending harness due to changes to 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.

2.19.10 Battery main switch

An electric battery isolator is available on request and is fitted under the battery and controlled a key switch.

For special operating conditions (e.g. when transporting fuel, hazardous goods, etc.), a special electric battery isolator complying with the regulations in force must be used.

2.19.11 Trailer 13-pole connector

When installing this connector you must not make a direct connection with any of the existing cables in order to avoid current overloads on the vehicle electrical system.

The connection must be made via an electronic control unit:

- install electronic control unit p.n.500347590 on the chassis, next to the fuel tank, by means of the special fastening bracket p.n.500349245;
- replace the corresponding cable with the cable shown in the table below (recommended option), or order the specific kit p.n.42535595 from the spare part department.

Table 2.23 - Cables on the chassis for 13-pole connector

Version	Wheelbase (mm)	Part number	Chart
Van	3000 short overhang	504093322 EZ	504093325 DA
	3000 long overhang	504093323 EZ	
	3300	504093324 EZ	
	3950	504093326 EA	504093326EA
Truck	3000 short overhang	504093309 EZ	504093316 DA
	3000 long overhang	504093310 EZ	
	3450	504093311 EZ	
	3750	504093312 EZ	
	4100	504093313 EZ	
	4350	504093314 EZ	
	4750	504093315 EZ	

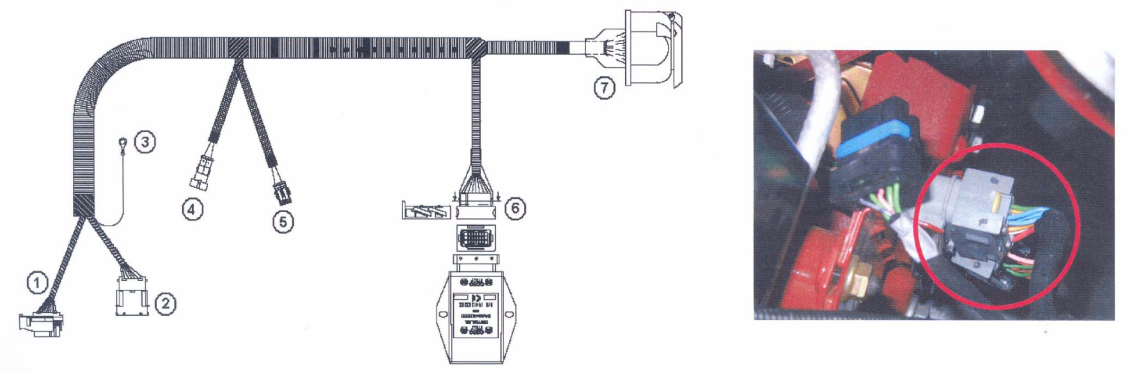
The electrical drawing shown in the chart column can be obtained from IVECO.

On all the vehicles manufactured after VAN 03683145, chassis number 5521889 (last seven numbers), a new electric cable is fitted. For those vehicles purchase from IVECO Parts the following components:

Component	Part number	Quantity
ECU	504115224	1
Support	504115223	1
Wire	504115226	1

Connectors 1 e 2 of wire 504115226 shall be connected to the 2 grey connectors (one to the chassis wire and the other to the cab wire) fitted on the right of the radiator (see Fig. 2.38).

Figure 2.38



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Connect to:
1-2 grey connectors close the radiator
3 earth points
4-5 neutral signal (on gearbox and related cable)
6 ECU 504115224
7 Trailer 13 pin connector

2.19.12 Installing Side Marker Lights

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

Vehicles in the Daily Range are equipped with a specific connector to which the side marker lights can be connected.

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

In order to keep the electrical characteristics of the female connector intect, do not remove the existing proctive cap if the connector is not yo be used.

For the position of the connector on chassis cab vehicles see Fig. 2.39.

Figure 2.39

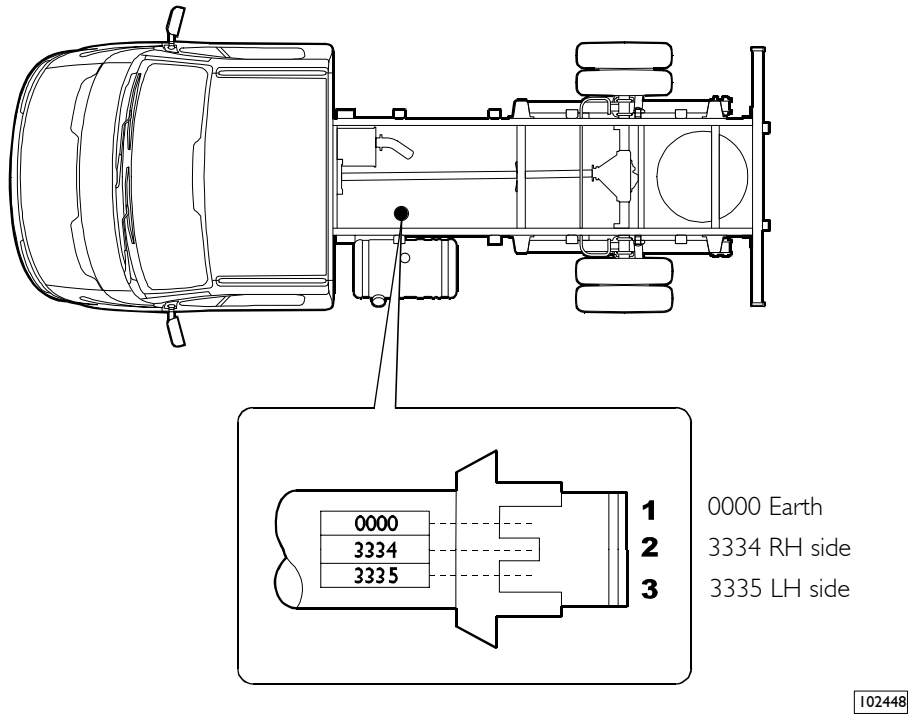


Table 2.24

Connector on vehicle	IVECO Code	Interface to use per connector	Part number	Q.ty
Female connector	98435344	Male connector	98435341	1
		Half bearing	98447231	1
		Cable terminal	98435372	3
		Gasket (rubber insert)	4861936	3
		Cap	7760165	1

Connector pin-out:

Table 2.25

PIN	Cable code	Function	Cable section (mm^2)	Max. current (A)
1	0000	Earth	1	10
2	3334	Vehicle right hand side overall dimensions lights	1	10
3	3335	Vehicle left hand side overall dimensions lights	1	10

2.19.13 Speed limiter to 30 km/h (optional 6341)

The speed limiter to 30 km/h is a device mainly used with Daily vehicles with F1A and F1C engines and fitted with waste compactor.

This arrangement consist of a 2 pin, female holder sealed connector, with respective cable, positioned at the end of the vehicle.

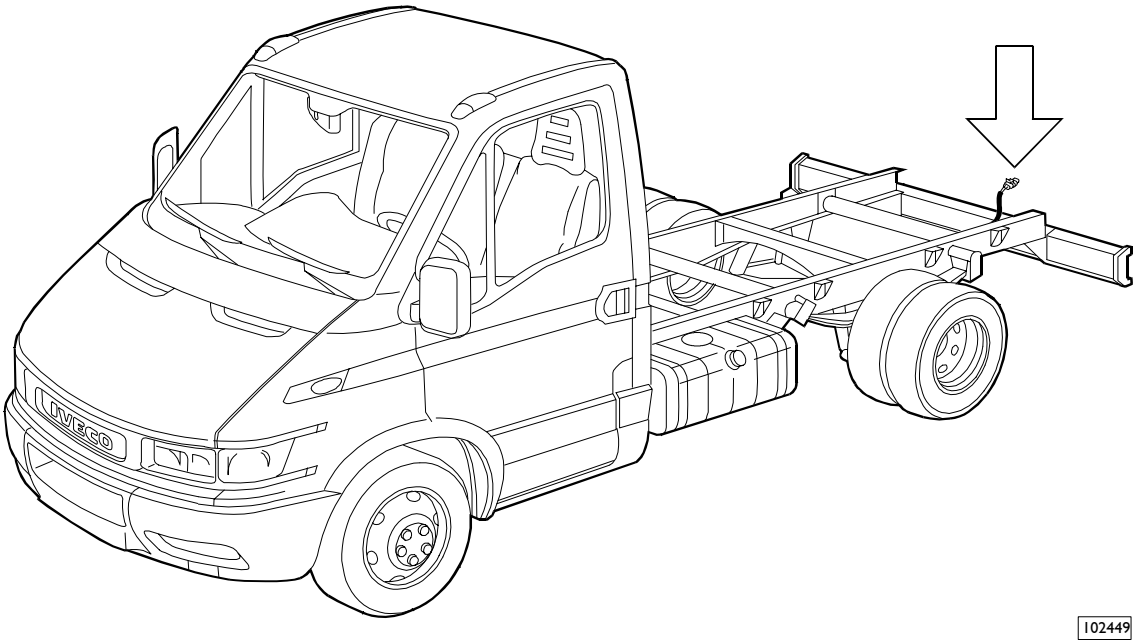
The body builder must take care, within the limits of their competence, to correctly wire and position the N.A. switch.

Purchase from IVECO Parts the following components:

Component	Part number	Quantity
Male connector	12453187	1
Cable terminal	12451944	2
Gasket (rubber insert)	12452181	2

The speed limiter to 30km/h is activated when the 2 pins are short-circuited.

Figure 2.40



2.20 Repositioning Parts and Mounting Auxiliary Assemblies and Equipment

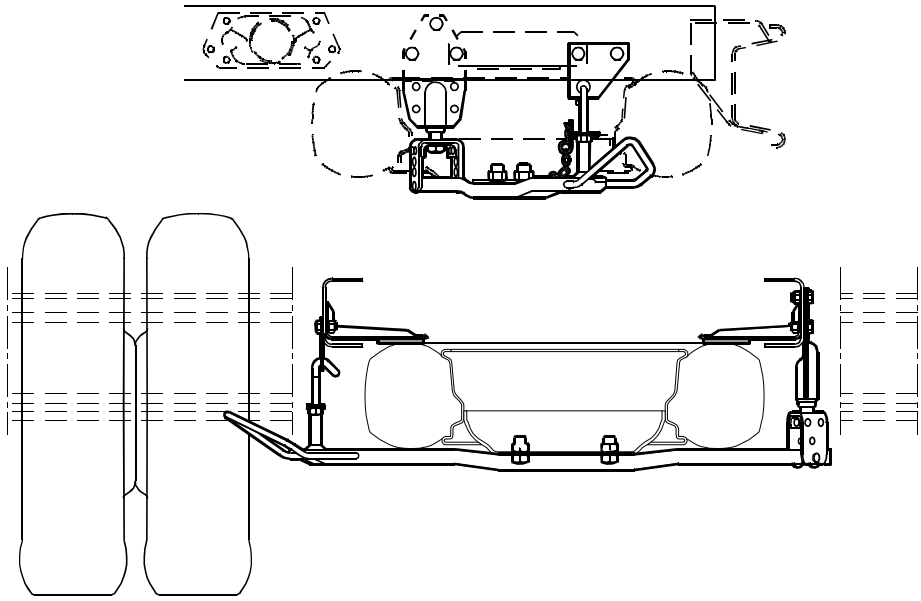
Whenever, in the course of modifying the vehicle, it should become necessary to reposition assemblies such as the fuel tank, batteries or the spare wheel, such relocation is permitted provided that the functioning of these parts is not impaired and provided that the same type of connections as originally 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 of suitable size that allows the wheel to be readily removed. Figures 2.40 and 2.41 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. 2.36).

