MASSIF

RANGE BODYBUILDER INSTRUCTIONS

LIGHT RANGE

IVECO

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Foreword

This publication provides the data, features and instructions for vehicle fitting and modifications.

It is intended for qualified, skill personnel. The body builder is responsible for designing the fitting, its modification and execution, and will have to ensure compliance with the provisions both of this publication and the law regulations in force.

Prior to carrying out any work, make sure you have the publication of the vehicle model on which you are about to work. Also make sure that all the accident-prevention equipment such as, for instance, goggles, helmet, gloves, boots, etc. as well as the working, lifting and handling equipment are available and in good working order. Finally, make sure that you operate on the vehicle in such conditions as to ensure maximum safety.

The execution of the work by strictly complying with the above provisions, as well as the use of the components shown, ensure that the work is carried out correctly and safely.

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.

IVECO is available to provide all and every explanation required to carry out the work and also help you handle the cases not dealt with in this publication.

After every single intervention, the functioning, efficiency and safety conditions established by IVECO shall be restored. Contact the IVECO service network for vehicle set-up, if necessary.

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

The data and information contained in this publication may not be updated due to the changes made by IVECO, at any time, for technical or commercial reasons, or to make the vehicles comply with the law regulations in force in the different countries.

In case of disagreement between the provisions included herein and the actual vehicle make-up, contact IVECO prior to carrying out any work.

Symbols - Warnings

Danger for persons

Missing or incomplete observance of these prescriptions can cause serious danger for persons' safety.

Danger of serious damage for the vehicle

Partial or complete non observance of these prescriptions can cause serious damages to the vehicle and sometimes guarantee lapse too.

General danger

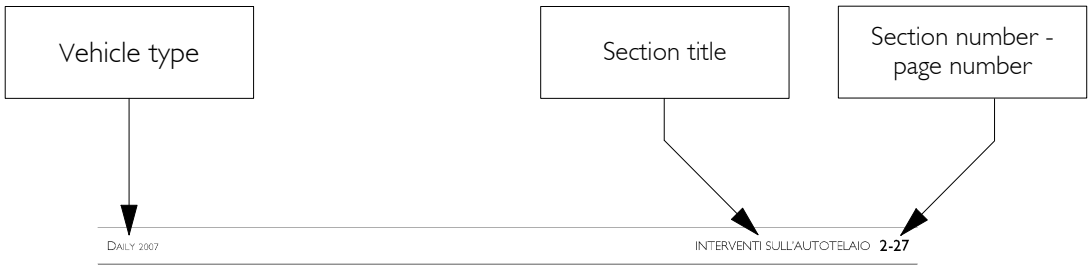
It includes the dangers of above described signals.

Environment protection

It indicates correct behaviour in order that vehicle use is environmentally friendly as much as possible.

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

Page header and footer interpretation



2.7 Applicazione di un asse supplementare

Non è prevista l'applicazione di assi supplementari sul veicolo.

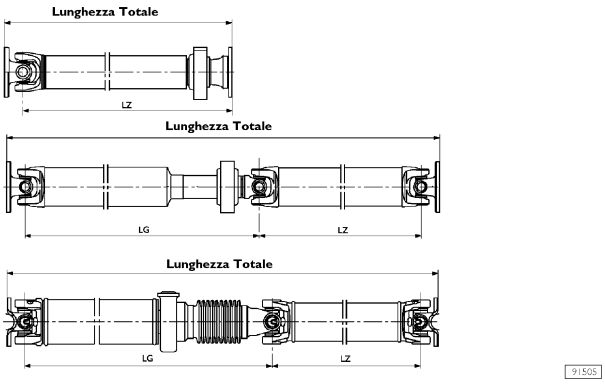
2.8 Modifiche alla trasmissione

L'intervento sulla trasmissione, a seguito della modifica del passo, dovrà essere fatto utilizzando, in linea di massima lo schema della trasmissione di un analogo veicolo avente all'incirca lo stesso passo. Dovranno essere rispettati i valori massimi delle inclinazioni degli alberi di trasmissione previsti sui veicoli di serie; ciò vale anche per i casi di interventi sulle sospensioni e sull' asse posteriore motore.
Nei casi di difficoltà, potrà essere interpellata l'IVECO, trasmettendo uno schema con riportate lunghezza ed inclinazione della nuova trasmissione proposta.
Le indicazioni tecniche riportate sulla manualistica dei Costruttori delle trasmissioni, potranno essere utilizzate per la corretta realizzazione e disposizione dei tronchi.
Le indicazioni qui contenute hanno lo scopo di salvaguardare il corretto funzionamento della trasmissione, limitarne la rumorosità ed evitare l'innesco di sollecitazioni trasmesse dal gruppo motopropulsore; ciò non esenta tuttavia l'allestitore dalla responsabilità dei lavori eseguiti.

2.8.1 Lunghezze ammesse

Le massime lunghezze di esercizio realizzabili, sia per i tronchi intermedi che scorrevoli "LG" o "LZ" (ved. Figura 2.11), possono essere determinate in base al diametro esterno del tubo esistente sul veicolo e dal numero dei giri massimo di esercizio (vedere formula) e sono riportate nella Tabella 2.15.
Qualora la lunghezza dell'albero indicato in Tabella 2.15, in funzione del diametro del tubo non risulti sufficiente, si dovrà prevedere l'inserimento di un nuovo tronco con le stesse caratteristiche di quelli esistenti. In alternativa in alcuni casi potrà essere utilizzato un albero di trasmissione avente un diametro del tubo di maggiori dimensioni; la dimensione occorrente del tubo potrà essere determinata in base alla lunghezza necessaria ed al numero di giri massimo di esercizio, direttamente dalla Tabella 2.15.

Figura 2.11



LZ Tronchi intermedi
LG Tronchi scorrevoli

INDEX OF SECTION

Section

SECTION 1

General specifications

1.1 Aim of bodybuilders instructions

The purpose of this publication is to provide data, specifications and instructions for the bodybuilding and conversion of an original IVECO vehicle to ensure the functionality, safety and reliability of the vehicle and its components.

1.2 IVECO approval for changes and fittings

Changes must be carried out in accordance with the requirements set out in the following guidelines.

The following may be carried out only with IVECO's approval after submitting a copy of the documentation required for technical evaluation of the proposed change (drawings, calculations, technical report etc.):

- 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;
- changes to the stabiliser bars and suspensions;
- changes to the cab, cab supports, locking and tipping devices;
- changes to the engine intake and exhaust systems;
- engine cooling system modifications;
- power unit and driving component modifications;
- work carried out on front and rear 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;
- the functionality, safety and reliability and in general the effective performance of the vehicle and also the effects that the changes and the conversion may have on vehicle performance and specifications.

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;
- an unsuitable frame has been used for the required conversion or application;
- 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;
- read and respect the safety standards and symbols applied before any operation;
- do not use the vehicle for applications other than those for which it is designed.

Maintaining the functionality of vehicle components.

The effective operation of vehicle components, all component safety and running conditions, compliance with national and international regulations (e.g. EC Directives) and also accident prevention standards must naturally be guaranteed in all permitted conversions and applications.

All our vehicles are covered by a warranty as laid down in the specific documents.

The bodybuilder must arrange to carry out operations at least in an equivalent manner.

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 by means of computer

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

- directives for transformation and equipping of vehicles;
- technical cards;
- chassis cab diagrams;
- chassis diagrams;
- other specifications concerning the vehicle range.

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

1.7 Trademarks and Logos

Trademarks, nameplates and denominations must not be modified or displaced in relation to the original design. The appearance of the vehicle must not be changed or modified.

The application of trademarks tied to the transformation or trim levels must be authorised by IVECO. They must not be applied near to the IVECO tradenames or logos.

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

Instruction for added assemblies

Where assemblies are added, the bodybuilder must provide the necessary service and maintenance instructions when the vehicle is delivered.

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

Do not allow unauthorised personnel to work on or operate the vehicle.
It is forbidden to use the vehicle if its safety devices have been tampered with or damaged.

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.

Components such as seats, coverings, linings, protective panels etc. may represent a potential fire hazard if they are exposed to an intense heat source.

Arrange for their removal before working with welding equipment and flames.

1.10 Choice of material to use: Ecology - Recycling

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

- everyone must be aware of the prohibitions on using harmful or potentially hazardous materials, such as ones containing asbestos, lead, halogen additives, fluorocarbons, 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.
- Batteries contain substances that are very hazardous to the environment. When replacing batteries, we advise contacting the service network, which is suitably equipped for battery disposal in compliance with environmental policies and laws.

In order to comply with EC directive 2000/53 (ELVs), 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;
- carry out the checks included in the "IVECO Pre-Delivery inspection" list (available from the IVECO network) with regard to the items affected by the work done;
- provide a guarantee for the modifications made;
- in the event that the connections originally provided with screws have been mounted and restored, the same screws shall not be used. In such an instance, and in the event that nails have been replaced with screws, you must check again the closing of the connection after travelling approximately 500-1000 km.
- measure the battery voltage. Ensure there is a minimum charge of 12.5 V. If the voltage reading is between 12.1 and 12.49 V, recharge the battery (slow charge). If the voltage is less than 12.1 V, the battery must be scrapped and replaced with a new one;
- the batteries must be serviced at regular intervals until the vehicle is handed over to the customer to prevent problems of low charge, short-circuits or corrosion. IVECO reserves the right to terminate the battery warranty if the maintenance procedures required by the IVECO network are not observed.

1.12 Vehicles identification

The commercial designation of IVECO vehicles is not the same as the type approval (homologation) designation. The tradename is MASSIF. IVECO

Vehicles identification

1.13 Dimensions and masses

1.13.1 General Specifications

The dimensions and maximum permissible weight on the axles are indicated on the bodybuilder layout drawings, on technical specification sheets 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 of the frame

As a result of production factors there could be at a ±5% variation in the published weights.

It is therefore, advisable to weigh the vehicle in the chassis cab condition before fitting the body and equipment and establish the weight distribution on the axles.

Body conversions

The body building limits for each model are mainly defined by the following:

- weight distribution on the axles;
- width of the mirrors used;
- rear bumper position

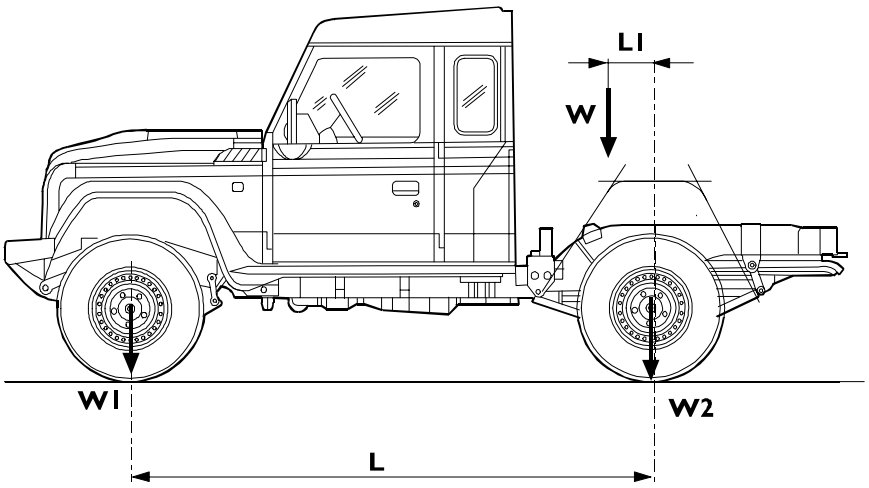
Greater values in compliance with the weights permitted on the axles may be authorized by IVECO after modifying such components as the chassis, bumper, mirrors, etc.