Figure 2.41

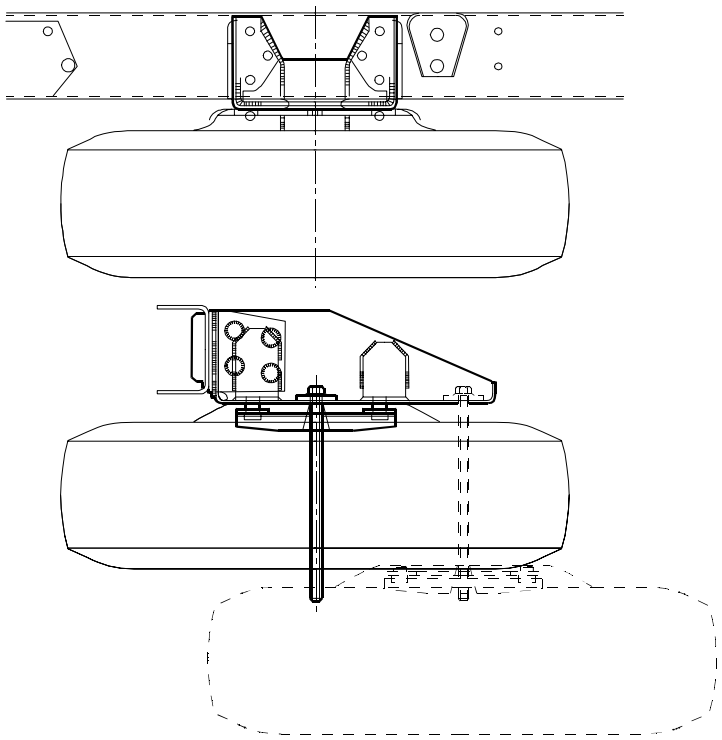


In order to limit the torsional stresses on the vehicle chassis, we recommend that the plate be fitted where there is a cross member, particularly in the case of heavy units.

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 3.2). 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 2.3. Holes already present must be made use of to the greatest extent possible.

Figure 2.42



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Fuel tank

In the event that the fuel tank capacity is not enough, a larger capacity thak may be fitted:

The table below illustrates the types of IVECO tanks available. Verify that the new tank is compatible with the original vehicle configuration.

Table 2.26 - Available tanks

Model	Fuel tanks		
	70L	90L (1)	120L (2)
29L-35S	standard	-	-
35C-40C-45C-50C-60C-65C	standard	opt 06163	-
65C chassis cab	standard	opt 06163	opt 06162

(1) Except 6+1 cab and wheelbase 3300 mm
(2) Except 6+1 cab and wheelbase 3300 mm and 3450 mm

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.

2.21 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 retarder manufacturer's workshops must carry out the installation in compliance with points 2.3, 2.8.9 and 2.19 of these instructions. The firm authorized to carry out the installation is responsible for correct operation, anchoring part size and good workmanship.

The table shows the vehicle on which a retarder can be fitted separately:

Table 2.27 - Brake retarder

Model	Permitted application
29L, 35S, 35C	no
40C, 45C, 50C, 60C, 65C	yes

The choice of retarder must be made based on the following formula:

$$\frac{i_p \cdot C_f}{R' \cdot GVW} \cong 1$$

i_P = rear axle ratio
Cf = maximum braking torque (Nm)
R' = radius of the tyre used when loaded (m)
GVW = Gross Vehicle Weight (Kg)

Example for calculating the maximum braking torque of a retarder for Daily

Daily 50C15V/P vehicle, with rear axle ratio 3.15 and 195/75R16 tyres.

From the data

1. i_P = 3,15
2. R' = 0,317m
3. PTT = 5200kg

we obtain:

$C_f = (5200 \cdot 0{,}317) / 3{,}15 = 520$ Nm

A brake retarder can be fitted with a maximum braking torque of 500Nm.

2.22 Modifications to the Rear Underrun

Our vehicles are fitted with a rear underrun bar in accordance with EC Directives.

The maximum permitted distance from the bar to the rearmost part of the body is 400 mm, deducting the distortion found during approval tests (10 mm on average).

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.

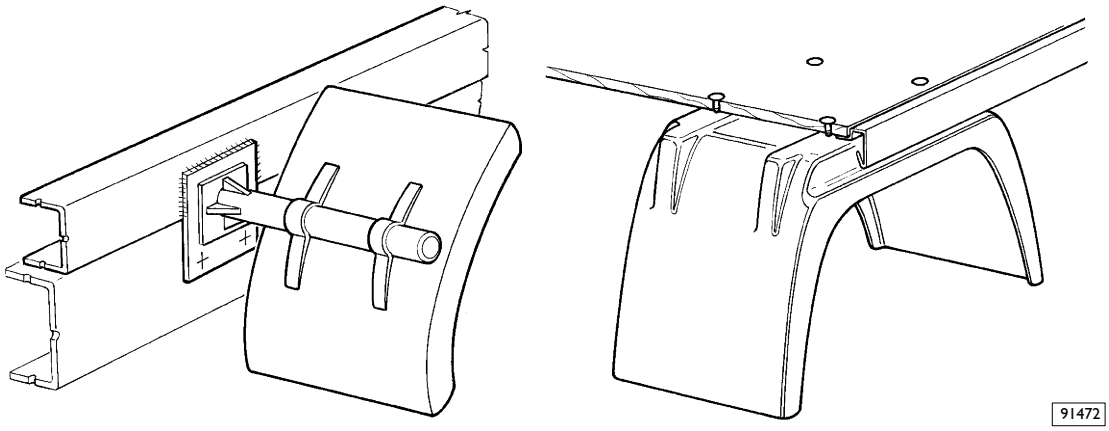
2.23 Rear Mudguards and Wheel Boxes

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 2.43.

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

Figure 2.43



2.24 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.

2.25 Side Guards

In some countries local or EC 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 2.3.

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.

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.

3 BUILDING AND MOUNTING THE STRUCTURES

Index

3.1 Basic instructions

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 access must be provided.
- 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 and battery box air circulation 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 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.

3.2 Dimensions and weights

3.2.1 General Specifications

The dimensions and maximum permissible weight 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 weight and its distribution on the axles.
On our vehicles, lights and rear-view mirrors are designed for widths of up to 2350 mm.

Weighing the Chassis

As a result of production factors there could be at a ±5% variation in the published weights for models 29L, 35S and 35C and a ±3% for models 40C, 50C, 60C e 65C.

It is therefore, advisable to determine the weight 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 weights on the axles;
- width of mirrors used;
- position of rear underrun bar.

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

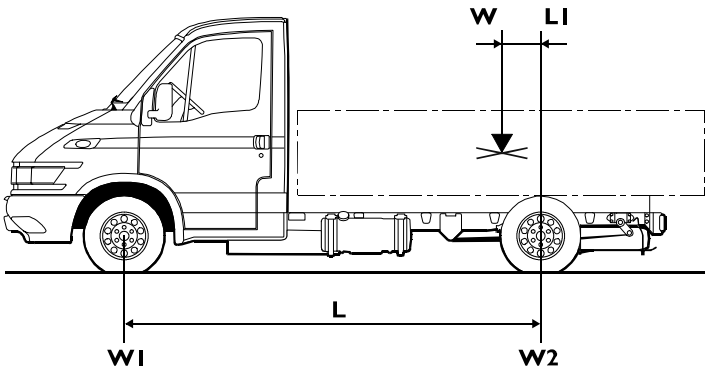
3.2.2 Determining the Centre of Gravity of the Body and Payload

Centre of Gravity: 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.

Figure 3.1 Positioning on longitudinal plane



$$L_1 = \frac{W_1 \cdot L}{W} \quad \text{or} \quad L_1 = L - \frac{W_2 \cdot L}{W}$$

W = Body + payload (kg)
W1 = Body and payload acting on front axle (kg)
W2 = Body and payload acting on rear axle (kg)
L1 = Distance of the center of gravity from the rear axle center line or the tandem center line (mm)
L = Wheelbase (mm)

Example of calculation of the load's center of gravity position

Consider a 40C13 vehicle with a wheelbase of 3450mm, with

1. GVW = 4200kg
   (permitted maximum: 1900 kg on front and 3100 kg on rear)
2. KERB WEIGHT = 1955kg (1340 kg on front axle and 615 kg on rear)

The permitted maximum load (Body + payload) will be W=4200-1955=2245 kg. Let us calculate the position of the center of gravity in which the maximum permitted on the front axle is achieved. Let us assume uniformly distributed load. In this case, out of 2245 kg, W_1=1900-1340=560 kg will affect the front axle, while the remaining W_2=2245-560=1685 kg will affect the rear axle. Thus:

1. W_1 = 560kg
2. L = 3450mm
3. W = 2245kg

$L_1 = W_1 \times L / W = 860$mm

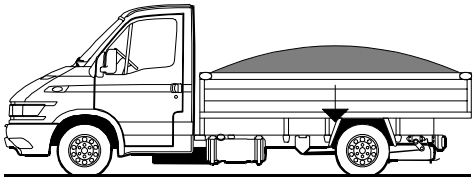
The center of gravity of the load (Body + payload) must not be more than 860 mm far from the rear axle; otherwise, the front axle will be overloaded.

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.

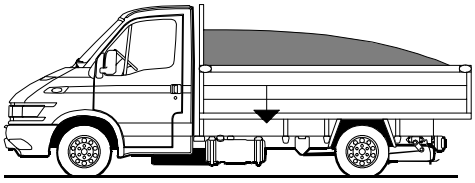
Regarding any equipment, the actual position of the centre of gravity must be used.

When building bodies or containers, loading and unloading systems must be devised which preclude excessive variations in the distribution of the load and/or excessive loads on the axles relevant instructions should also be given to the operator.

Figure 3.2

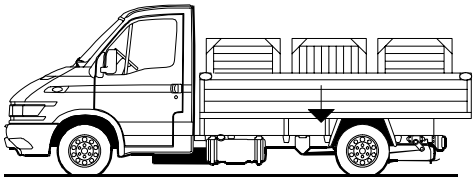


Uniform distribution of the load

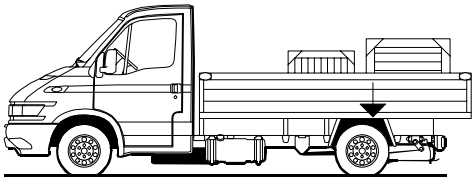


Non-uniform distribution of the load due to the lack of a rear overhang

Figure 3.3



Uniform distribution of the load



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

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3.2.3 Observing the Permitted Weights

All limits indicated in IVECO documentation must be adhered to. Compliance with max. weight value on front axle is of particular importance under varying load conditions, in order to ensure the correct steering and braking 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. bulk tankers).

When positioning the body and equipment, the loads must be correctly distributed transversally. For each wheel a variation in the rated load (50% of the axle load) of ±4% is permitted (e.g. load on axle: 3,000 kg; permitted load on each wheel: 1,440 to 1,560 kg) provided 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: 30% of the total vehicle weight (with uniformly distributed loads and with loads 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 any tow hook and of the underride guard stipulated by the relevant laws and regulations.

Variations in the Permissible Weight

Special exceptions to the maximum permissible weight 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 request for authorisation must include:

- Vehicle type, wheelbase, identification number, designated use.
- Unladen weight 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.

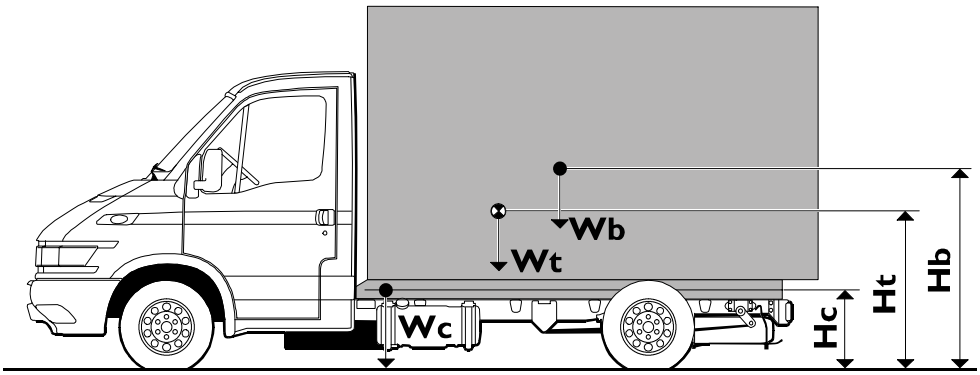
The reduction in the permissible weight on the vehicle (derating) may involve changing various elements (such as suspension and brakes) and may require recalibration of the load sensing valve. In these circumstances necessary instructions will be supplied.