1.13.2 Determining the Centre of Gravity of the Body and Payload

Positioning on the 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 1.1



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$$L_1 = \frac{W_1 \cdot L}{W} \quad \text{respectively} \quad L1 = L - \frac{W2 \cdot L}{W}$$

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 centre of gravity from the rear axle centre line (mm)

L = Wheelbase (mm)

Example of calculation of the load barycentre position

Consider a Massif chassis cab vehicle with a wheelbase of 2768 mm with:

1. GWW= 3050 kg (permitted maximum: 1175 kg on the front and 2150 kg on the rear)
2. KERB WEIGHT = 1,955 kg (1,340 kg on the front axle, 615 kg on the rear)

The permitted maximum load (body + payload) will be W = 3050 - 1860 = 1190 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 an uniform distributed load .

In this case, out of 1190 kg. W_1 = 1175 - 1020 = 155 kg will affect the front axle, while the remaining W_2 = 1190 - 155 = 1035 kg will affect the rear axle.

Thus, the following will be obtained:

1. W_1 = 155 kg
2. L = 2768 mm
3. W = 1190 kg

$L_1 = W_1 \times L / W$ = 360 mm

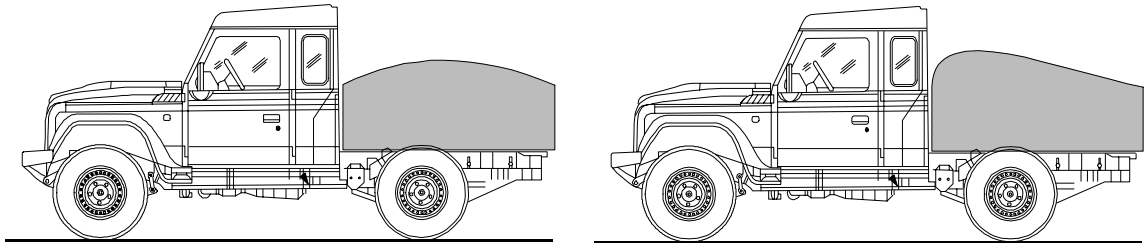
The center of gravity of the load (Body + payload) must not be more than 360 mm far from the rear axle; otherwise, the front axle would be overloaded.

In order to determine 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.

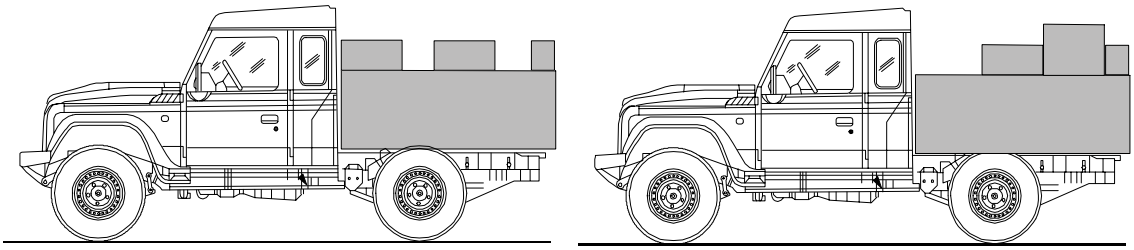
Figure 1.2



Uniform load distribution

Uneven load distribution

Figure 1.3



Uniform load distribution

Uneven load distribution
(beware of axle loads and minimum axle ratio)

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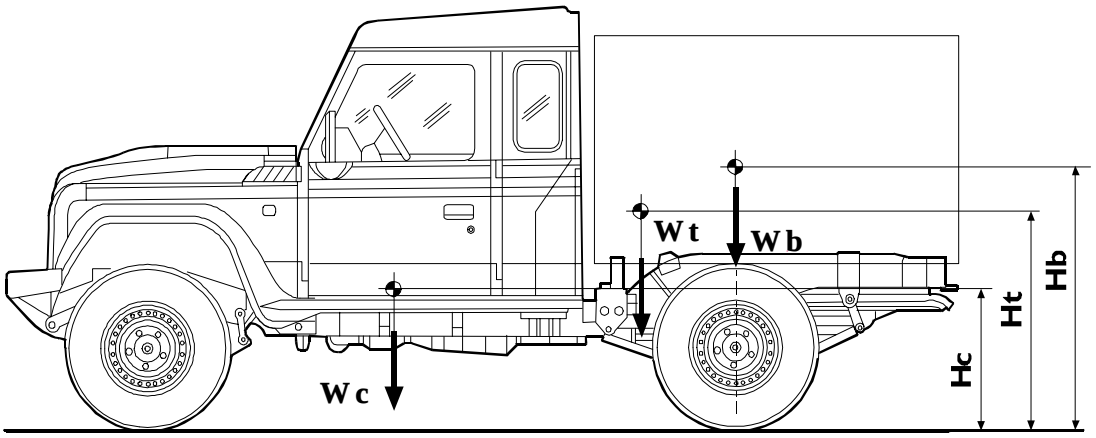
Height of centre of gravity

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 1.4

Verification with full load:



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

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 the above formula but for Wb use only the vehicle unladen weight (The position for Hc will depend on the load and deflection of the suspension).

The height of the centre of gravity indicated in Table 2.6 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 2.6 refer to the body with fixed payload. In versions where the payload tends to move sideways (e.g. suspended loads, fluid loads etc.) especially when turning, higher dynamic transverse forces 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 body type, to the wheelbase and to the distribution of the transverse forces 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 body is very rigid (e.g. van conversion).

1.13.3 Observing the Permitted Weights

All the limits specified on the IVECO documents must be complied with. It is essential that **the maximum weight on the front axle is not exceeded**, under any load condition, so as to ensure the correct steering and braking characteristics regardless of the road surface conditions.

Particular attention must be taken with vehicles where the load is concentrated on the rear overhang (e.g. cranes, tail lifts, trailers) and to vehicles with short wheelbases and a very high centre of gravity.

Ensure transverse loads are properly distributed when positioning auxiliary components and superstructures. A +4% variation on the rated load (50% of load on the axle) is permissible for each wheel (for example: permissible load on axle 2150 kg; 1032 to 1118 kg allowed for each wheel side); in compliance with load allowed by tyres, without affecting braking properties and vehicle driving stability.

Apart from different specifications for specific vehicles, the following may be taken to be the minimum weights 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 rear under-run guard stipulated by the relevant National and EC regulations.

Variations in the Permissible Weight

Special exceptions to the maximum permissible weights 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 Government 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) including positions for 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 components such as suspension, brakes etc) and may require recalibration of the load sensing valve where one is fitted. In these circumstances necessary instructions may be provided.

1.14 Instructions for the Correct Functioning of the Parts of the Vehicle and Accessibility for Maintenance

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

For example:

- Ready access to all parts requiring inspection or maintenance and periodic servicing must be provided. In the case of closed body types suitable opening doors must be provided.
- 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.), fuel supply (pump position, filters, pipe diameter, 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 ventilation of the brakes and battery case (especially in the case of vans) must be guaranteed.
- When positioning the mudguards and wheel arches, the rear wheels must be free to rebound even when used with chains.
- When the vehicle has been set up, for safety reasons, headlight attitude must be checked and adjusted as necessary. Perform the adjustment according to the instructions provided in the use and maintenance manual.
- 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 possible national laws.

1.15 Quality System management

For some time IVECO has been promoting Quality System development and training for bodybuilders.

This is a requirement due not only to compliance with domestic and international regulations on product liability, but also the growing demand for increasingly higher quality levels. The creation of new forms of organization in the various sectors and the quest for increasingly more advanced levels of efficiency.

IVECO believes it essential for bodybuilders to be equipped with an organization where the following are defined and available:

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

1.16 Vehicle maintenance

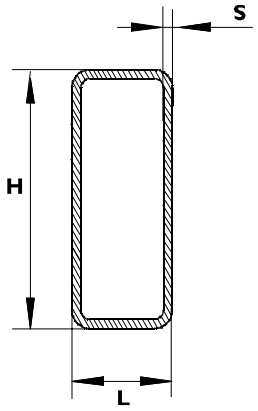
In addition to making the necessary checks on the outfit in keeping with customary working procedures, the bodybuilder shall perform the checks specified in the "IVECO pre-delivery inspection" list, which can be obtained from the IVECO network, for the aspects affected by the modifications performed.

1.17 Conventions

In these bodybuilders instructions, the wheelbase is taken as the distance between the centreline of the first steering axle and the centreline of the first rear axle (driven or non-driven). This definition differs from the definition of wheelbase in the CE Directives. The rear overhang is taken as the distance between centreline of the last axle and the rear end of the chassis runner. For dimensions H, L and s of the frame and counterframe section please refer to the figure below.

Figure 1.5

wheelbase area side member section



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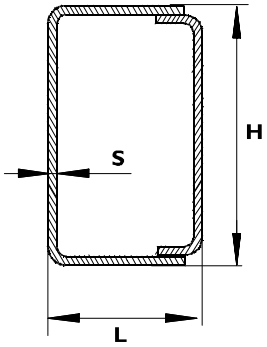
rear overhang area side member section



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SECTION 2

Operations on the vehicle

2.1 General instructions for chassis modifications

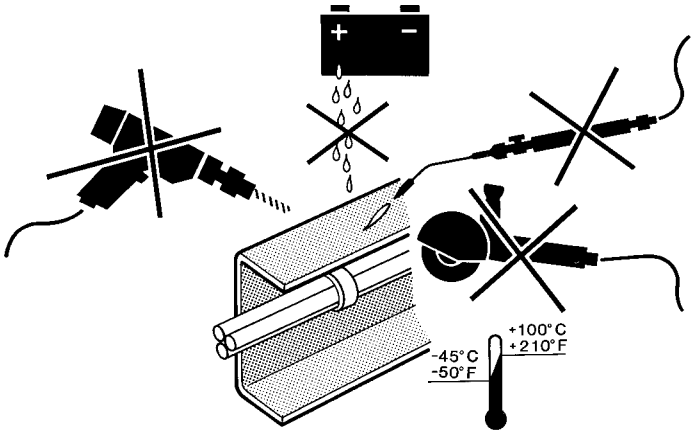
Particular attention must be given to the following points:

- **Welding to the bearing structures of the chassis is explicitly prohibited** (with the exception of the items described at points 2.3.4 e 2.5);
- **Holes in the flanges of the side members are not permitted** (except for the items described at point 2.3.4);
- If the original bolted connections have been fitted and renewed, it is forbidden to reuse the same bolts. In this case, the tightness of the connection must be rechecked after about 500-1000 km.

2.1.1 Specific Precautions

During the welding, drilling, grinding and cutting operations when working in the proximity of brake lines and particularly if these are of plastic material or electric wiring, care must be taken to ensure their protection. Where necessary they should be removed (comply with the provisions given at points 2.15 and 2.16).

Figure 2.1



Regarding the electrical equipment remember to:

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

b) Checking the earth connections.
As a general rule the original earth connections of the vehicle must not be changed. If it is necessary to move these connections or to implement further earth points use the existing holes on the chassis as far as possible and:

- Remove, mechanically, and/or with an appropriate chemical product, the paint on the chassis side and on the terminal side creating a resting plane free from indentations or ridges.
- Apply appropriate high conductivity paint between the cable terminal and the metal surface (e.g. galvanizing paint IVECO Part number 459622 by PPG).
- Connect the earth cables within 5 minutes from the application of the paint.

For signal level earth connections (e.g. sensors or devices with low power uptake), avoid using IVECO m3, m4, m5 (battery earth connection), and is m6 standard points under all circumstances (see point 2.16.1).

With regard to the electronic devices, avoid linking earth connections between the devices; only use single wire earths with optimised lengths (as short as possible).

c) Electric wiring

For further information regarding the braking and electronic system, refer to point 2.15 and 2.16.

2.2 Protection against Rust and Painting

NOTE All parts fitted to the frame must be painted in accordance with Iveco St. Iveco 18-1600 Colour IC444 RAL 7021 70/80 gloss.

2.2.1 Original components

In Table 2.1 details the operations for protecting and painting the components of the original vehicle (Table 2.3 for painted parts, Table 2.2 for non-painted or aluminium parts).