Centre of Gravity: positioning along the vertical plane

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 regarding braking) or requested by the Manufacturer to ensure good handling of the vehicle (e.g. transverse stability of the moving vehicle).

Figure 3.4

Verification with full load:



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$$Ht = \frac{Wc \cdot Hc + Wb \cdot Hb}{Wc + Wb} \qquad Hb = \frac{(Wc + Wb) \cdot Ht - Wc \cdot Hc}{Wb}$$

Wc = Chassis cab vehicle kerb weight
Hc = Height of centre of gravity of chassis cab vehicle (laden condition)
Wb = Body and payload
Hb = Height of centre of gravity of body and payload in relation to ground
Wt = Vehicle weight 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 kerb 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 3.1 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 3.1 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 2.11) 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. 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 steering, etc.)

Table 3.1
Maximum heights in relation to the centre of gravity of the payload and cornering stability [1)]

MODELS	Max. height (approx.) of centre of gravity of payload (includ. body and equipment) in relation to the ground (mm)
29 L	1400
35 S	1500
35 C (transverse leaf)	1800
35 C (torsion bar)	1900
40 C	1900
45 C	1950
50 C	1950
60 C	2050
65 C	2050

3.3 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:

3.3.1 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 not lower than those of the following material:

Table 3.2 - Material to be used for subframe manufacturing

Steel name		Tensile strenght (N/mm^2)	Yield point (N/mm^2)	Elongation A5
IVECO	Fe360D	360	235	25%
Europe	S235J2G3			
Germany	St37-3N			
UK	40D			

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 we suggest to use shown below:

Table 3.3 - Material to be used for subframe manufacturing

Steel name		Tensile strenght (N/mm^2)	Yield point (N/mm^2)	Elongation A5
IVECO	FeE420	530	420	21%
Europe	S420MC			
Germany	QStE420TM			
UK	50F45			

Table 3.4 - Material to be used for subframe manufacturing

Steel name		Tensile strenght (N/mm^2)	Yield point (N/mm^2)	Elongation A5
IVECO	Fe510D	520	360	22%
Europe	S355J2G3			
Germany	St52-3N			
UK	50D			

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, centre 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 km/mm^2 as against 21.000 kg/mm^2 for steel) 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.

3.3.2 Longitudinal runner dimensions

The table below specifies the values for the section modulus W_x for C-longitudinal runner recommended by IVECO. The indicated W_x value refers to the real section and allows for the section bar coupling radii (it can be calculated with some approximation by multiplying by 0.95 the value obtained by considering the section made up of simple rectangles). Longitudinals of different sections can be used as replacements for the indicated ones, provided the section modulus W_x and the moment of inertia J_x of the new C-section is not lower than those shown in the table.

Table 3.5 - Longitudinal runners recommended by IVECO

Section modulus Wx (cm^3)	Recommended C-section H x L x s (mm)	Section modulus Wx (cm^3)	Recommended C-section H x L x s (mm)
9	60 x 50 x 3	74	140 x 70 x 7
16	80 x 50 x 4	89	160 x 70 x 7
19	80 x 50 x 5	105	180 x 70 x 7
21	80 x 60 x 5	119	200 x 80 x 6
26	100 x 50 x 5	135	200 x 80 x 7
31	100 x 60 x 5	150	200 x 80 x 8
36	100 x 60 x 6	173	220 x 80 x 8
46	120 x 60 x 6	208	250 x 80 x 8
57	140 x 60 x 6		

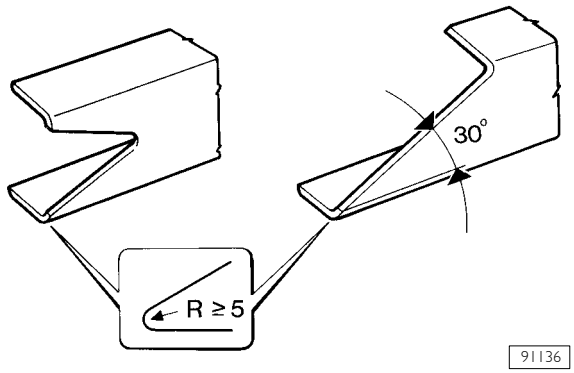
3.3.3 Elements making up the subframe

Longitudinal Runner Profiles

The longitudinal for the added structure must be continuous, extending forward to the front of the vehicle to include, the area in front of the front spring rear hanger and rest on the chassis of the vehicle and not on the body mounting brackets.

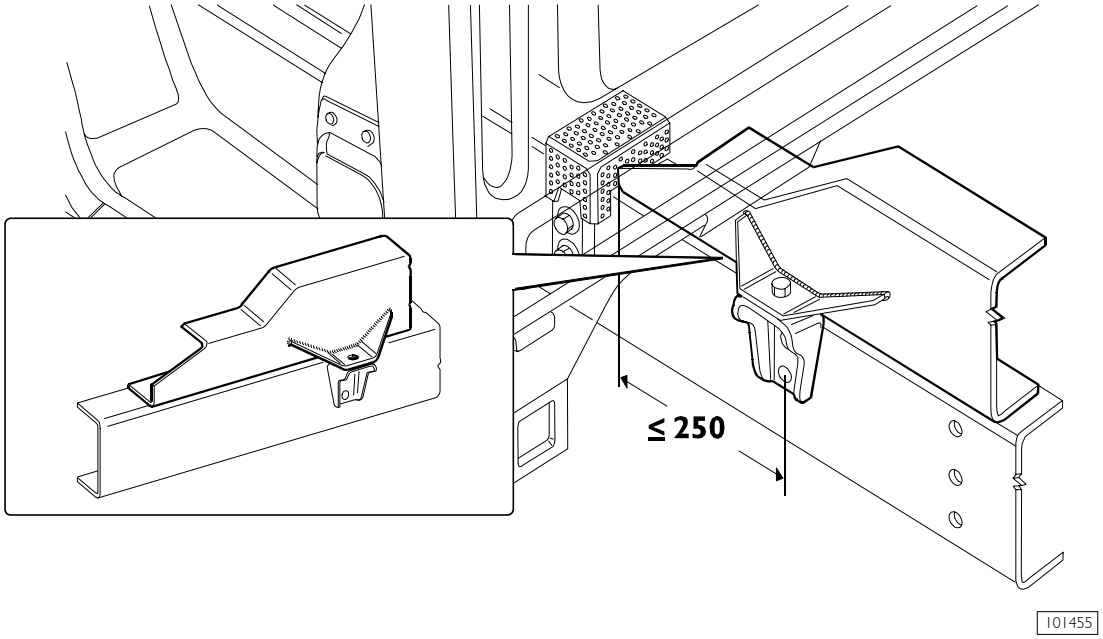
In order to achieve a gradual reduction in the resistant section, the front ends of the longitudinal runner must be tapered upwards at an angle of no more than 30°, or tapered in some other equivalent way (see fig. 3.5) ensuring that the front end in contact with the chassis is suitably connected, min radius 5 mm.

Figure 3.5



If the rear profile of the cab (e.g., with crew cabs 6+1) does not allow the entire longitudinal to pass underneath, the longitudinal section can be reduced as shown in Figure 3.6, with a fixing preferably no further than 250 mm from the front end of the subframe.

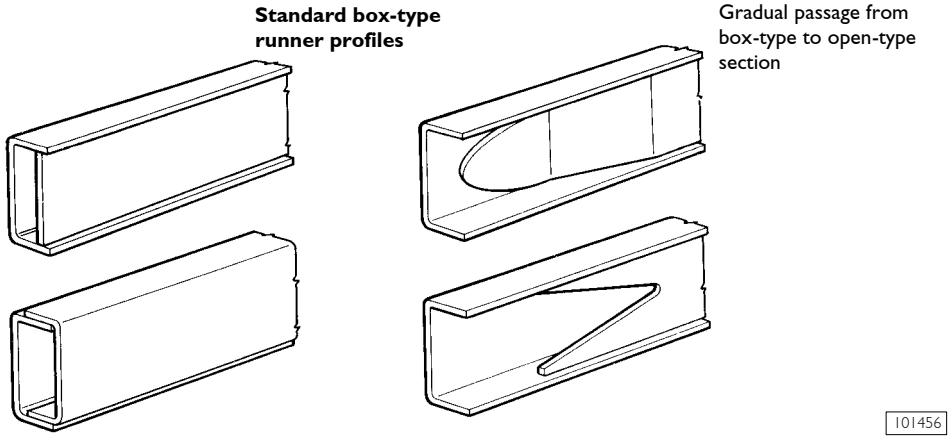
Figure 3.6



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 C-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. 3.7.

Figure 3.7



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 longitudinal runners the various types of body are for minimum recommended values that, as a rule, hold for vehicles with standard wheelbases and rear overhangs. 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.

Subframe crossbars

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 (Figure 3.8) or, if greater rigidity is desired, of the closed type (Figure 3.9).

Figure 3.8

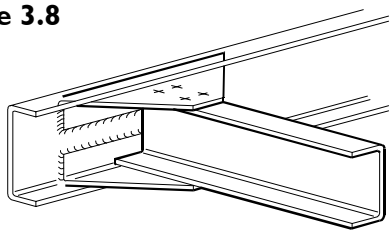
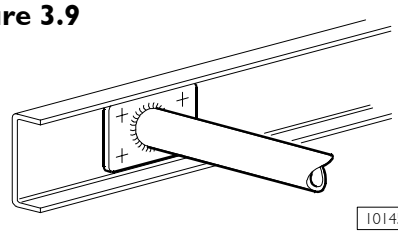


Figure 3.9



Stiffening the Subframe

In the case of certain bodies (e.g., tippers, elevating platforms, 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:

- change the rear section of the longitudinal member to a box-frame construction.
- closed-section cross members (see fig. 3.10).
- crossties (see fig. 3.11)

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

Figure 3.10

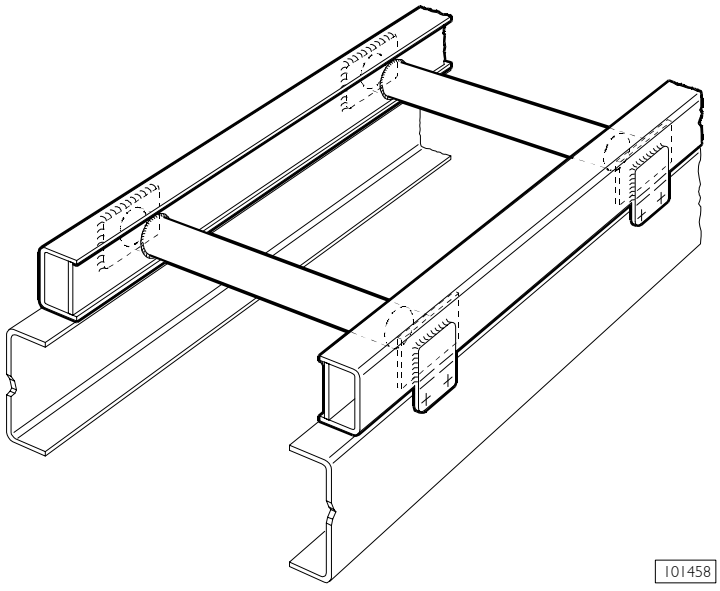
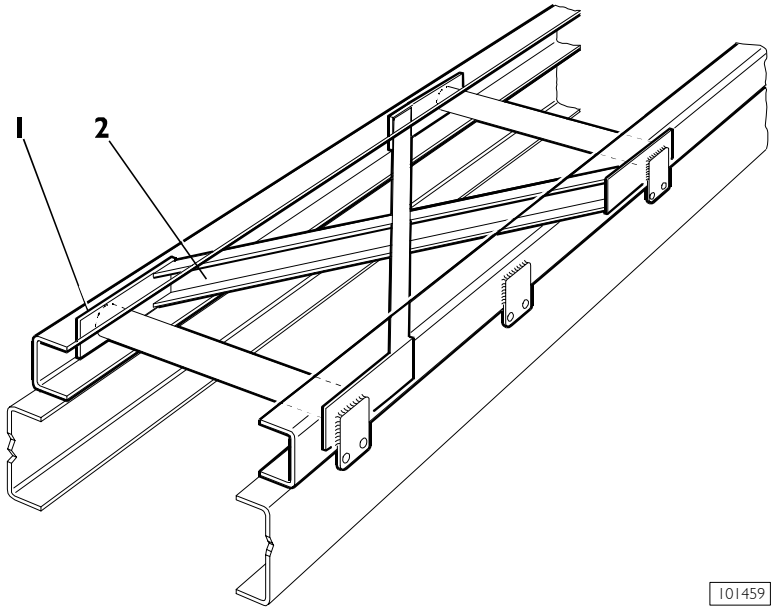


Figure 3.11



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.