Table 2.1 - Protection category - STD 18 - 1600 (Schedule I)

Class	Parts requirements	Specific examples affected
A	Parts in direct contact with atmospheric agents.	Body - Door mirrors - Windscreen wipers - Aerodynamic kit metal structure - sun blind metal structure - Metal bumpers - Cab attachment lock - Door stopdevice - Body fasteners (screws,bolts, nuts, washers), etc.
B B2	Parts in direct contact with atmospheric agents.with mainly structural characteristicsin direct view.	Frame and parts, includingfasteners. Parts beneath grille (category B). Exterior cab steps.
B1		Only for rear axles and axles
C	Parts in direct contact with atmospheric agents.not in direct view.	Engine and parts
D	Parts not in direct contact with atmospheric agents.	Pedals - Seat reinforcements - Fasteners - etc., fitted inside cab.

NOTE Parts must be supplied only with cataphoretic coating or rustproofing (Schedule III). The enamel will be appliedduring the frame finishing stage.

Table 2.2 - Various unpainted and aluminium parts and components - STD 18 - 1600 (Schedule IV)

Type of protection		IVECO standard	Class			
			A	B - B1 - B2	C	D
Stainless steel [1]		18-0506	yes	-	-	-
Dacromet (■)	DAC 320-8	18-1101	yes	-	-	-
	DAC 500-8				-	-
	DAC 320-5		-	yes	-	-
	DAC 500-5		-		-	-
	DAC 500-5 PL		-	yes Category B1 wheel studs		
Geomet (■■■)	GEO 321-8-PM	18-1101	yes	-	-	-
	GEO 321-5		-	yes		
	GEO 321-5-PM					
	GEO 321-5-PL			yes Category B1 wheel studs		
Zinc coating (■)	Fe/Zn 12 III (yellow)	18-1102	-	-	yes	yes
	Fe/Zn 12 V (olive green)		-	yes	-	-
	Fe/Zn 25 V (olive green)		-		-	-
	Fe/Zn 12 III S (yellow)		-		-	-
	Fe/Zn 12 V S (olive green)		-		-	-
Zinc coating (■■)	FE/ZN 12 II		-	-	yes	yes
	FE/ZN 12 IV S		-	yes	-	-
Aluminium	Anodic oxidation	18-1148	yes	yes	yes	yes
	Painting	See Schedule III	yes			

(■) Hexavalent chromium coatings.
(■■) Hexavalent chromium-free coatings.
(■■■) Chromium-free coatings.
[1] Matching with other metals must not generate battery effects.

Table 2.3 - Painted parts - STD 18 - 1600 (Schedule III)

Description of the cycle phase		Classes					
		A	B [8]	B1 [5]	B2	C	D
MECHANICAL CLEANING SUPERFICIAL [1]	Sanding/sandblasting	-	yes ★	-	yes ★	yes ★	yes ★
	Brushing	yes ★					
	Sandpapering						
PRETREATMENT	Iron phosphatation (only for non-precoated ferrous materials)	-	yes ★	-	yes ★	yes ★	yes ★
	Zinc phosphatation ☆	yes					
CATAPHORESIS	High thickness (30-40 µm)	yes [2]	yes ★ [6]	-	yes ★ [6]	yes ★ [9]	yes ★
	Medium thickness (20-30 µm)	yes [3]					
	Acrylic top coat (>35 µm)	-			-		
RUSTPROOFING	Dual component (30-40 µm)	-	yes [10]	-	yes [10]	yes ★ [9]	yes ★
	Single component (30-40 µm)		-	yes	yes		
CHIP-RESISTANT PRIMER	Single (130 °C) or dual component (30-40 µm)	yes [3]	-	-	-	-	-
ENAMEL	Single (130 °C) or dual component (30-40 µm)	yes	yes ★	-	-	yes ★	yes ★ [7]
	Powder (40-110 µm)	yes [4]					
	Single component, low temperature (30-40 µm)	-	-	yes			

[1] = Carry out operation in presence of shearing burrs, oxidation, welding swarf, laser-cut surfaces.
[2] = Two-coat body cycle.
[3] = Three-coat body cycle.
[4] = As an alternative to single or dual component enamel only for body parts (windscreen wipers. Rear view mirrors etc.).
[5] = Only for rear axles and axles.
[6] = Excluding parts that cannot be submerged in pretreatment or paint baths because this would affect their operation (e.g.: mechanical parts).
[7] = Colour is specified on the drawing by means of an IC
[8] = For fuel tanks in ferrous sheet metal or precoated.
[9] = Only parts to be fitted on engine.
[10] = Parts that cannot be treated with cataphoresis (see [6]).
☆ = For galvanised or aluminium panels, use special phosphating treatments.
★ = Alternative products and cycles for the same class, as long as they are compatible with the part being treated.

2.2.2 Added or modified painted 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 2.4 (painted) and Table 2.5 (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.

Never use powder enamels directly after degreasing.

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	yes	-
Dacromet		-
Zinc treatment	-	yes

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 hubs, avoid increasing the thickness and especially avoid the build-up of paint on the connecting flanges of the wheel disks and resting points of the fixing nuts.

Ensure that the disc brakes are adequately protected.

The electronic components and modules must be removed.

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

2.2.4 Exceeding the Limits

In case of special transport with considerable high centre of gravity (e.g. special body versions, advertising vehicles, etc.), from a technical point the values shown in the table may be exceeded, provided the vehicle is driven carefully (e.g. low speed, gradual running direction changes, etc.).

Table 2.6 - Maximum heights in relation to the centre of gravity of the payload and cornering stability

Models	Max. height (approx.) of centre of gravity of payload (include. body and equipment) in relation to the ground (mm)
-	955

2.3 Drilling the Chassis

The frame must not be drilled.

When auxiliary units or components are to be applied to the frame, existing factory-made holes must be used and the following instructions must be applied.

Positioning and sizes

If it is necessary to make holes in the frame, it is compulsory to ask IVECO for authorisation.

2.3.1 Screws and nuts

In general, use connectors of the same type and class as those for similar fixings on the original vehicle (Table 2.7).

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 screws and nuts with flanged heads. Use self-locking nuts. Nuts must be tightened using a torque wrench set to the correct torque setting for the fixing.

Table 2.7 - 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

2.3.2 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 2.8) and thickness (Table 2.9) 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 2.8 - Materiale da utilizzare nelle modifiche del telaio Standard IVECO 15-2110 e 15-2812

Steel name		Tensile strength (N/mm^2)	Yield point (N/mm^2)	A5 elongation
IVECO	FEE490	610	490	23%
Europe	S355J0W			
Germany	QSTE500TM - S355J0W			
UK	S355J0W			

Table 2.9 - Truck chassis dimensions, section and thickness

Model	Type	Wheelbase [mm]	Chassis rear overhang [mm]	A x B x t wheelbase area side member section [mm]	A x B x t rear overhang area side member section [mm]
Chassis cab	truck	2768	1000	170 x 75 x 3	156 x 75 x 2,5

2.3.3 Stresses on the chassis

Under no circumstances is it permitted to exceed the stress levels under static conditions, calculated taking into consideration that:

- within the wheelbase, the safety coefficient relating to yield under conditions of maximum load on the axles is equal to 3.5
- On the rear overhang, the safety coefficient relating to yield under conditions of maximum load on the axles, is equal to 3

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.

2.3.4 Welding the Chassis

NOTE All frame welding must be carried out after authorisation from IVECO.They must then be carried out scrupulously following the instructions given below.

Welding operations must only be carried out by specialist, trained personnel, using suitable equipment and in a perfectly workmanlike manner (see norms EN 287). Any intervention on the system not carried out as per instructions provided by IVECO or carried out by unskilled staff, might severely damage the on-board systems, thus adversely affecting vehicle operation safety and efficiency and causing damages not covered by guarantee contract.

In case of arc welding, strictly follow instructions below in order to protect electric units and ECUs:

- before disconnecting power cables, check for no loads engaged;
- in case an electric switch is installed (main contactor) wait for cycle end;
- disconnect negative power pole;
- disconnect positive power pole without connecting it to ground and DO NOT short circuit it with negative pole;
- disconnect ECUs connectors, operate carefully and do not touch ECU connector pins;
- In case of welding next ECU, disconnect it from vehicle;
- connect welding machine ground directly on part to be welded;
- protect plastic material pipes against heat sources and disassemble, if required:
- in case of welding near leaf springs or air springs against welding spatters, carefully protect surfaces;
- avoid electrode or gun contact with spring leaves;

Operations for welding preparation

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 2.2.2).

a) Carry out arc welding in several passages using properly dried basic electrodes Recommended electrodes:
For S 500 MC (FeE490: QStE 500TM)
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 to 1.2 mm).
Recommended welding rod: DIN 8559 - SG3 M2 5243
gas DIN 32526-M21 or DIN EN 439
If FeE490 is used at very low temperatures, we recommend:
PrEN 440 G7 AWS A 5.28 - ER 80S - Ni 1 gas DIN EN439-M21
Avoid current overloading. Welding must be free from marginal cuts and waste material.

b) Repeat the operation on the reverse side by welding as detailed in point **a)**.

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

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

2.3.5 Closing of existing holes

If, when making new holes, the existing holes are found to be too close 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.

2.4 Modifying the Wheelbase

2.4.1 General Specifications

It is only possible to alter the wheelbase after obtaining specific approval from IVECO.

2.4.2 Authorisation

Provided the chassis converter gives sufficient guarantees from the technological and control point of view (qualified personnel, adequate operating processes, etc.).
Conversion must be carried out performed in compliance with these instructions by making the necessary changes and adjustments and taking the appropriate precautions (e.g., determining whether ECU parameters need updating, rearranging the exhaust pipes, ensuring compliance with specific load limits on the rear axle, etc.), by taking into due account the requirements specified for the original wheelbase lengths.

2.4.3 Consequences for steering

In general, changes to the wheelbase affect steering specifications. Each operation is directly linked to the authorisation requested from IVECO.

2.4.4 Effect on Braking

In general, changes to the wheelbase affect braking specifications. Each operation is directly linked to the authorisation requested from IVECO.

2.5 Modifying the Rear Overhang

2.5.1 Authorisation

Rear lengthening of the frame must be specifically authorised by IVECO.

2.6 Installing a Towing Device

2.6.1 General Specifications

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

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

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

In trailers with one or more axles close together (mid-axled trailers), bear in mind the instructions given in point 2.6.3.

The tow hook must be appropriate for the permitted loads and of the type approved by national laws.

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.

The size of the hook attachment flange does not coincide with the holes on the vehicle rear beam, modification of the drilling on the beam may be authorised in specific cases after applying appropriate reinforcements.

The bodybuilder is obliged to construct and fit the superstructure to make the necessary manoeuvres and control of the attachment possible without impediment or hazards.

The trailer drawbar must be free to move.

2.6.2 Traditional towing hooks

A towing hook may be fitted, without obtaining prior approval only on crossmembers provided for this purpose and to vehicles on which IVECO provides for a towing hook to be installed.

The installation of a towing hook on vehicles which IVECO does not provide a towing hook installation then authorisation from IVECO must be obtained before any installation is carried out.

Detail of rail reinforcement for installation of the tow hook.

The values of the trailer loads and of the permissible vertical loads are contained in the technical documentation of the manufacturer of the tow hook or on the production data plate (e.g. DIN 74051 and DIN 74052).

There are also tow hooks with special type approval, whose values are greater than the ones mentioned in the above standards. These hooks may in any case be subjected to restrictions depending on the trailers used (e.g. drawbar length). In addition this can imply that the rear cross member should be further reinforced and a subframe runner of larger size be fitted.

For mechanical attachment devices designed for mid-axled trailers, the Dc, S and V values are defined by the following equations:

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

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

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 ≤ 0,1 · R ≤ 1000kg;
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

Let us consider a Massif chassis cab vehicle with maximum weight 2800 kg that is to be used to tow a mid-axled trailer weighing 3000kg with S = 250 kg, load surface length of 5m and theoretical drawbar length of 4m.