3.4 Connection between chassis and subframe

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 analysing the stress forces which the additional equipment 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 must be located, if possible, at a distance of approx. 250-350 mm from the front end of the subframe.

Any connecting points already 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. 3.15). Alternatively, use the connection of Figure 3.14.

Body Mounting Characteristics

Eastic and flexible connection (see Figures 3.12 and 3.13) 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. 3.14) 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.

Subframe dimensions

In case of elastic or flexible connection between the chassis and the subframe, the bending moment Mf shall be distributed between the chassis and the subframe in proportion to the moments of inertia of the sections:

$$M_f = M_t + M_c$$

$$\frac{M_c}{M_t} = \frac{I_c}{I_t}$$

$$M_c = M_f \times \frac{I_c}{I_t + I_c} \qquad \sigma_c = \frac{M_c}{W_c} \le \sigma_{amm}$$

$$M_t = M_f \times \frac{I_t}{I_t + I_c} \qquad \sigma_t = \frac{M_t}{W_t} \le \sigma_{amm}$$

M_f = static bending moment generated by the superstructure (Nmm)
M_c = additional dimension of the static bending moment Mf applied to the subframe (Nmm)
M_t = additional dimension of the static bending moment Mf applied to the chassis (Nmm)
I_c = moment of inertia of the subframe section (mm^4)
I_t = moment of inertia of the chassis section (mm^4)
σ_c = maximum static stress applied to the subframe (N/mm^2)
σ_t = maximum static stress applied to the chassis (N/mm^2)
W_c = section modulus of the subframe section (mm^3)
W_t = section modulus of the chassis section (mm^3)
σ_{amm} = maximum static stress permitted on the chassis (N/mm^2)

Example of stress calculation using elastic connection with the chassis

Consider two C-section profile swith the following dimensions H x L x S

3. chassis: 182 x 70 x 4mm
4. subframe: 100 x 60 x 6mm

and stressed, at a given section, by the maximum bending moment Mf equal to 8500 Nm as applied in a perpendicular direction to the plane containing the side-member rib.

From the calculation, the following values will be obtained:

	I_x (cm^4)	W_x (cm^3)
1. chassis	588	64
2. subframe	183	36

By applying the formulas, the following will be obtained:

1. $M_t = M_f \times [I_t / (I_c + I_t)] = 8500 \times [588 / (588 + 183)] = 6482$ Nm
2. $M_c = M_f \times [I_c / (I_c + I_t)] = 8500 \times [183 / (588 + 183)] = 2018$ Nm

Thus:

1. $\sigma_t = M_t \cdot / W_t = 101 N/mm^2$
2. $\sigma_c = M_c \cdot / W_c = 56 N/mm^2$

In case of rigid connection (shear resistant plates) between the chassis and the subframe, the bending moment M_f shall be applied to the single chassis-subframe section.

$$\sigma_t = \frac{M_f}{W_t} \leq \sigma_{amm} \qquad W_t = \frac{I}{y_{tmax}}$$

$$\sigma_c = \frac{M_f}{W_c} \leq \sigma_{amm} \qquad W_c = \frac{I}{y_{cmax}}$$

σ_c = maximum static stress applied to the subframe (N/mm^2)
σ_t = maximum static stress applied to the chassis (N/mm^2)
M_f = static bending moment generated by the superstructure (Nmm)
I = moment of inertia of the single chassis-subframe section (mm^4)
σ_{amm} = maximum static stress permitted on the chassis (N/mm^2)
$y_{t\,max}$ = distance from the neutral stressing axle of the chassis outermost fibres (mm)
$y_{c\,max}$ = distance from the neutral stressing axle of the chassis outermost fibres (mm)

Example of stress calculation using shear resistant plates with the chassis

Consider two C-section profiles with the following dimensions H x L x S

1. chassis: 182 x 70 x 4mm
2. subframe: 100 x 60 x 6mm

and stressed, at a given section, by the maximum bending moment Mf equal to 8500 Nm as applied in a perpendicular direction to the plane containing the side-member rib.

From the calculation, you will obtain that the center of gravity lies approximately 20 mm from the contact segment from the part of the section, with H x L x D equal to 182 x 70 x 4 mm (chassis). Thus:

1. $y_{t\,max}$ = 182 - 20 = 162 mm
2. $y_{c\,max}$ = 100 - (-20) = 120 mm

Moreover

		I_x (cm^4)	W_t (cm^3)	W_c (cm^3)
1.	chassis + subframe	2015	166	125

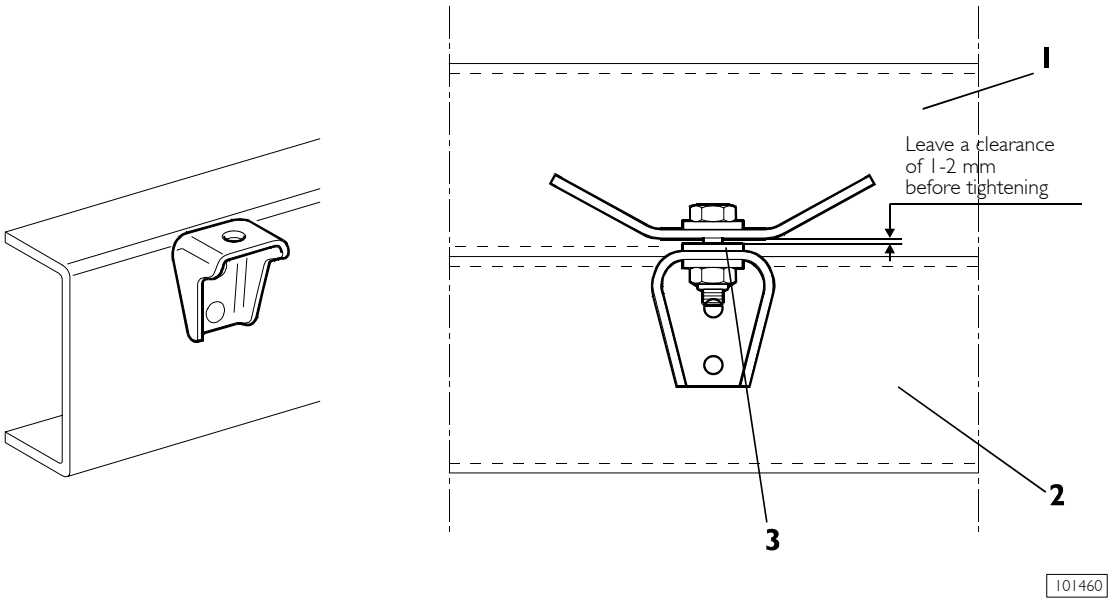
By applying the formulas, you will obtain:

1. $\sigma_t = M_f / W_1 = 51\ N/mm^2$
2. $\sigma_c = M_f / W_2 = 68\ N/mm^2$

3.4.1 Elastic connection with Brackets

These are the standard connections on the vehicles (see Fig. 3.12).

Figure 3.12



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. When tightening the securing bolts, brackets will come in contact. Initial gaps larger than 1-2 mm 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.

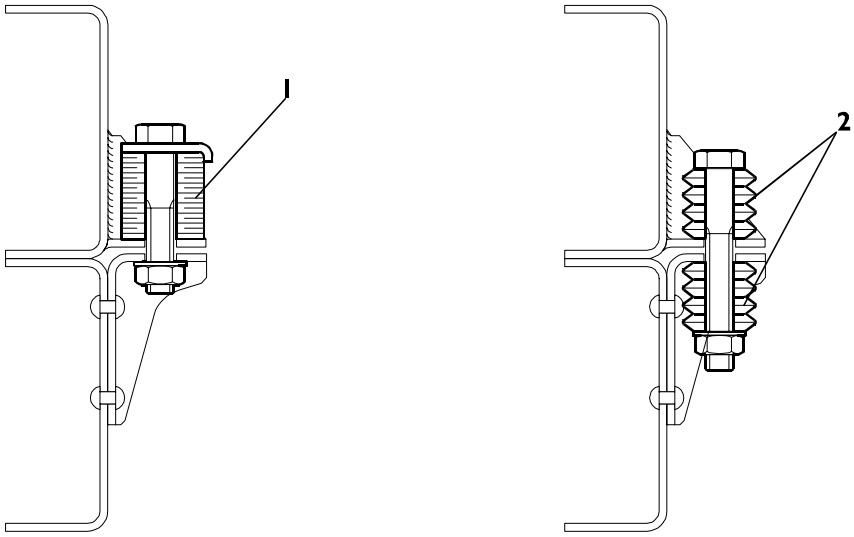
In order to guide and better contain the loads transversally, in transformations where this is necessary, the side guide for the body structure must be secured by other means (e.g., using guide plates connected only to the vehicle chassis frame, see Fig. 3.14). When the front connection is of the flexible type (see Fig. 3.13), 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.

Flexible connection

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. 3.13 should be used behind the cab.

Figure 3.13



1 Elastic element

2 Elastic elements

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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 elastic 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.

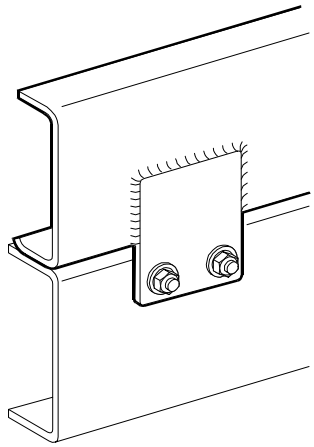
The whole connection capacity can if necessary be re-established using shearing resistant plates in the rear suspension area.

Where the vehicle is supported by means of hydraulic stabilizers (e.g., cranes, elevating platforms), limit the elastic element deformation so as to ensure sufficient co-ordinated movement of the subframe, and avoid excessive bending movements on the original chassis.

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

This type of anchorage shown in fig. 3.14 is achieved by means of a plate that is welded (or bolted) 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.

Figure 3.14



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 centre axle trailers, crane on rear overhang, tail lifts, etc.). Observe the instructions given in the following table:

Table 3.6

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)
≤ 1.0	500	60C; 65C	5	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.

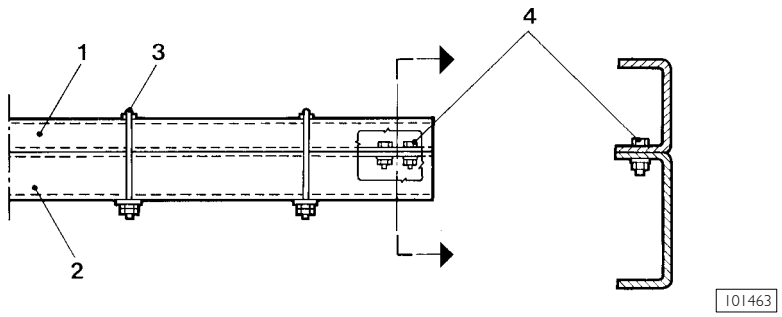
3.4.3 Mixed Connection

On the basis of instructions given for the construction of the subframe (point 3.3.) and considerations included in the general section of point 3.4., 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.).

For this purpose it is also possible to use bolt-type connections at the rear end of the chassis as illustrated in fig. 3.15.

Figure 3.15



1 Subframe
2 Frame
3 Longitudinal transversal securing anchoring.

3.5 Volume weights

When designing each installation, the volume weight of the material to be transported should be assessed beforehand. This data can be obtained from specialized manuals. Table 3.7 shows a few volume weight values provided as a guide.

Table 3.7 - Volume weights of a few solids at 25 °C

Material	ρ (kg/m^3)
Iron	7890
Aluminium	2700
Concrete	1900-2300
Cardboard	350
Celluloid	1400
Powder cement	1400
Granite	2600
Wood (pine)	640
Marble	2500-2700
Ordinary, dry brick	1800
Solid, urban wastes	90-120 (1)
Dry sand	1600
Sand with 7% humidity	2100
Glass	2200-2700

(1) To be multiplied by the compacting ratio (approximately 3 for the compactors usually fitted to the Daily range vehicles).

3.6 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 3.8.

Table 3.8

MODELS		Minimum reinforcing runner		
		WHEELBASE (mm)	Section modulus Wx (cm^3)	Dimensions (mm)
29 L; 35S	1)	All	9	60x50x3
35C; 40 C; 45C; 50C		All	16	80x50x4
60C, 65C		Up to 3750 Over 3750	21 26	80x60x5 100x50x5

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

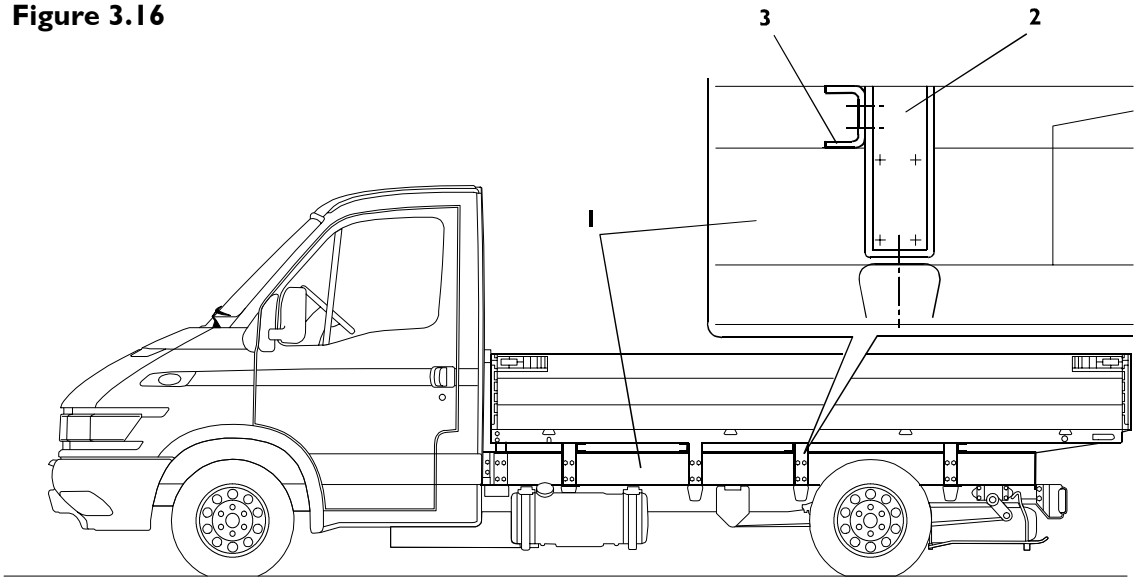
The attachment is carried out using the brackets arranged on the vertical web of the side members. If such brackets have not been provided by the Manufacturer, they must be installed according to the specifications given in point 3.4. In order to provide an adequate lengthwise securing when brackets or clamps are used, it is good common practice to arrange a rigid joint (one on each side) on the rear overhang, using either cleat plates or bolts on the upper flange of the side member (see figs. 3.14 and 3.15).

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. 3.16.

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 3.16



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1 Subframe
2 Brackets
3 Securing anchorages

3.7 Building Vans

Dimensions and centres of gravity

Check the weight is correctly divided. In particular, bear in mind the guidelines concerning the height of the centre of gravity given in point 3.2, taking suitable precautions to ensure the load has the utmost stability during transport.

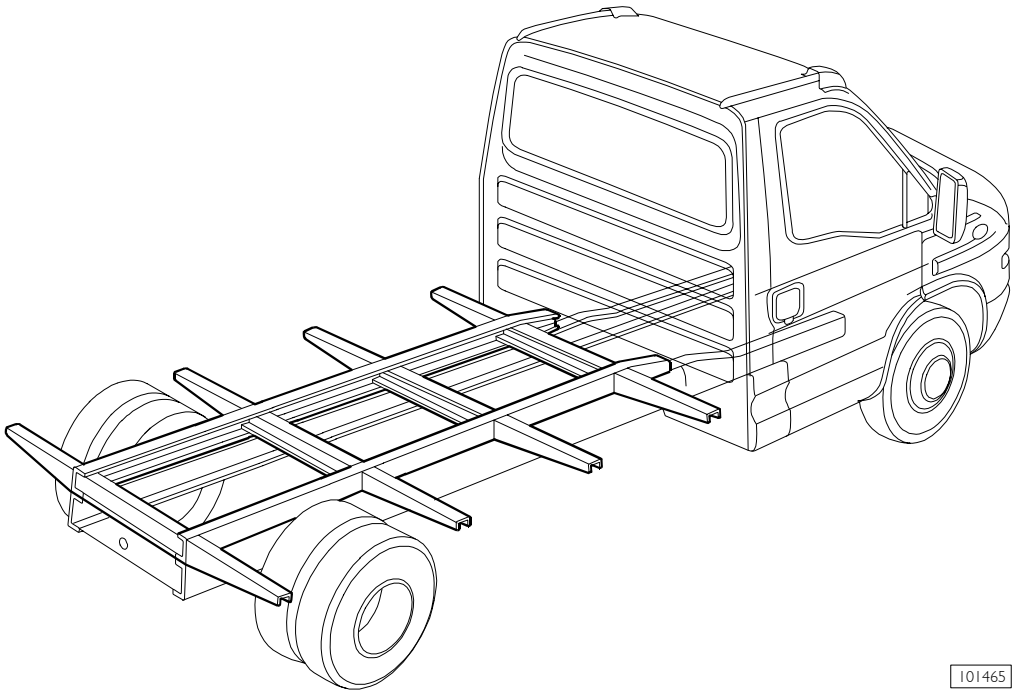
Base structure

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 3.8.

Figure 3.17 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.

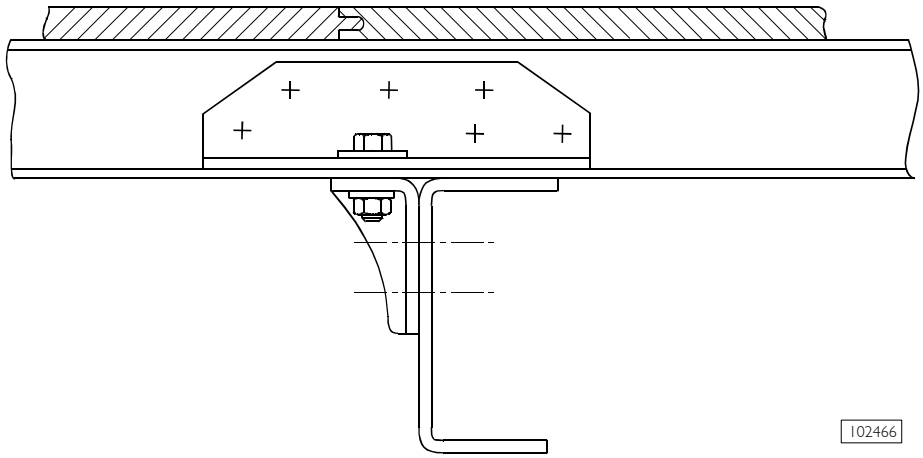
Figure 3.17



If the body floor cross bearers are spaced no more than 700 mm and suitably connected to form a sufiiciently rigid structure (self supporting) it is not essential to use longitudinal runners (see fig. 3.18).

To ensure the cross bearers have the necessary stability and prevent the vehicle chassis frame being too stiff towards the front, the instructions given in paragraph 3.6 should be followed.

Figure 3.18



When installing body structures with a high torsion rigidity, to avoid the possibility of chassis frame deformation elastic connections should be used at the front body mountings of the structure. This is especially important if thevehicle is to be used under either off road or semi off road conditions.

Front bulk-head

This must be strong and sturdy enough to withstand the forces generated by the load during sharp braking.

Bodies integrated with the cab

With this type of body the connection to the cab must be made so as not to transmit any stress to the cab itself.

Connecting the body to the Cab:

- The structure must not be welded to the cab only mechanical fixings should be used.
- The body structure must be self-supporting and must not be supported by the cab.
- All parts of the cab that have been modified in any way must be protected against oxidation and corrosion (see point 2.2).

3.8 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 3.9 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.

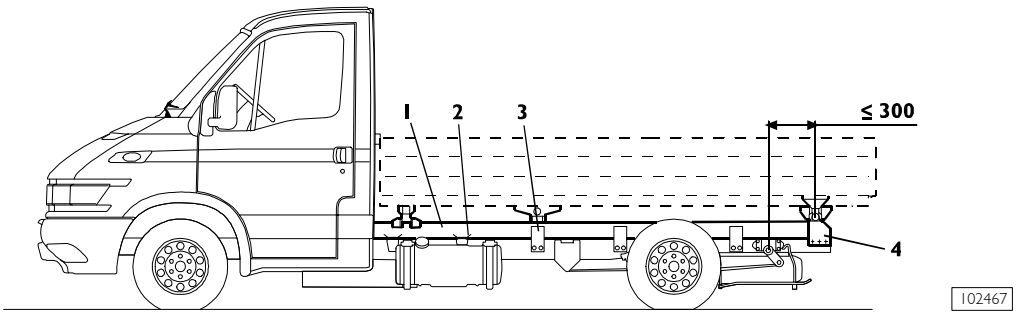
After fitting the body, the bodybuilders must ensure that the vehicle remains stable during tipping.

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. 3.10 and 3.11). 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. 3.14). 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. 3.19 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 3.19



1 Subframe
2 Brackets
3 Plates
4 Butt strap

Table 3.9

MODELS	Minimum reinforcing runner	
	Section modulus W(cm^3)	Dimensions (mm)
35 C; 40C	19	80x60x4
45 C; 50C	36	100x60x6
60C, 65C	36	100x60x6

Fitting tipper bodies is not recommended for models with single rear wheels 29L and 35S.

3.9 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 subframe.

Table 3.10 contains the guidelines for the dimensions of the longitudinal runners to be used for the subframe.

Table 3.10

MODELS		Minimum reinforcement profile	
	WHEELBASE (mm)	Section Modulus Wx (cm^3)	Dimensions (mm)
35C; 40C, 45C; 50C	All	16	80x50x4
60C; 65C	Up to 3750 Over 3750	21 26	80x60x5 100x50x5

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 subframe 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 a subframe 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 800 mm.
- 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 a subframe 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 weight on the front axle and fully loaded vehicle weight (see point 3.2).