Therefore, from the data

1. S = 0.25 t
2. C = R – S = 3.0 - 0.25 = 2.75 t
3. (T + S) = 2.8 + 0.25 = 3.05 t
4. $X^2 / l^2 = 25 / 16 = 1.5$

we obtain:

$D_c = 9.81 \times (2.8 \times 2.75) / (2.8 + 2.75) = 13.61$ kN, and $V = 2.4 \times 1.5 \times 2.75 = 10.3$ kN

The use of trailers with centre axles (rigid tow bar trailers with single or tandem axles), with respect to articulated tow bar trailers, entails an increase in bending stress on the rear chassis overhang as well as an increased torsional stress of the rear towing cross member resulting from the vertical static and dynamic loads which the tow bar exerts on the hook (for example when braking or on bumpy roads).

Two tow hooks are available as options: one fixed and one mobile, with specifications as shown in the following table (see Table 2.10)

Table 2.10 - Approved towing hooks available

Maker	Type	Class	D (kN)	D_C (kN)	EC approval no.
LAFUENTE	EE0146	A50-X	22.5	15,42	e 9*94/20*94/20*2909* ???
LAFUENTE	EE0180		22.5	15,42	e9*94/20*94/20*2918* ???

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

Model	Maximum S (kN)
Chassis cab	125

2.6.3 Kinds of hook

•) 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 crossmembers provided for the ball hook.

•) Removable hook

When fitting the removable hook, carried out in accordance with the hook manufacturer's instructions, the guidelines laid down in national and international regulations must be respected (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 the hook for the truck version may also be fitted to the crossmembers provided for the removable hook.

2.6.4 Lowered Rear Cross Member

If the type of trailer used requires that the tow hook be positioned lower than originally intended, IVECO may issue authorisation for the original cross member to be lowered or for an additional cross member (of the original type) to be fitted in a lower position. Figure 2.2 shows an example.
The installation of the new cross member in its new position must be carried out in the same manner as before, using the same type (diameter and class) of bolt.

Figure 2.2

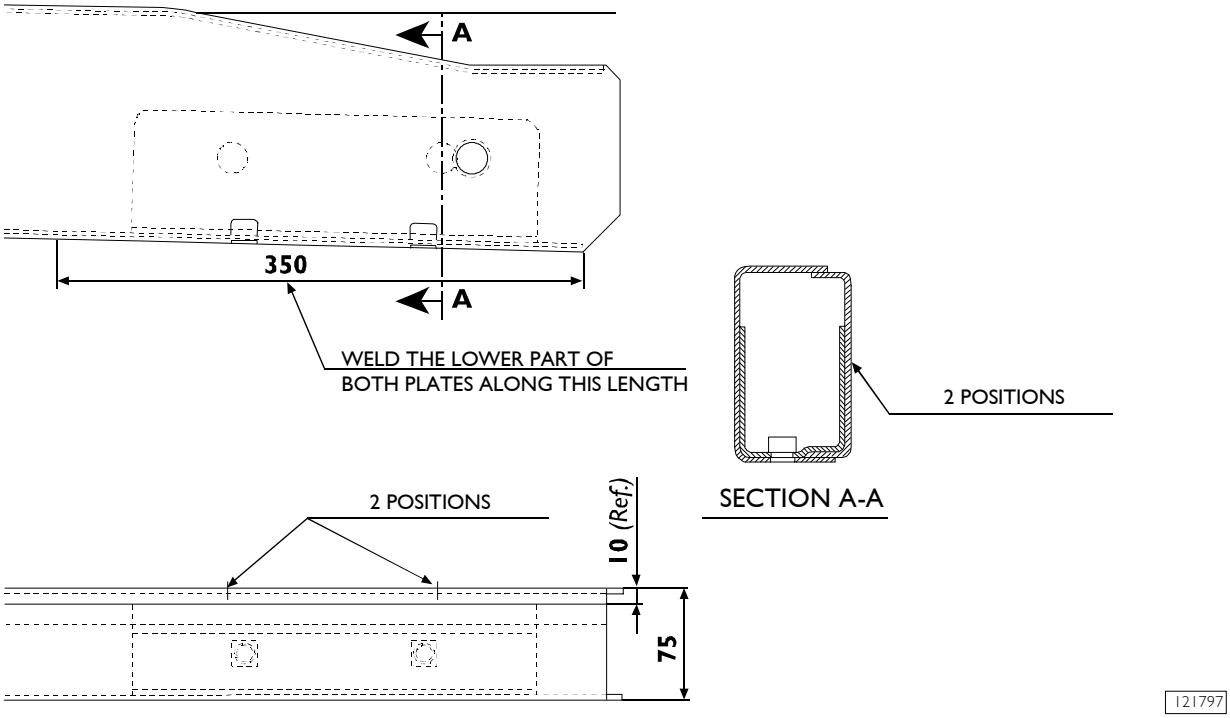
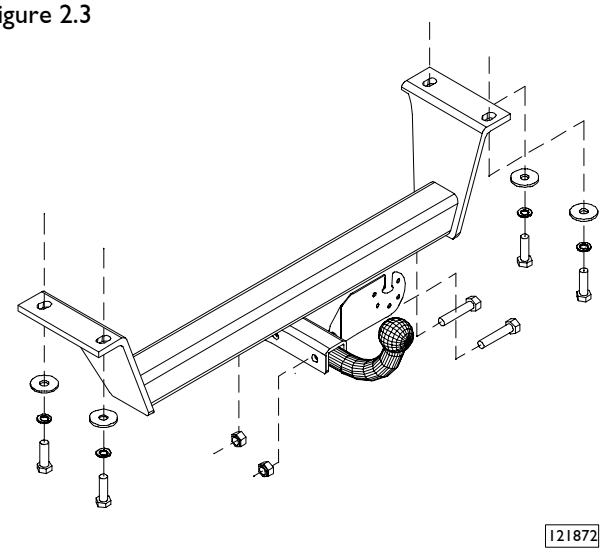
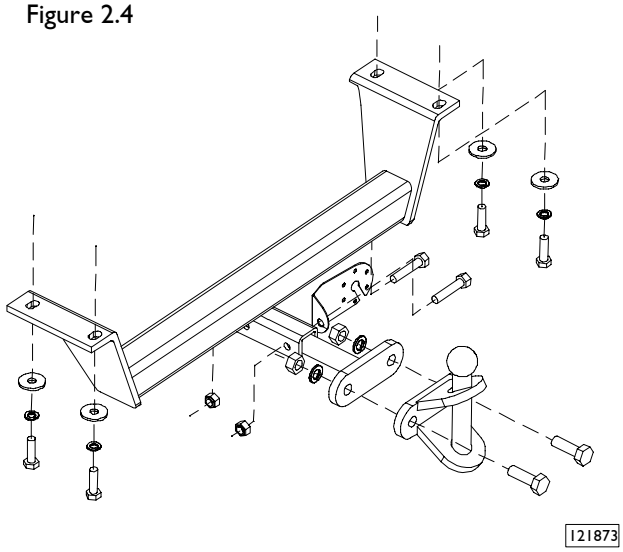


Figure 2.3



Fixed hook

Figure 2.4



Removable hook

A device to prevent the bolts from loosening must be adopted for the joints.

Remarks about the Payload

It should be ascertained that the static drawbar load does not cause the allowable load on the rear axle or axles to be exceeded and that the required minimum load acting on the front axle is adhered to see point 1.13.3.

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 Figure 2.2), the instructions for installing a reinforced cross member when available, and those on the brake system to be made.

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

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

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.

2.7 Installing a Supplementary Axle

Supplementary axles are not approved for use on the vehicle.

2.8 Modifying the Drive Line

Modifications to the vehicle transmission are not allowed.

2.9 Modifications of the Engine Air Intake and Exhaust Systems

2.9.1 Intake

The specifications of the engine air intake and exhaust systems must not be altered without authorisation by Iveco. Operations carried out should not alter the vacuum levels (for the intake) and the original counterpressure levels (for the exhaust).

Table 2.11 - Maximum back-pressure permitted at the intake and exhaust, at the rated engine speed and full load

Engine	Engine Code	Back-pressure at the exhaust (kPa)	Minimum/maximum back-pressure at the intake (kPa)
.15	F1CE0481F*A	38	1.6 - 8.5

Any work done on the exhaust system of the vehicle requires that the vehicle be homologated again with regard to noise and smoke wherever government regulations require it. The air intake must be positioned to avoid the intake of hot air from the engine and/or of dusty air or snow and rain. The apertures for the intake of air which may have to be made in the bodies of vans, must have a working surface of not less than two and a half times that of the master hose located upstream of the filter. These apertures (e.g. openings in the grill) must be of such a dimension that they do not become obstructed. It is prohibited to alter the air filer or replace the original filter with a lower air capacity unit. 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 exhaust emissions.

2.9.2 Engine exhaust

Pipes must be laid as straight as possible, bend angles must not exceed 90° and radiuses must be at least 2.5 times the outer diameter. Leave a big enough gap between the exhaust piping and the electric system, plastic piping, spare wheel (minimum 150 mm), steel fuel tank (minimum 100 mm), etc. Lower values (e.g. 80 mm) may be approved if steel guard panels are used. Further reductions require the use of heat insulation or the replacement of plastic pipes with steel pipes. Modifications to the silencer body are not permitted and neither is it permitted to make changes to equipment (injection pump, regulator, injectors, etc.) that could impair efficient engine operation and affect exhaust gas emissions.

2.10 Modification 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;
- always reinstall the radiator anti-clogging protection after making alterations to the engine cooling system.

2.11 Work on the Suspension

2.11.1 General Specifications

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 operations 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 only by specialised firms after approval from IVECO.

It is forbidden to fit a parabolic spring on one side and a semi-elliptic spring on the other side on the same axle.

On vehicles equipped with a load apportioning valve (LAV) for the braking system, modification of the rear suspension requires adjustment of this LAV valve (see point 2.15).

Modifications to the rear suspension

Changing the features of the rear spring (e.g., no. of leaves, spring rate etc.) requires adjusting the brake load apportioning valve 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 axle(s) or the total weight of the vehicle, it may be necessary to adapt the braking forces to permit compliance with the requirements for the brake regulations in force. The necessary instructions will be given on the documentation 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 weight, the brake load apportioning valve must be adjusted by an IVECO dealer. So as not to alter the vehicle's braking capacity, it is necessary to observe the ground load / brake pressure ratio (under various load conditions) given on the rating plate of the brake load apportioning valve.

In these cases, to adjust the brake load apportioning valve, follow the instructions given in point 2.15.4, applying a load on hole 9 corresponding to the stiffness of the new spring.

It will be necessary to check the ground load / brake pressure ratio is observed for all load conditions.

Should this not be, contact IVECO for a further check on compliance with the brake regulations.

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

2.12 Heating/Air conditioning system modifications

2.12.1 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 2.16). 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;

a) When installing a water heater, original vehicle heating and engine cooling circuits are involved (see point 2.10), it is advisable to follow the instructions listed below to ensure reliability of the heating system and safe operation of the original system:

- ❑ special care must be taken when defining the connections between the supplementary equipment and the main one; refer to IVECO, 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;
- ❑ ensure that the circuit may be fully drained by providing additional plugs if necessary;
- ❑ proper insulation should be used to prevent heat dissipation.

b) 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.

2.12.2 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 2.16.3). Provide the new circuitry with a protection fuse;
- in liaison with IVECO, establish a method for installing the compressor; if it is fitted to the engine, use the original IVECO compressor;
- 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.

2.13 Cab Modifications

2.13.1 General Specifications

Any work on the driver's cab must be authorised 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.

When defining the position of payload, account shall be duly taken of the variation in cab weight, in order to ensure the correct distribution of the permitted loads on the axles (see point 1.13).

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, 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 legislation.

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.