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 3.2); 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.

3.10 Installation of Cranes

The selection of the crane must be made with due consideration to its characteristics (weight, 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.

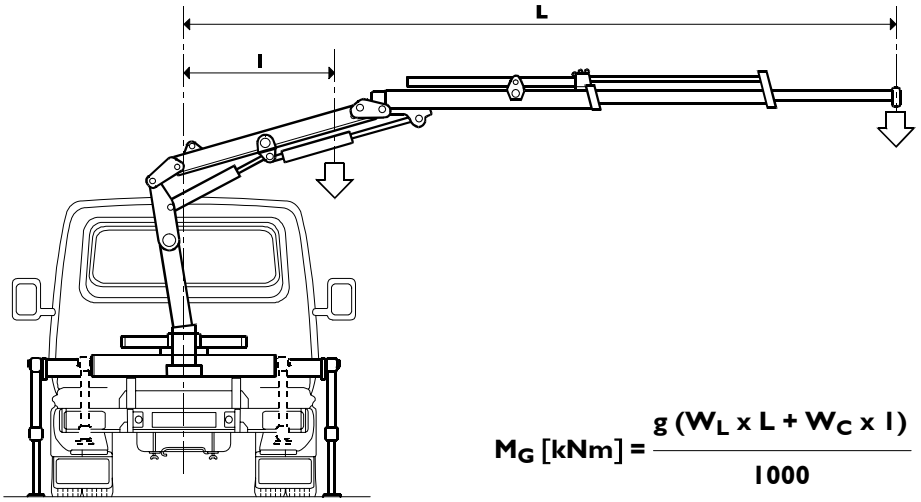
Use stabilisers while the crane is operating. As a general rule, the installation of a crane requires the use of a suitable subframe, whose construction must take into account all general specifications relating to it (point 3.3). Concerning the dimensions of the runners for the subframe, refer to tables 3.11, 3.12 and 3.13.

The dimensions of the subframe strength module 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. 3.20.

If for instance a crane is to be fitted to a tipper which has its own subframe with a greater section modulas (W_x) than that required for the crane the tipper subframe should be used. In all applications the structure or ancilliary requiring the greater section modulas (W_x) must be used.

Where the capacity of the crane (M_G value) falls within the area with a letter "E" (or for greater values) in the table, these must be check each time by IVECO and approval fgiven (by IVECO) before the installation is carried out.

Figure 3.20



$$M_G\,[kNm] = \frac{g\,(W_L \times L + W_C \times l)}{1000}$$

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g = acceleration of gravity, equal to 9.81 m/s^2;
W_L = weight applied to the end of the crane (kg);
L = horizontal distance between the point where load W_L is applied and the vehicle center line [m];
W_c = crane's own weight applied to its center of gravity [kg];
l = horizontal distance between the center of gravity of the crane and the vehicle center line [m];

The body builder shall verify each time the vehicle's stability and take all the necessary precautions to ensure correct operation. Both the crane manufacturer and the body builder are to define the type and number of the stabilizers and make the subframe depending on the maximum static moment and the crane position.

3.10.1 Crane Behind the Driver's Cab

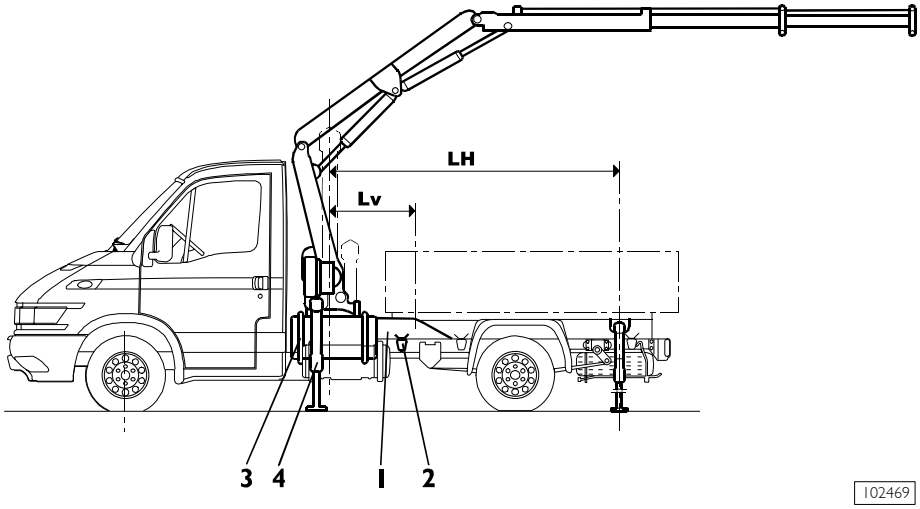
The mounting of the subframe onto the chassis frame will, as a rule, be performed by using plates (see fig. 3.21).

The dimensions and the subframe to be used are specified in table 3.11 (brackets) and in table 3.12 (plates).

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. 3.21, 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 3.21



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. 3.6), 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 vehicles used on rough or unmade roads may require fitting elastic or flexible mountings between the chassis frame and subframe on the front and central areas (see fig. 3.12) is flexible 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.

Normally, when the crane is placed behind the cab, it is necessary to move the platform body or equipment towards 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 3.8).

Fitting a crane behind the cab is not recommended for models with single rear wheels 29L and 35S.

Table 3.11
Cranes mounted behind the driver's cab
(subframe mounted with brackets)

MODELS		Crane capacity M_G max (kNm)						
Chassis frame section at centreline (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	21	36	57	89	E		
45; 50 C (182x70x4)	360	21	36	57	89	105	E	
60 C; 65 C (184x69x5)	360	19	21	46	57	89	105	E

Table 3.12
Cranes mounted behind the driver's cab
(subframe mounting with shear resistant plates)

MODELS		Crane capacity M_G max (kNm)						
Chassis frame section at centreline (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		
45 C; 50 C (182x70x4)	360	19	21	31	57	89	E	
60 C; 65 C (184x70x5)	360	19	19	21	46	57	89	E

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.

3.10.2 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 3.13.

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 3.3.) and brackets are to be employed in the area corresponding to the rear suspension and the rear overhang (Length Lv as per fig. 3.22). Care must also be taken to ensure that the transition from box-type to open section be well blended as illustrated in fig. 3.7.

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 3.2).

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 3.22) 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.

Fitting a crane to the rear pivot is not recommended for models with single rear wheels 29L and 35S.

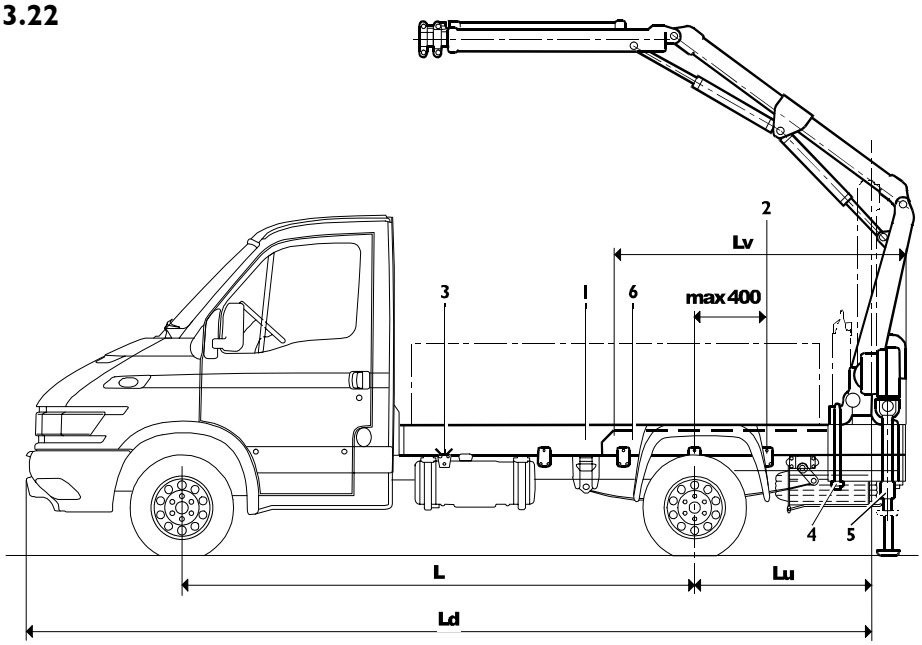
Table 3.13
Cranes fitted on the rear overhang (subframe mounting with a cleat plates)

MODELS		Total torque M_G max (kNm)						
Chassis section at the centre (mm)	Subframe material Yield point (N/mm^2)	-20	20-30	30-40	40-50	50-60	60-70	70-80
		Minimum value of the subframe section modulas Wx (cm^3)[1)]						
35 C; 40 C (122x70x4)	360	32	57	71	E			
45 C;50 C (122x70x4)	360	32	57	71	110	E		
60 C; 65 C (184x69x5)	360	23	23	32	42	71	E	

Notes:

E = To be checked on a case-to-case basis (forward the technical documents with the stress and stability calculations).

Figure 3.22



1 Subframe
2 Plates
3 Brackets
4 Crane connections
5 Stabilizers
6 Subframe stiffening areas

3.11 Installation of Tail Lifts

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

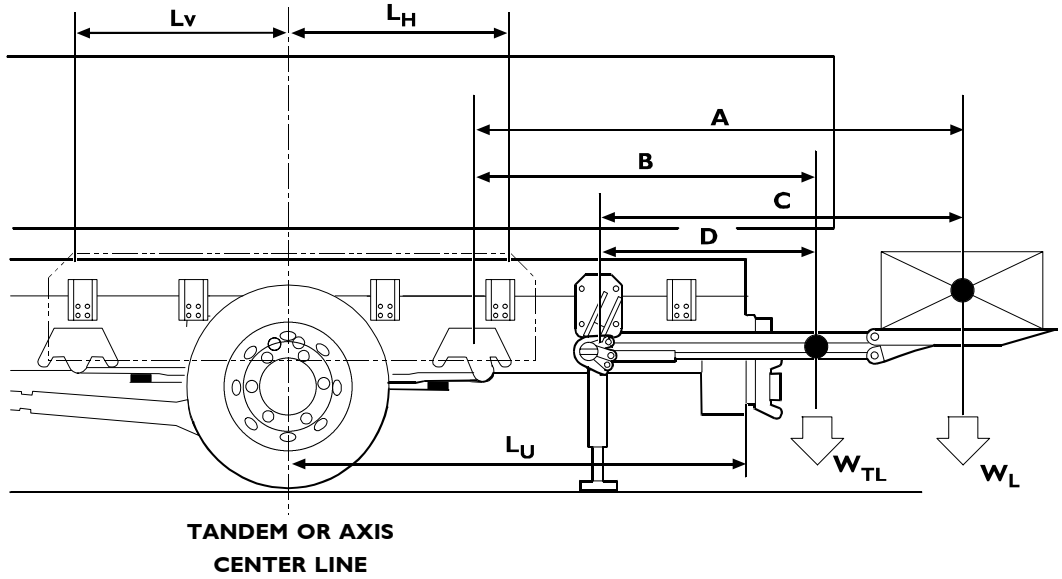
- By means of Table 3.14, with the standard rear overhangs and mean bending moments induced by tail lifts; depending on their capacity . In the table, the minimum capacity values are specified above which suitable stabilisers must be used.
- With different lengths of the rear overhang and with special tail lifts (e.g., of aluminium), the bending moments induced on the chassis frame can be defined with the information in Figure 3.23.

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 subframe (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 hanger of the rear suspension.

Figure 3.23



W_{TL} = Tail lift weight
W_Q = Tail lift capacity

The bending moment on the chassis can be calculated using formula below:

$$M\ [Nm] = W_L \times A + W_{TL} \times B \quad \text{for tail lifts without stabilizers}$$

$$M\ [Nm] = W_L \times C + W_{TL} \times D \quad \text{for tail lifts with stabilizers}$$

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 mouvement of the chassis, which is inevitable when the tail lift is in operation, the bodybuilder may make use of longitudinal runner profiles of larger size in comparison to the one indicated in table 3.14. The dimensions of the sections shown in Tab. 3.14 are for standard rear overhangs. For longer overhangs you need to check whether it is necessary to fit larger sections or stabilizers (see Fig. 3.23). 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 3.2); 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 2.19). IVECO recommends to fit a switch to disconnect the electric circuit of the tail lift from the vehicle electric circuit when the tail lift is not working. The bodybuilder is responsible for any modification to the rear underrun guard or for installing a different type (see point 2.22) and for mantaining the visibility of the rear lights. For the departure angles, for the installation of any tow hook and full compliance with all relevant nation regulations.

Table 3.14
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			
60C/65C	3450 ÷ 3750	21		21		26 + S		26 + S		31 + S		E	
	4350 ÷ 4750	26		21 + S		26 + S		26 + S		36 + S		E	

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.

Fitting tail lifts is not recommended for models with single rear wheels 29L and 35S.

3.12 Tractor for semi-trailers

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

However, it is possible to make the conversion, 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 weights 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. 3.24) 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 3.15 gives the minimum dimensions to use for the longitudinal reinforcing sections.

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

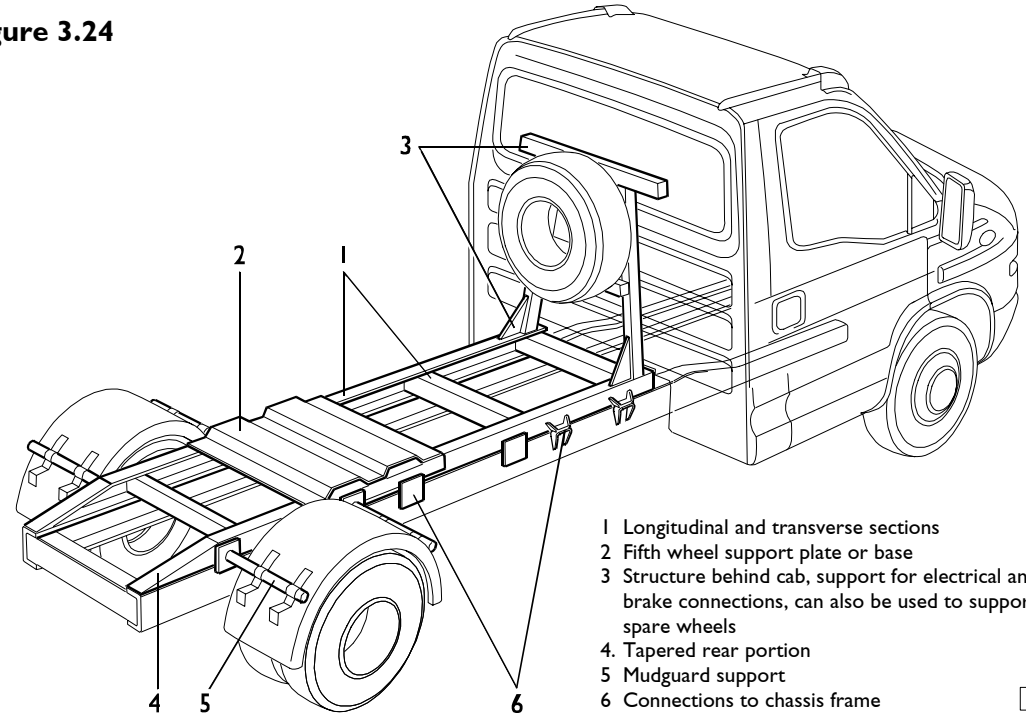
- The structure must be adequately dimensioned to handle the vertical and horizontal loads transmitted to it by the fifth wheel.
- Concerning the properties of the material of the structure, refer to point 3.3.
- The upper and lower surfaces of the structure must be even to ensure a good bearing on the 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 3.15

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

Figure 3.24



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

102471

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, 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. For installation on vehicle engine refer to table 4.2.

Electrical system

Make the electrical system in compliance with the general requirements given in point 2.19.

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.

3.13 Recovery 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 weights, vertical loads at the hook and the minimum ratio between the weights 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 weight, load at hook, maximum speed, etc.).

3.14 Municipal Vehicles , 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 hanger (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 (not allowed on Euro 4 vehicles)
- Using rear suspensions that are more rigid or made with asymmetrical springs.
- Rearranging the rear lights.

Do not use the switch fitted to the IVECO gearboxes (intended for signalling reverse gear engagement) for functions that require very high reliability and safety (e.g. engine stop when reversing; on vehicles fitted out for urban waste collection, with operators standing on the rear footboards).

3.15 Installation of Snow-ploughs 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 2.3 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 limited top speed - 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.

3.16 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 2.3 ensuring that the reinforced areas are not locally limited to the mounting area (see point 2.20) 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.

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.

3.17 Special transformations

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

As stated in paragraph 1.8, 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

Particular attention must be given to ensure the total weight of the vehicle is observed and the individual axles are not over or under loaded.

A sufficient load margin should be left to allow for the total number of people to be carried with essential items, such as:

- luggage, curtains, sports equipment;
- water tank capacity, toilet facilities food;
- 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 rear overhang, see the instructions given in point 2.9.

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

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4.1 General Specifications

For the control of the auxiliary groups like tippers, cranes, compressors, municipal vehicles etc. various types of power take-off (PTO) 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 rpm) must be avoided to prevent irregular running .

The value of the power absorbed by the PTO can be obtained from the relation below:

$$P(HP) = \frac{M_{max} \cdot n \cdot i}{7023} \qquad P(kW) = \frac{M_{max} \cdot n \cdot i}{9550}$$

n = engine rotation speed (rpm)
M_{max} = Maximum torque that can be drawn (Nm)
i = gear ratio = PTO outlet revs / engine revs

Type of utilization

The values of the maximum torque that can be drawn M_{max} refer to continuous utilization (up to 60'). Any higher value for occasional utilization (less than 30') shall be agreed upon each time depending on the type of utilization.
In case of utilization of more than 60', you shall consider to reduce, if necessary, the values established depending on the conditions of use (engine cooling, gearbox, etc.).

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 2.8.9 should be followed.

Figure 4.1

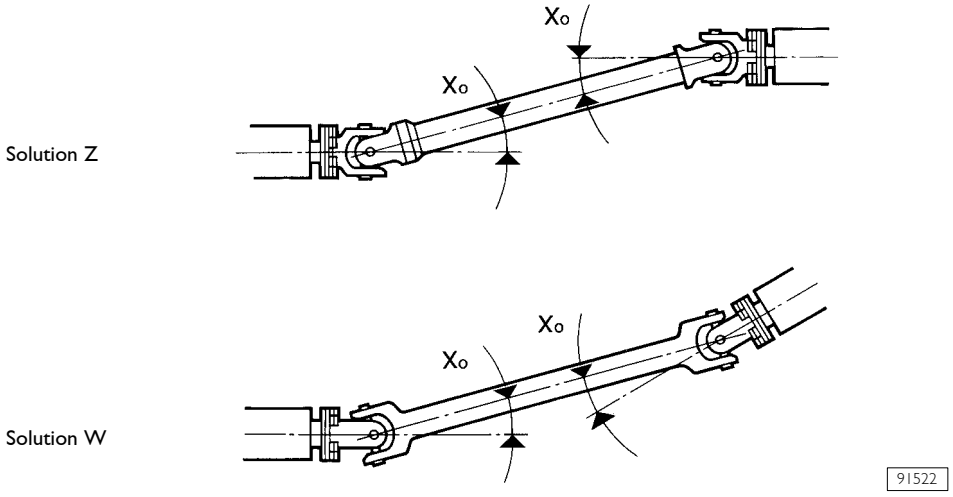
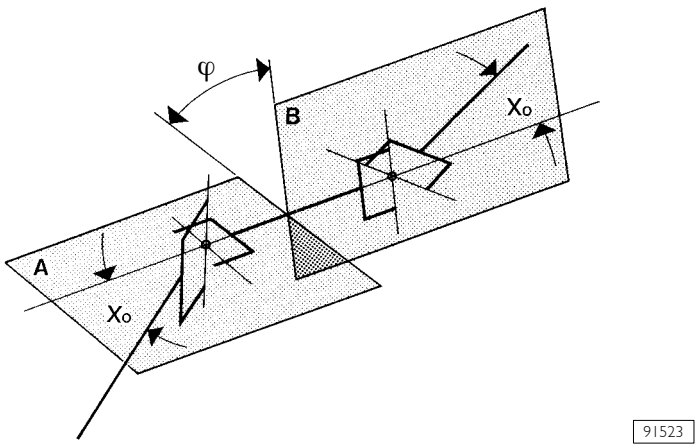


Figure 4.2



4.2 Power Take-off from Gearbox

4.2.1 PTO operation

Depending on the type of gearbox, power can be drawn from the countershaft with the PTOs illustrated in Table 4.1.

Table 4.1 - PTO Hydrocar

Gearbox	PTO opt.	PTO	Assembling	Outlet	Direction of rotation (1)	Flange	Max. torque Cmax (Nm) (2)	i	Wgt. (kg)
5S200 5S270 5S300	06364	20Z1	Sideways	Rear	Clock-wise	Pump	120	1.00	9
6S300 61S300	06365	20Z2	Sideways	Rear	Clock-wise	Pump	180	0.91	9
65380	06365	23Z2	Sideways	Rear	Clock-wise	Pump	180	1.04	8.5

(1) When viewing the PTO outlet from the front
(2) The maximum torque that can be drawn refers to an engine speed of 1500 r.p.m. output from the PTO. For higher speeds, the value of the torque that can be drawn shall be reduced proportionally.

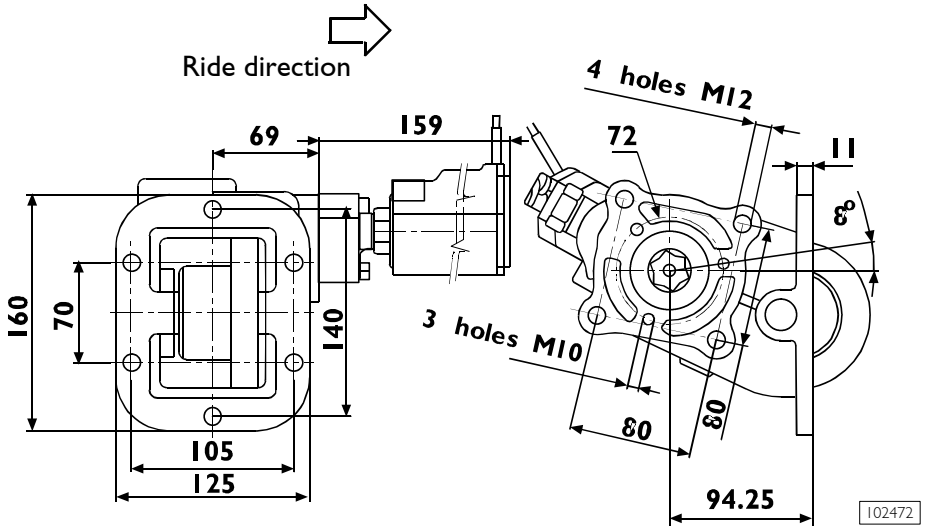
Any damage to the gearbox caused by fitting on the gearbox a PTO different from those in the Table will not be covered by the vehicle warranty.