2.13.2 Roof Panel Modifications

Modifications to the cab roof are not allowed

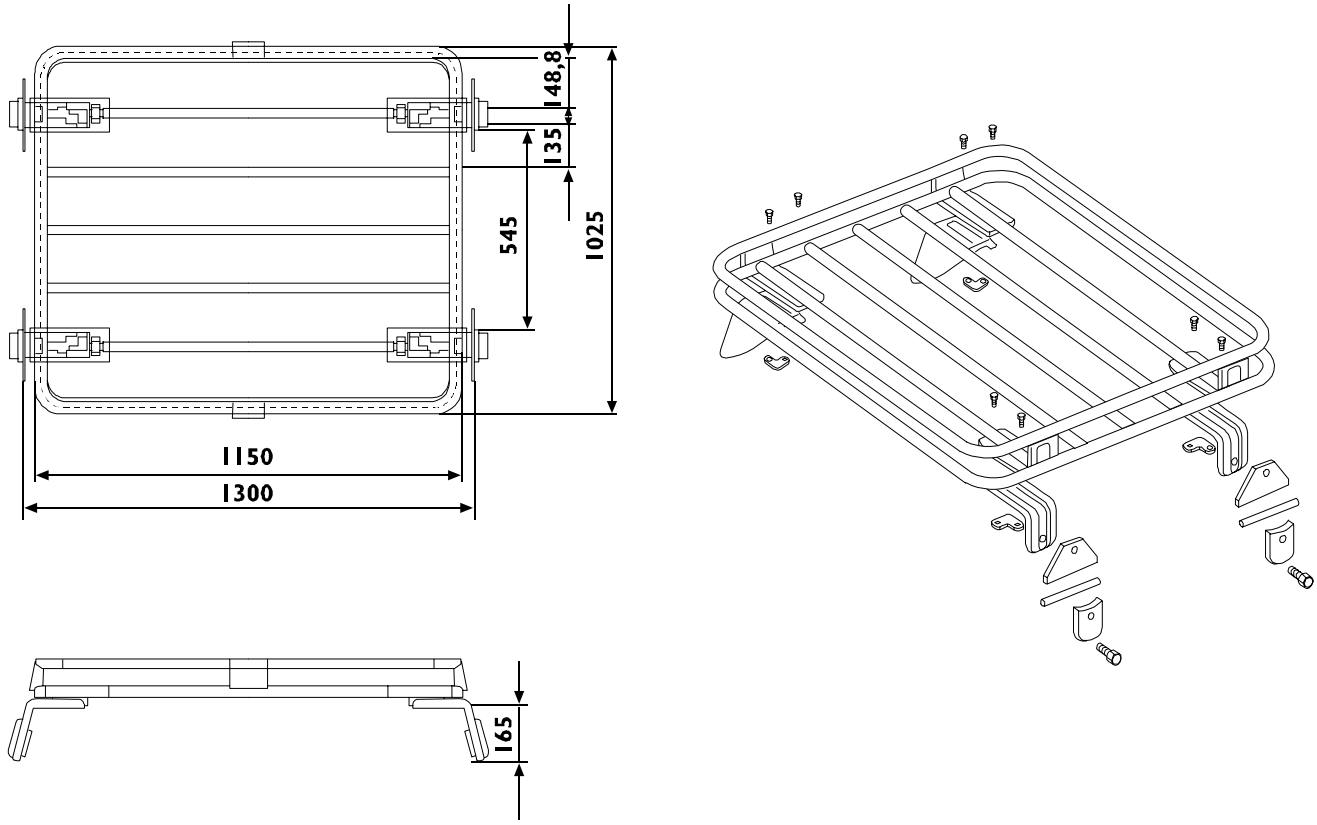
2.13.3 Van and combi bodywork modifications

Fitting roof rails

Roof rails must only be used on the "low roof" or the "medium roof" vans and must only be fitted using the specially designed fixings provided on the roof panel for this purpose (see figures) using the following guidelines.

- the fixing element must include the anchoring device, by ensuring the necessary resistance to the longitudinal and transverse forces. A total of 2+2 fixings are provided for all the wheelbases;
- in order to guarantee good stability when cornering, the total value of 50 kg must not be exceeded;
- the weight permitted for each fastener shall not exceed 12,5 kg.

Figure 2.5



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2.13.4 Crew Cabs

The construction of deep cabs is not allowed.

2.13.5 Occupant protection

The seatbelt attachments (positioning of reels and pre-tensioners), the seat anchorage, as described below, are an integral part of overall occupant safety.
Any modification to these components may jeopardize the safety of the passengers and compliance with legal requirements.

Anchoring safety belts

Any work carried out in the areas of the seat belt fixing points may affect their compliance with EC certification.
The company carrying out the work must verify compliance with all legal requirements in force.

Seats

The seats have been fixed to the floor structure in compliance with legal requirements on locking systems.
Moving or fitting additional seats requires making suitable fixing areas in the structure under the floor, similar to the IVECO installation, in order to ensure compliance with the legal requirements.

2.14 Changing the Size of the Tyres

Replacing the tyres with others of a different size or load capacity to those specified during vehicle type approval require IVECO authorisation. It may also be necessary to reprogram theEBD and ETC systems.

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 the compliance with the national legal requirements must be verified. Its supporting brackets, where necessary, may be replaced with other appropriate, type-approved brackets. See point 2.19.

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.

Where there is local national legislation specifying overall widths (e.c. Jersey etc.) these must be complied with.

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.

NOTE Altering the tyre size may require replacement of the box mounting brackets.

Changing the Size of the Tyres

2.15 Modifications to the Braking System

2.15.1 General remarks

The braking system and components are very important for driving safety and vehicle use.

No changes may be made to the following parts: brake cylinders and callipers, adjustment units and valves, parking brake, brake control and auxiliary systems.

Any modification to the braking system requires authorisation from IVECO.

It is recommended that when new units are fitted they should be the same makes as those fitted to the original vehicle. When required by national regulations, the vehicle must be submitted for testing to the respective authority.

2.15.2 Brake pipes

Pipes must not be welded for any reason whatsoever.

In the event that the vehicle wheelbase is modified, the brake pipes affected by the change must be replaced by new one-piece pipes. If this is not possible, fittings of the same type as the ones originally used on the vehicle must be used. When replacing pipes the minimum internal dimensions of the new pipes must not be less than that of the existing pipes.

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, dimensions, fittings): : ISO 4038 or JASO F402-90 standard
- bending radii (referred to the pipe centre line = 4.76 mm): : min. 25 mm
- tightening torque:
  rigid pipes, M10x1 fittings: : 12 ÷ 16 Nm
  rigid pipes, M12x1 fittings: : 15 ÷ 20 Nm
  flexible pipes, M10x1 male fittings: : 2 ÷ 2,5 Nm

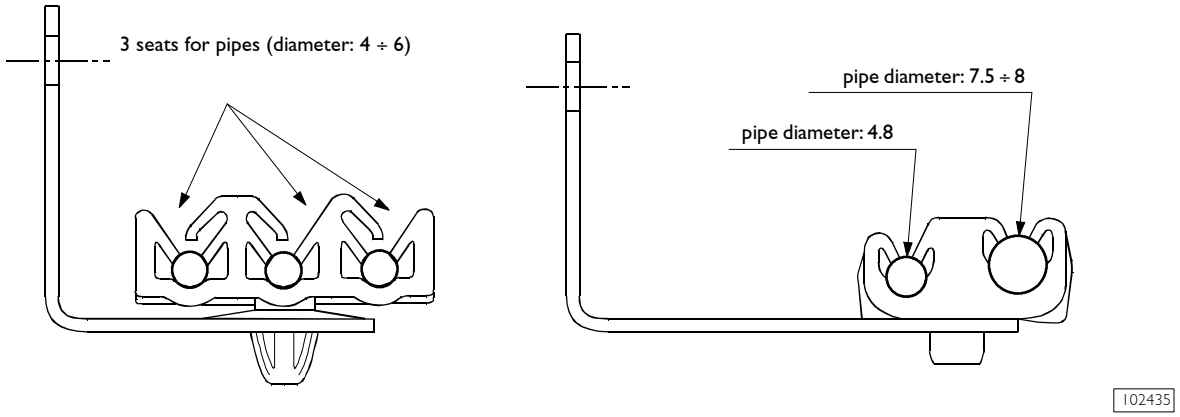
2.15.3 Fitting pipes on the vehicle

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

Pipes shall be secured into their correct positions and the fasteners must fully wrap the pipes: they may be made either of metal, with rubber/plastic protections, or plastic.

Figure 2.6 illustrates two examples of brackets complete with retaining clips, used to secure the brake pipes along the chassis.

Figure 2.6



When a pipe has to pass through the chassis frame (sidemember 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 should be considered.

For plastic pipes, in order to prevent distortion and tension on the connectors when fitting them, take the necessary precautions when arranging the pipe runs and fitting the fixing brackets or clips onto the chassis. Correct 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, the air must be bleed from the system correctly, following the instructions given below. The braking system must then be checked for correct operation and efficiency.

Manually bleeding air from the hydraulic brake system

There is one bleed screw on each brake calliper.

Carefully repeat the following operations on each of the callipers (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 procedure 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 new fluid of the prescribed type, contained in original, sealed containers that should only be opened when using the fluid.

Bleed air from the hydraulic braking system using MODUS or E.A.SY. on vehicles with ABS/ABD/ETC

On vehicles equipped with ABS/ABD/ETC 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 uncharacteristic operation of the system.

Manual operations must be carried out, which will be driven by the program in "MODUS"or "E.A.SY.".

This program makes it possible to perform full drain (primary circuit and secondary circuit of the modulator) under item "System filling / emptying".

An operator starts the repeated operation of the modulator solenoid valves and the pump and at the same time, by operating the brake pedal and releasing the drain screw on the calliper (according to the manual procedure) air bubbles still present in the concerned part of the system will be blown out.

Then follow the instructions that appear each time on the screen, taking care not to exceed the solenoid valve and pump operating time, so as to avoid component overheating.

If this occurs the system will be deactivated, and you will have to wait for the established time in order to let the system cool down before the operation can be started again.

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

The ABS, ABD, ETC modulating devices, placed on the chassis in the engine compartment, must Not be moved.

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

Warning

Great care must be taken, when carrying out the work, to make sure the correct connection of the pipes are made to each wheel.

After every modification carry out the necessary checks and tests for correct operation at the Authorized Workshops equipped with the specific equipment.

2.15.4 Instructions for adjusting the braking load proportioning valve

Load proportioning valve version

A single type of spring corrector is used for both vehicles with ABS and for vehicles without ABS.