On vehicles with automatized gearbox (6AS300) the use of a PTO with remote control is not allowed

PTOs feature a flange for direct pump assembling with 3-hole UNI coupling. The outlet consists of a grooved shaft 21 ISO 14 (figure 4.3).
Contact Hydrocar for available couplings:

- pump, 4-hole SE flange (Hydrocar X1K reference);
- 4-hole DIN 00 flange (Hydrocar KFL12 reference);
- 4-hole, Spider 1120 flange (Hydrocar KFL01 reference);

Figure 4.3 PTO Hydrocar type 20Z1 and 20Z2



With a gearbox PTO, in order to avoid excessive stress in the gearbox the PTO must only be used when the vehicle is stationary and engaged only after the clutch has been disangaged, certain applications however require the PTO to be used with the vehicle moving, in this instance the gear must not be changed.

For continuous utilization (up to 60') or longer, verify that the gearbox oil temperature does not exceed 110°C, and the engine water temperature does not exceed 100°C.

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 gearbox casing. The moment due to the additional masses must be no greater than 23 Nm.

The value of the added weights shall be checked for the inertia effects so as not to bring about resonance conditions in the power unit within the range of the engine operating speeds.

For further information on the PTOs and the after sale fitting, contact IVECO direct.

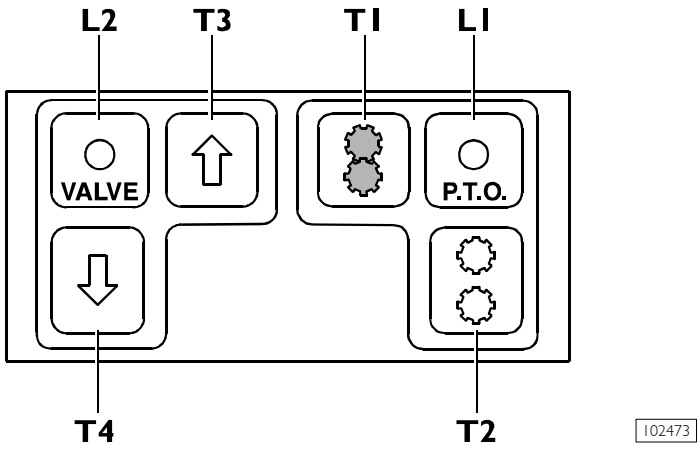
PTO activation

The control console (Figure 4.4) 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 controls the tipping operation, for non tippers this section is not active this section has an indicator light and two push-buttons that interact with the hydraulic control valve linked to the lifting system.

Figure 4.4 PTO control on dashboard



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.

For additional functions and safety features refer to the hydrocar literature.

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 2.8.9).
- The angles of the drive line on the horizontal plane and vertical plane must be kept as close as possible to the original values.
- Weight and rigidity added to the drive line must not cause a loss of balance or abnormal vibrations or damage the transmission drive line (from engine to axle) either during vehicle movement or during operation PTO.
- 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

The power take-off from the front of the crankshaft can be used, for limited power requirements to be drawn off (e.g., air-conditioning, compressors, etc.), by belt drives.

The data shown in the table refer to a drawing made with a special pulley made according to the construction examples illustrated in figures 4.5 and 4.6.

Table 4.2 - PTO from the front of the engine

Engine	Engine code (1)	n_{max} (rpm) (2)	Maximum speed in no-load condition (rpm)	Max. torque that can be drawn (Nm)	Max. moment of inertia (kgm^2)	Max. bending moment (Nm) (3)
9	8140.63	3800	4250	35	0.005	42
11	8140.43C	3600	4250	35	0.005	42
9	8140.43R	3600	4250	35	0.005	42
11	8140.43B	3600	4250	35	0.005	42
13	8140.43S	3600	4250	35	0.005	42
15	8140.43N	3600	4250	35	0.005	42
10	F1AE0481A	3900	4500	35	0.005	42
12	F1AE0481B	3900	4500	35	0.005	42
14	F1AE0481M	3900	4600	35	0.005	42
14	F1AE0481E	3900	4600	35	0.005	42
14	F1C0481A	3500	4200	35	0.005	42
17	F1C0481B	3500	4200	35	0.005	42

(1) Verify engine code on engine plate
(2) Maximum revs corresponding to the maximum rating
(3) With respect to the base front edge

Figure 4.5 Engine 8140.63

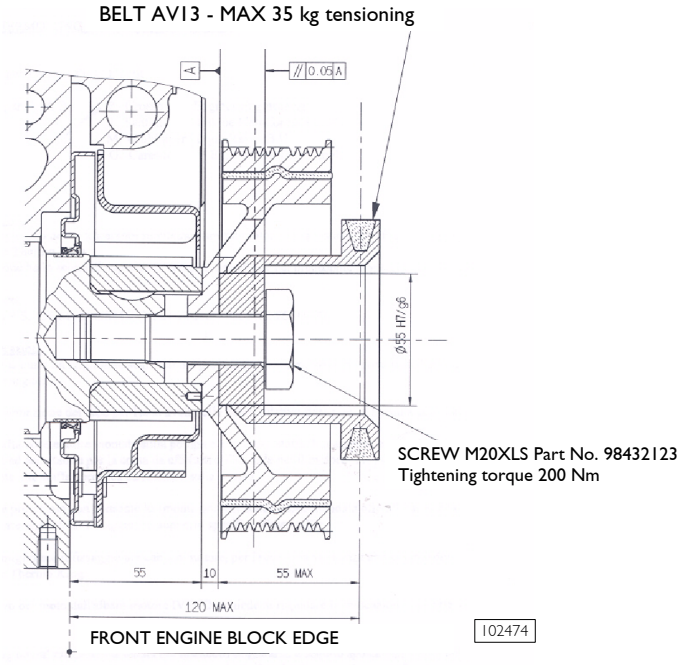
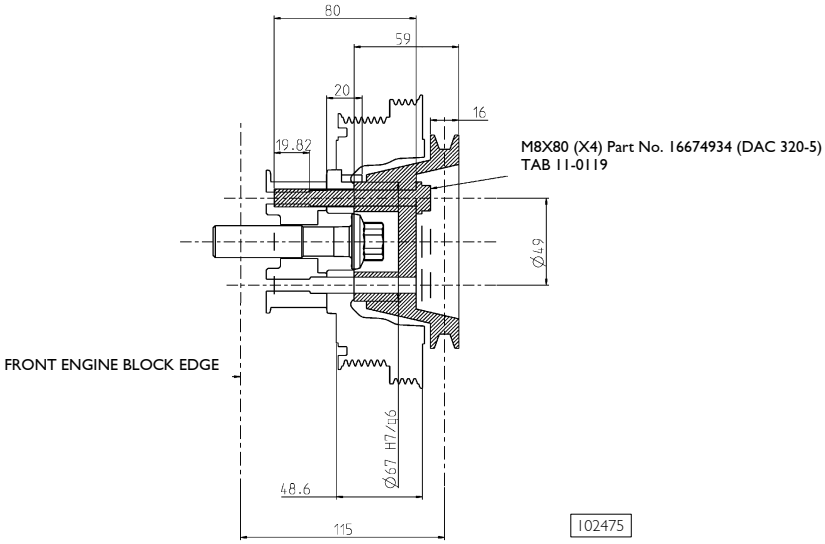


Figure 4.6 Engine F1A



4.5 Engine r.p.m. control for power take-off

8140.43 engine (for vehicles destined to non-EC markets)

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.

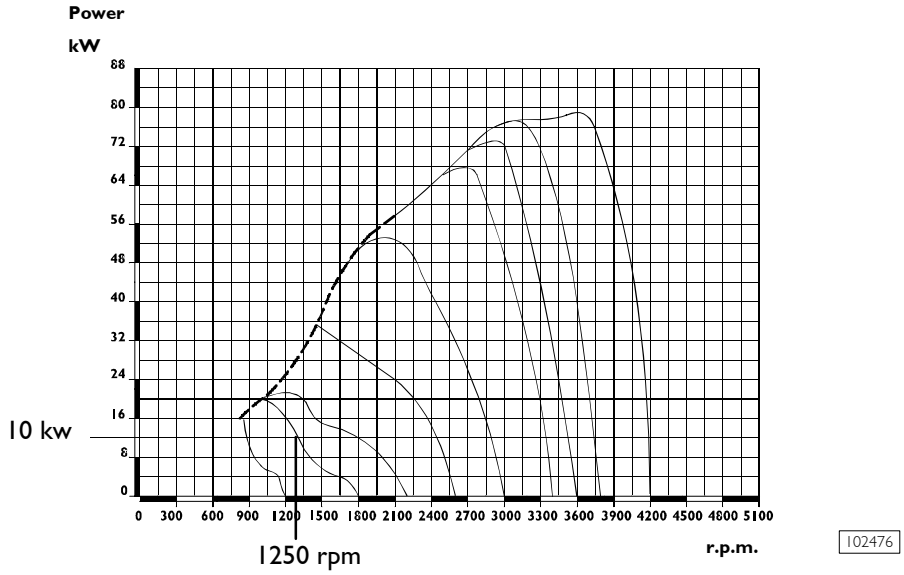
The change in adjusted speed depends on the r.p.m. used by the engine and the power taken.

The following diagram shows that the change decreases as the engine speed increases and it increases in proportion to the value of the power taken.

This version is particularly suited to operate assemblies that need the operator outside the vehicle (e.g., cranes).

Where the characteristics of the added ancillary (e.g., pumps, compressors, etc.) require the maximum rpm to be limited (permitted r.p.m.) during the take-off phase. It is necessary for the governor to be equipped with a device that, operates mechanically or pneumatically with the engagement of the power take-off.

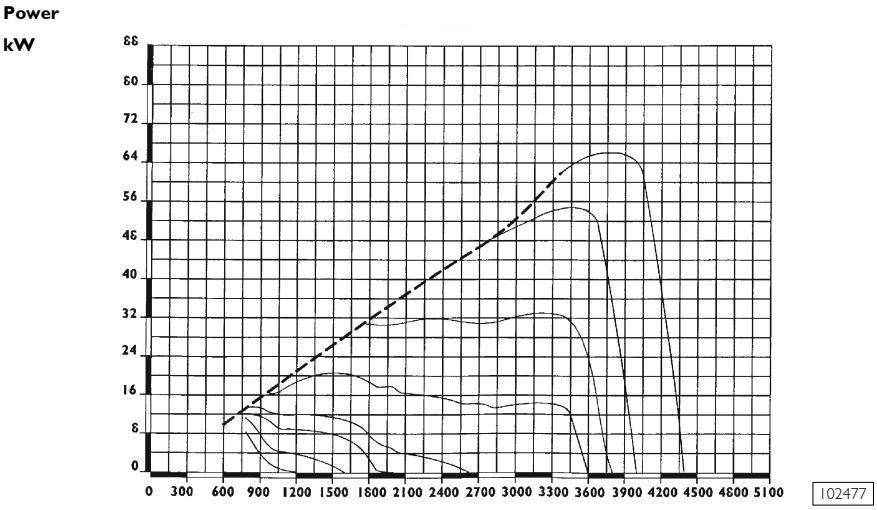
Figure 4.7 - Adjustment curve for 8140.43



Example: It is required that 10 kw are taken at a loaded speed of 1250 r.p.m. using the corresponding characteristic curve, a no-load speed of 1800 r.p.m. will be obtained. The regulator deviation shall be:

$$\frac{1800 - 1250}{1250} = 44\%$$

Figure 4.8 - Adjustment curve for 8140.63



Engines 8140.43R, 8140.43B, 8140.43S, 8140.43N, F1A, F1C

Engines 8140.43R, 43B, 43S, 43N, F1A and F1C are equipped with electronic control unit for engine management. They feature, as an option, the POwer Take Off (PTO) function, which makes it possible to obtain isochronous control of the selected speed (the speed can be controlled with a step of 50 r.p.m.; the curves feature a regulator deviation of less than 1% until the maximum torque curve is reached). On these engine versions, it is recommended that the above option is used in the event that a PTO is fitted.

Alternately, the PTO speed can be adjusted by means of the accelerator pedal, with a performance similar to an engine fitted with a mechanical pump.