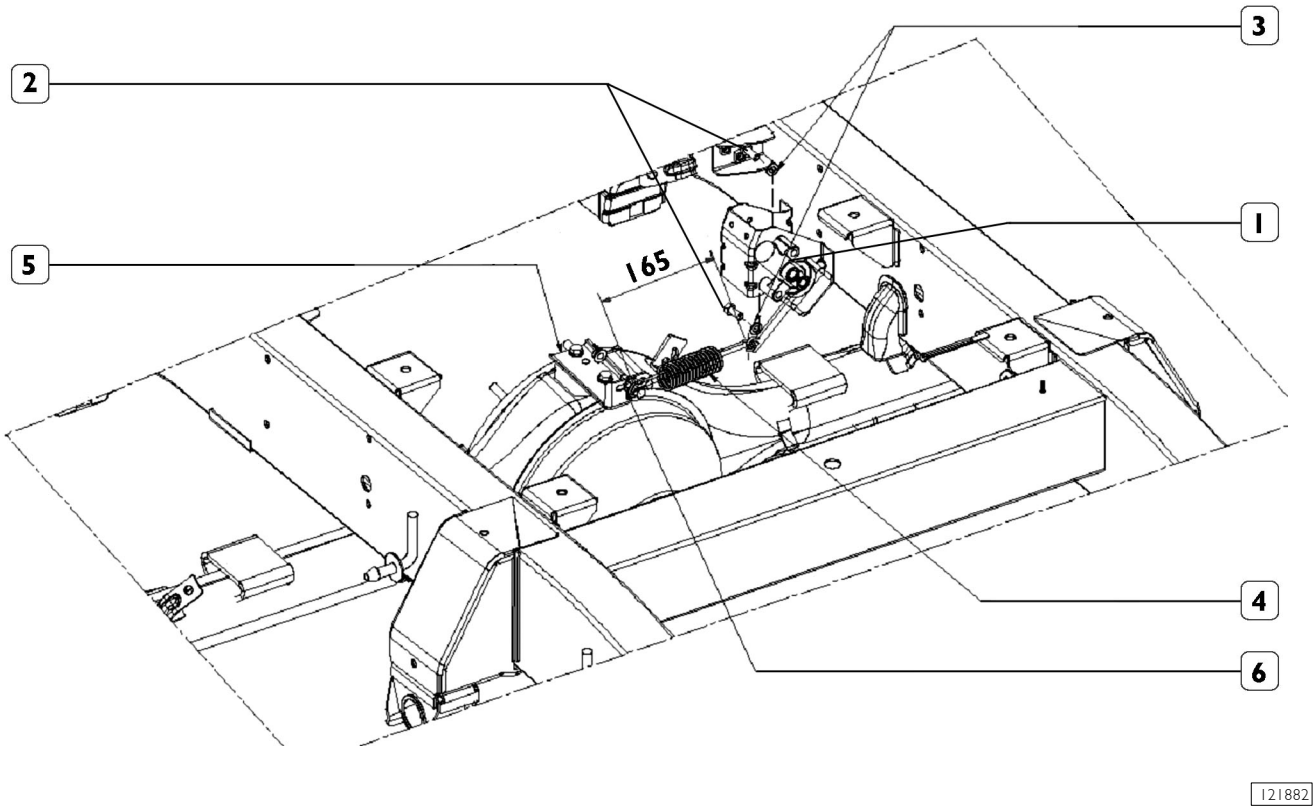
Load proportioning valve adjustment

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 characteristic 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.

Should it become necessary to adjust the braking load proportioning valve, this can be done following the instructions given below.

Figure 2.7

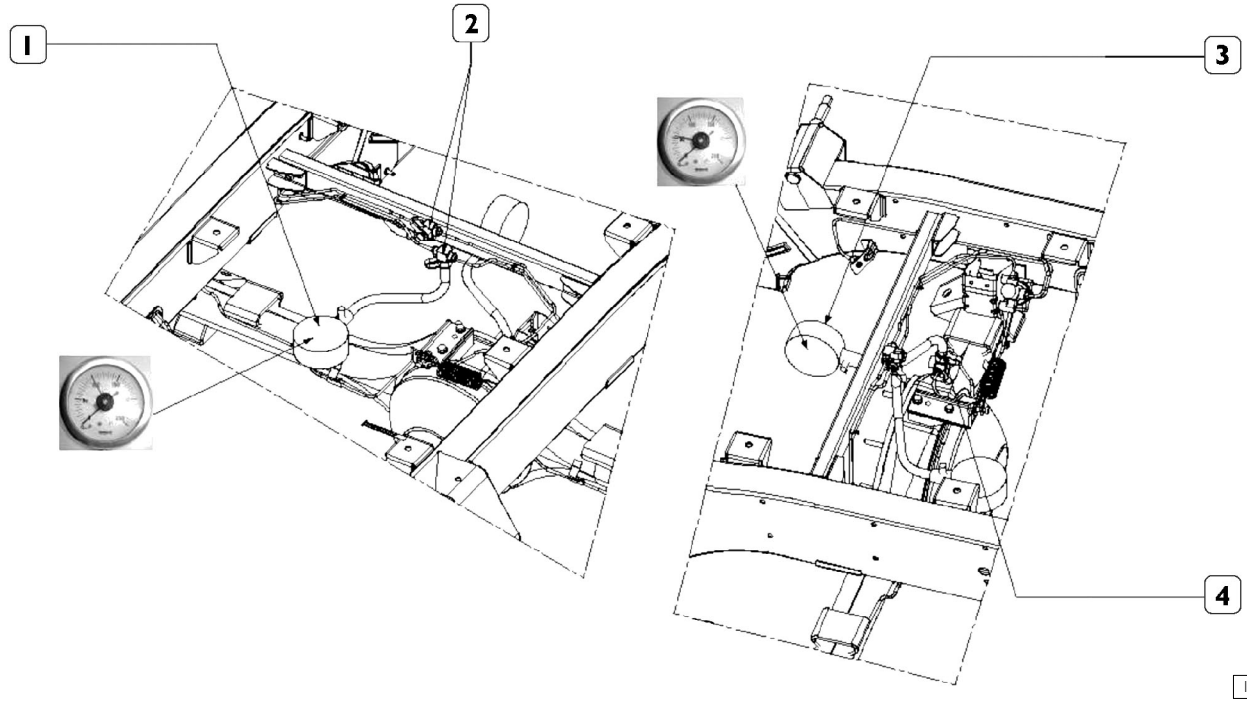


Fitting and adjustment of the load proportioning valve.

- Fit valve (1) to the frame support bracket, tightening bolts (2), with washers (3) to a torque of 18-20 Nm.
- Connect spring (4) to the bracket on rear axle (5).
- Adjust spring (4) to the required height of 165 mm.
- Tighten pin (6) adjusting spring (4) to the bracket on rear axle (5) with a tightening torque of 18-20 Nm.

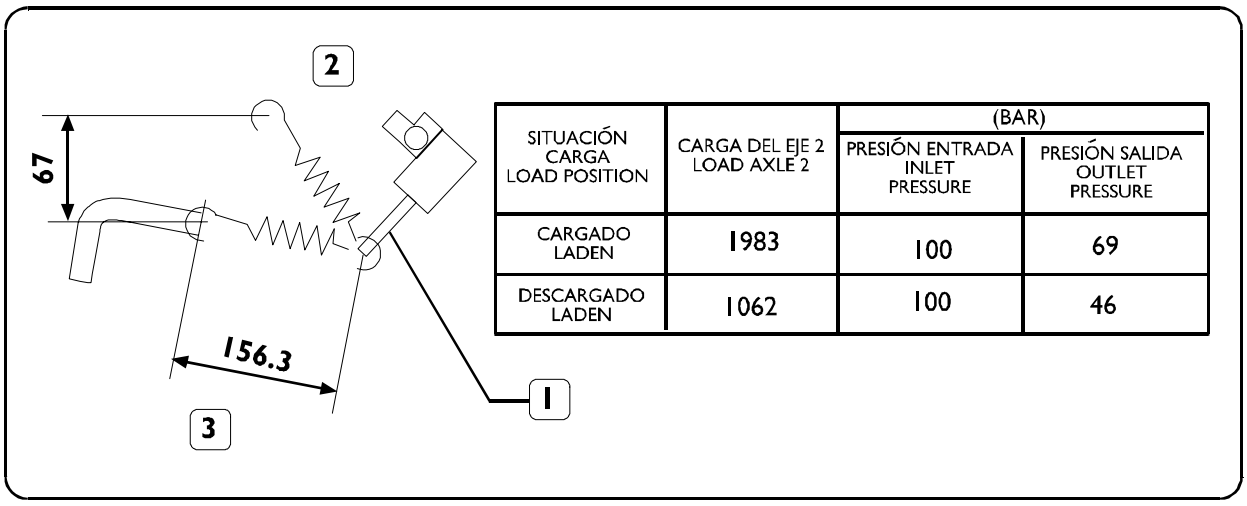
Checking load proportioning valve cut-in pressure

Figure 2.8



- Connect pressure gauge (1) to the pressure point upstream of the load proportioning valve.
- Connect pressure gauge (3) to the pressure point (4) downstream of the load proportioning valve.
- If the pressure gauges are not equipped with automatic bleed valves, bleed them manually by means of the screws on the pressure gauges. Carry out at least five cycles on the pressure gauge.

Figure 2.9



SITUACIÓN CARGA LOAD POSITION	CARGA DEL EJE 2 LOAD AXLE 2	(BAR)	
		PRESIÓN ENTRADA INLET PRESSURE	PRESIÓN SALIDA OUTLET PRESSURE
CARGADO LADEN	1983	100	69
DESCARGADO LADEN	1062	100	46

1. Lever - 2. Charge - 3. Discharge

- With the engine idling, gradually press the brake pedal to obtain a pressure of 100 bars on the pressure gauge (1, Figure 2.8) fitted upstream of the load proportioning valve. This pressure must be constant whether the vehicle is laden or unladen.
- Check that the pressure reading on the pressure gauge (3, Figure 2.8) fitted downstream of the load proportioning valve corresponds to the values on the plate (Figure 2.9). For example, with a load of 1983kg on the rear axle, with an upstream pressure of 100 bars and spring set to 165 mm, the downstream pressure must be 69 bars.
- If the pressure downstream of the load proportioning valve is different, adjust the control link (6, Figure 2.7) to restore it to the correct values.

Settling the vehicle rear suspension

If new springs are fitted, remember that you need to settle the rear suspension correctly beforehand.

To obtain good results, the vehicle must be partly loaded (approximately two thirds of the maximum permitted load), and driven some distance (20 km) over an uneven surface, carrying out a series of breaking manoeuvres during forward motion and reverse.

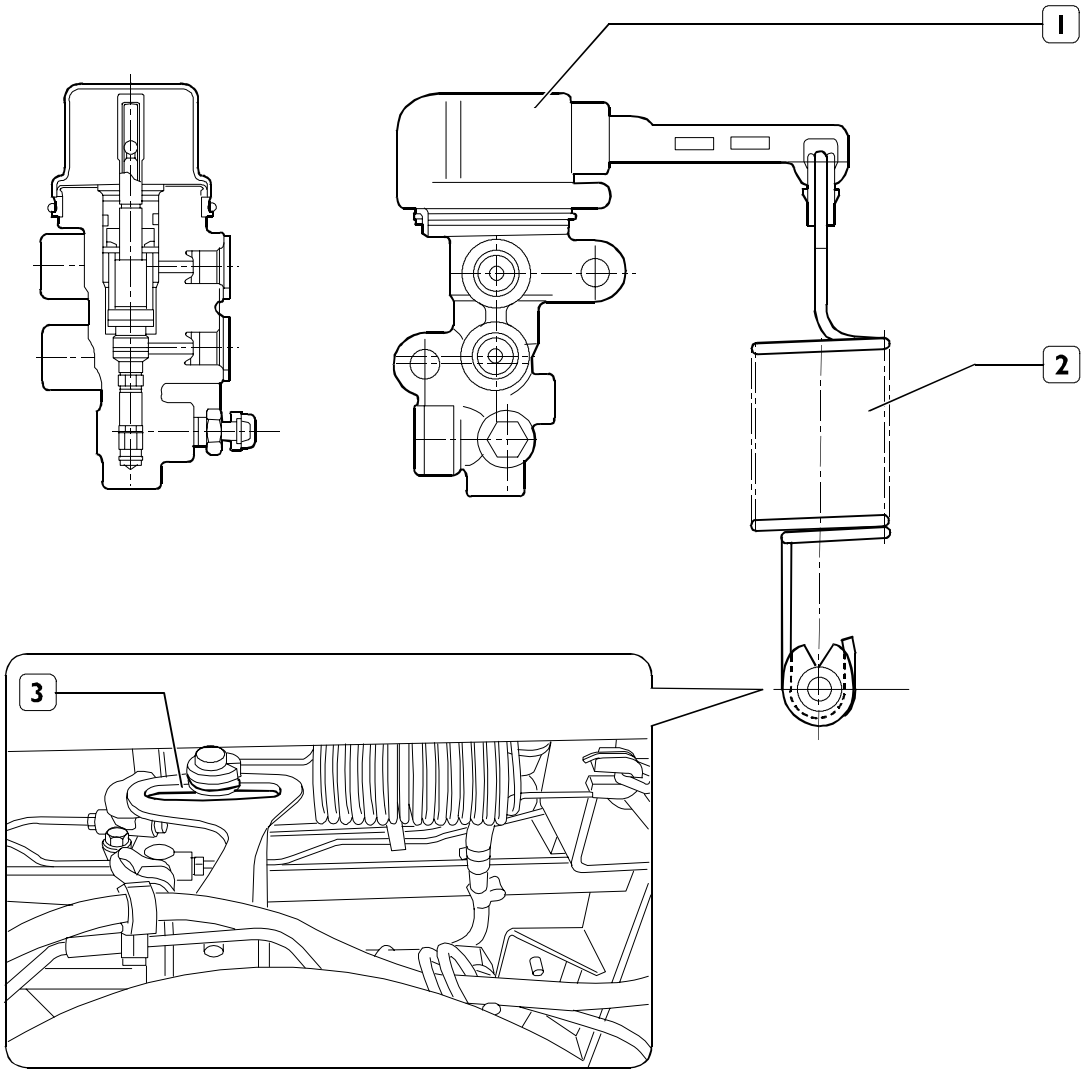
NOTE The friction material must be settled by carrying out approximately 100 low speed breaking manoeuvres and subsequent emergency braking manoeuvres to ensure that the rear brakes do not lock in advance.

Check spring length after settling

After settling the suspension check that the spring length is equal to the length shown in Figures 2.7 and 2.9.

If the spring length is different, carry out the adjustment operations indicated previously again.

Figure 2.10



1. Load proportioning valve - 2. Spring - 3. Adjustment slot

2.16 Electrical System: Modifications and Drawing-Off Power

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 greater details on the vehicle's electrical system, see the specific Workshop Manual, publication no. 603.93.711 (Massif Euro 4).

This manual is available at the IVECO Service network and can be requested from the relevant Departments of the IVECO Sales Organisation.

Precautions

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.

- To avoid damaging the vehicle's electric system, carefully follow the cable manufacturer's instructions. The cable section and route shall be adequate to the type of load and the positioning of the same on the vehicle.
- Do NOT use a quick battery charger for emergency vehicle starting. Otherwise, the electronic systems - in particular, the control units that perform the lighting and power supplying functions - may be damaged.

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).

During **work on the chassis** frame, to safeguard the electrical system, disconnect the relevant components and the earth connections, follow the guides given in points 2.1.1 and 2.3.4.

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 2.1.1). 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.

Engine cranking

Never start the vehicle by towing.

Do not start the engine without first disconnecting the batteries permanently.

If the batteries require charging, disconnect them from the vehicle circuit.

If starting using auxiliary methods, this must be carried out only using an external battery trolley in accordance with the following procedure:

- To prevent damage to the vehicle, it is important to ensure the tanks contain sufficient fuel during start-up. Attempting to start the engine with insufficient fuel could cause serious damage to the injection system.
- Observe all current accident prevention precautions (including the use of gloves).
- Use a battery trolley with specifications similar to those of the vehicle battery.
- Use an appropriate cable to connect the battery trolley positive terminal to the positive terminal of the CBA fitted on the vehicle battery positive terminal.
- Use a suitable cable to connect the negative terminal of the charged battery to the earth of the vehicle with the flat battery.
- When starting the engine on vehicles with a manual gearbox: turn the key ON and wait for all the engine warning lights on the instrument panel to go off. Start the vehicle engine. The starter motor must not be used for longer than 10 seconds. Do not depress the accelerator pedal during start-up.
- Wait for the vehicle engine to reach idling speed.
- Do not turn on any vehicle electrical appliances, e.g. low beams, heater. This will prevent any current peaks and damage to electric control units when the battery trolley is disconnected.
- Firstly disconnect the vehicle negative terminal and then the battery trolley negative terminal.
- First disconnect the CBA cable fitted to the vehicle battery positive terminal and then the battery trolley positive terminal.
- The battery must in any case by recharged subsequently by disconnecting form the circuit using the correct slow, low current recharging procedure.
- Do not use other devices (battery charger) to start the engine. If in doubt, contact the IVECO service network.

Any damage to electronic control units caused by failure to comply with procedure is not covered by the warranty.

See Chapter 5 for precautions to be adopted for installed control units.

2.16.1 Earth points

The vehicle's original ground connections should not be modified in principle. In the event that such connections need be displaced or addition ground points need be realized, use the holes found on the chassis as much as possible, taking care to:

- **remove by mechanical means, i.e. by using a file and/or a suitable chemical, the paint both on the chassis side and on the terminal, until the anaphoretic paint is fully taken off the chassis, thus obtaining a base surface free from nicks and steps;**
- **apply a suitable paint with high electric conductivity properties between the cable terminal and the metal surface;**
- **connect the ground not later than 5 minutes after applying the paint.**

As regards the signal-related ground connections (e.g. sensors or low-absorption devices), do not use the standardized points for engine ground connection and chassis ground connection.

The additional signal grounds shall be positioned at different points from the power grounds.

Figure 2.11

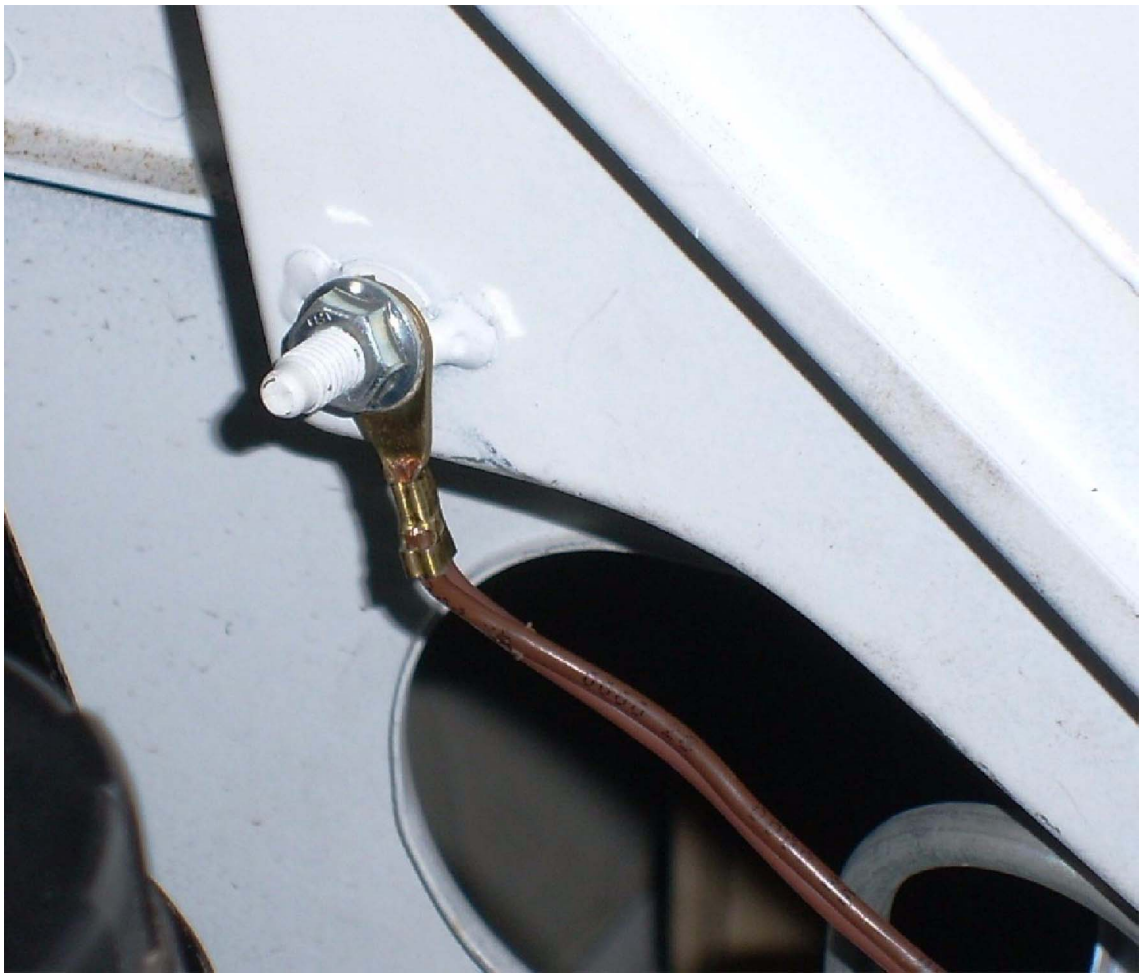


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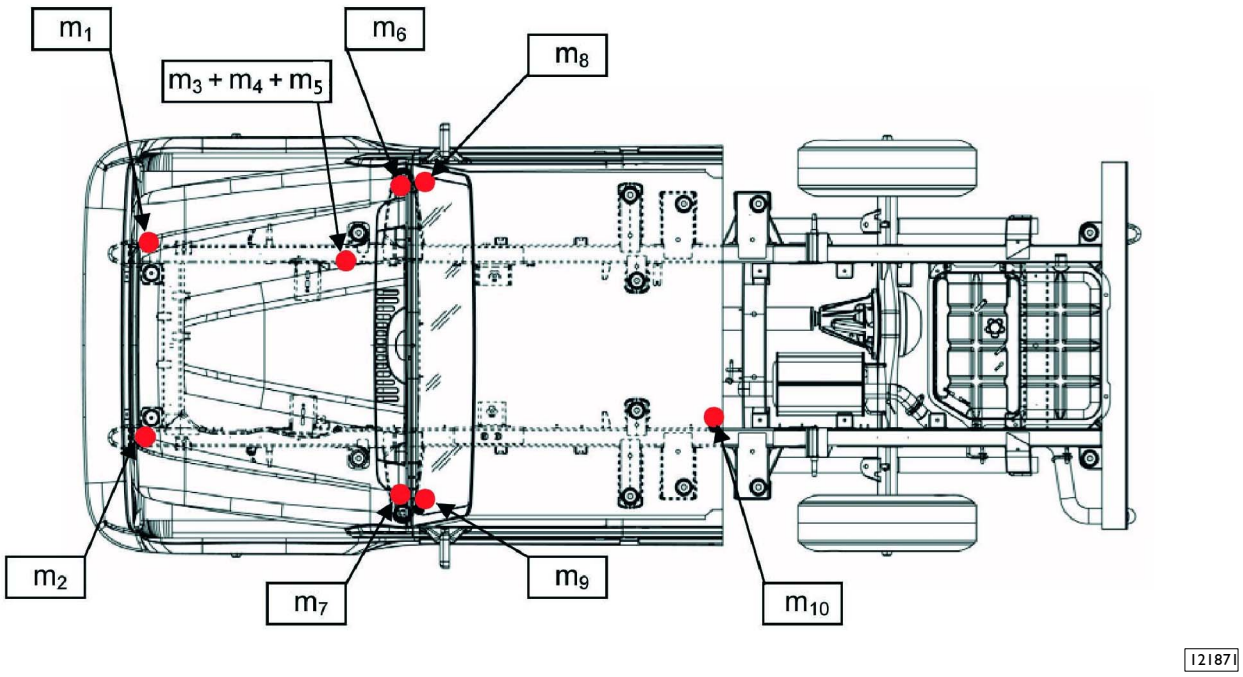
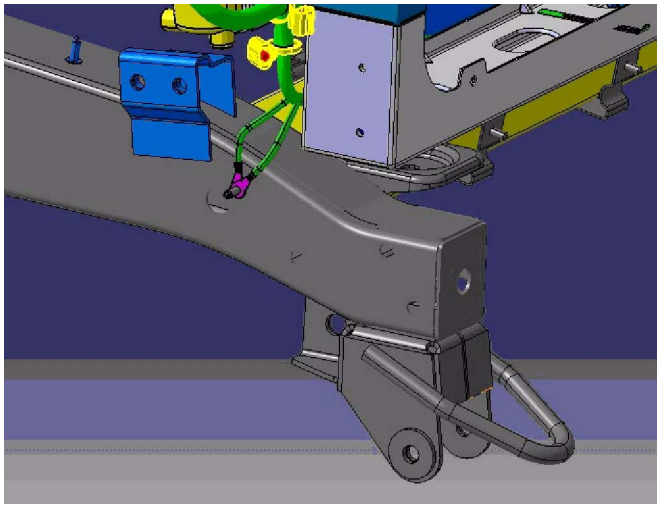
Figure 2.12



EARTH POINTS ON VEHICLE

m1. Right frame rail earth - m2. Left frame rail earth- m3+m4+m5. Right rail engine compartment earth (under battery amount) - m6. Engine compartment earth near windscreen washer motor- m7. Engine compartment earth behind brake serve - m8. Right cab interior (speaker compartment) - m9. Left cab interior (speaker compartment) - m10. Left rail surface wiring earth (near thermal protector)

Figure 2.13



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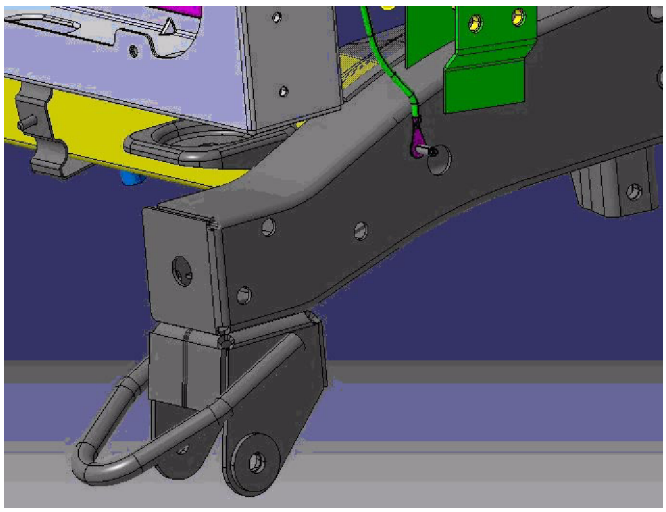
m1. Right frame rail earth

Figure 2.14



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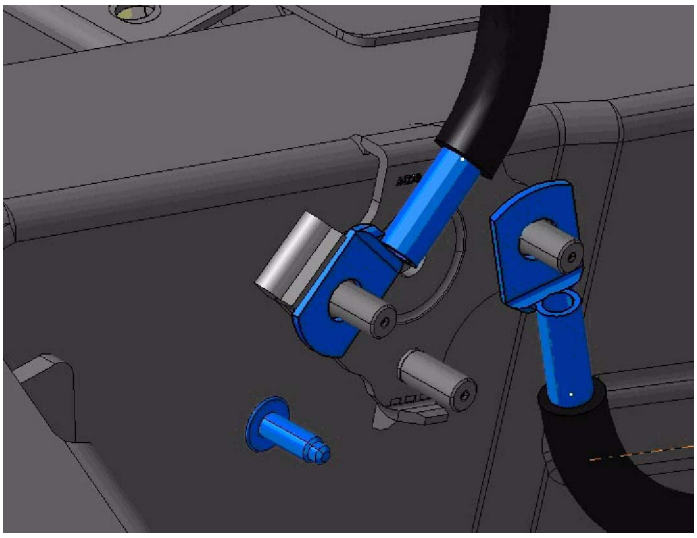
m2. Left frame rail earth

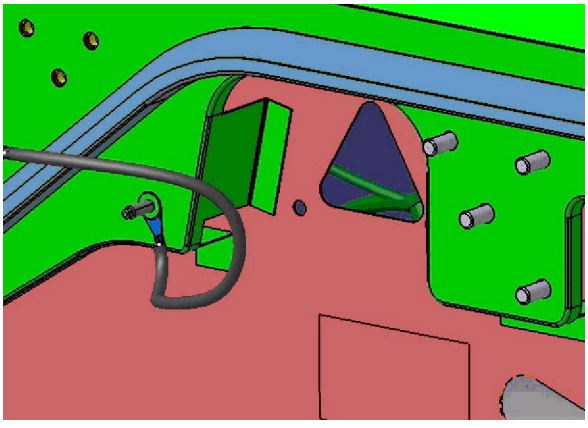
Figure 2.15



121865

m3+m4+m5. Right rail engine compartment earth (under battery amount)

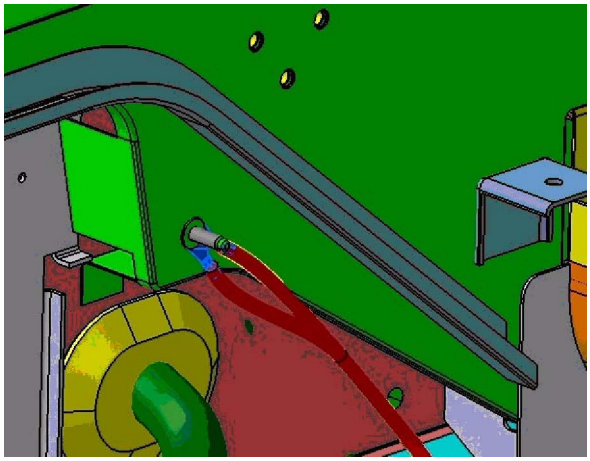
Figure 2.16



121866

m6. Engine compartment earth near windscreen washer motor

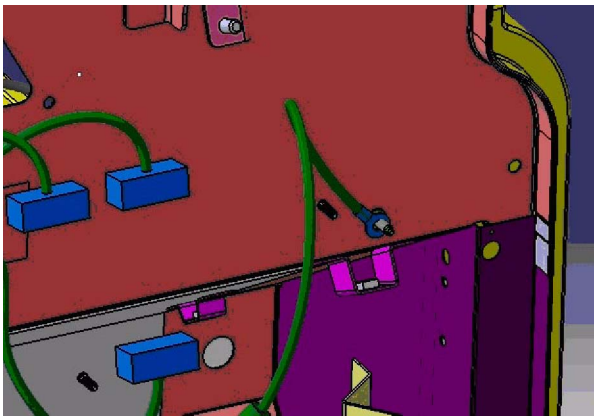
Figure 2.17



121867

m7. Engine compartment earth behind brake serve

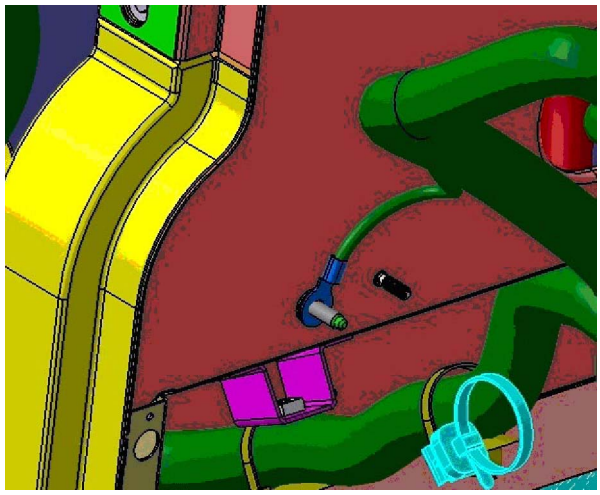
Figure 2.18



121868

m8. Right cab interior (speaker compartment)

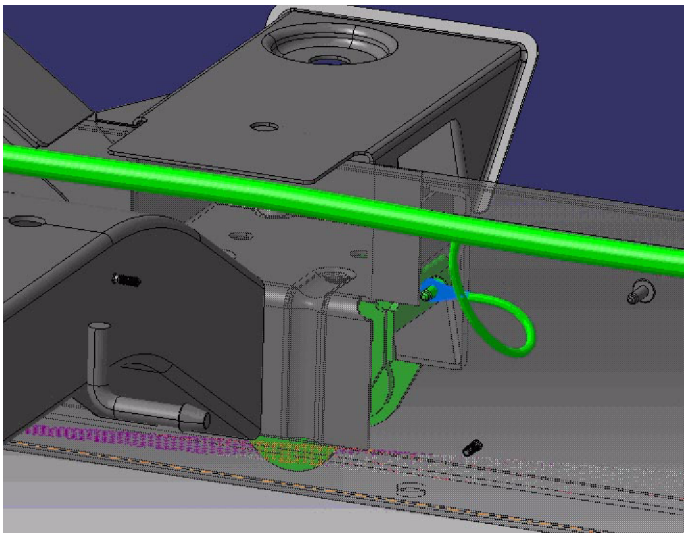
Figure 2.19



121869

m9. Left cab interior (speaker compartment)

Figure 2.20



121870

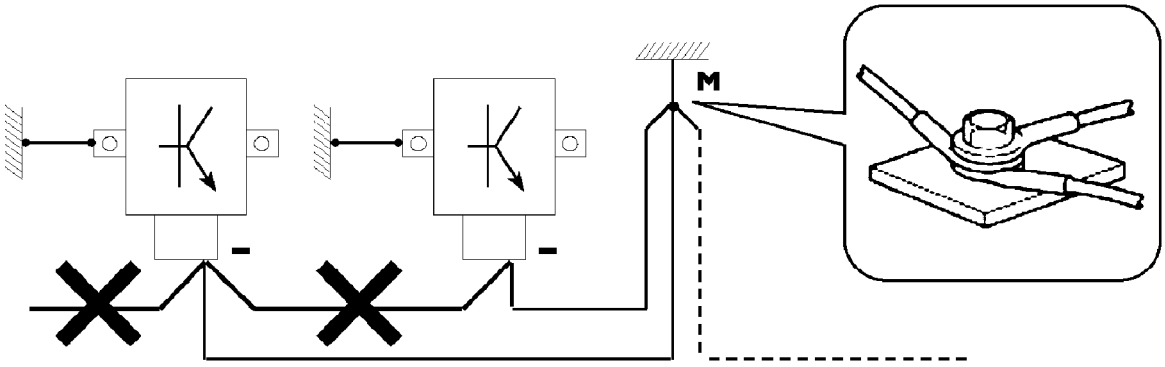
m10. Left rail surface wiring earth (near thermal protector)

The negative leads connected to a system ground point shall be as short as possible and connected with one another according to a "Y" or "X" arrangements. Therefore, they shall be tightened as orderly and properly as possible.

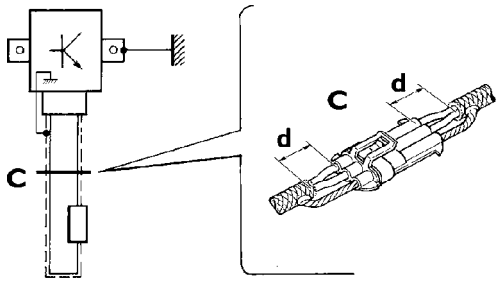
As far as electronic components are concerned, the following instructions shall also be followed:

- The electronic control units shall be connected to the system ground when they are equipped with metal cases.
- The negative cables of the electronic control units shall be connected both to a system ground point and to the negative terminal of the battery.
- The analog grounds (sensor) shall feature very good conductivity, though they are not connected to the system ground/negative terminal of the battery. As a result, the greatest care shall be taken with the cable terminal stray resistance: oxidation, seaming defects, etc.
- The screened circuit metal braid shall come into electric contact only at the end facing the control unit into which the signal is fed.
- If junction connectors are available, the unscreened length "d" next to the same shall be as short as possible.
- The cables shall be laid in such a way that they are parallel to the reference plane, i.e. as near the chassis/body structure as possible.

Figure 2.21



"Y" or "X" connection of various negatives with the system ground



Metal-braid screening of a cable to an electronic component

2.16.2 Electromagnetic compatibility

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 devices performing secondary functions (not impacting on direct vehicle control), for frequencies varying from 20 MHz to 2 GHz.
- 100V/m immunity for devices performing main functions (not impacting on direct vehicle control), for frequencies varying from 20 MHz to 2 GHz.

The maximum admissible variation in transient voltage for units powered with 12 V is +60V, 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.

NOTE The 12 V supplied devices must be free from immune from negative noises, such as -300V spikes, positive +100V spikes, +/-150V burst.

They must operate correctly during voltage lowering phases to 5V for 40mS and to 0V for 2ms.

Moreover, they must resist the load dump phenomena up to 40V.

Max levels measured on bench for radiated and driven emissions generated by 12V devices are shown in table below:

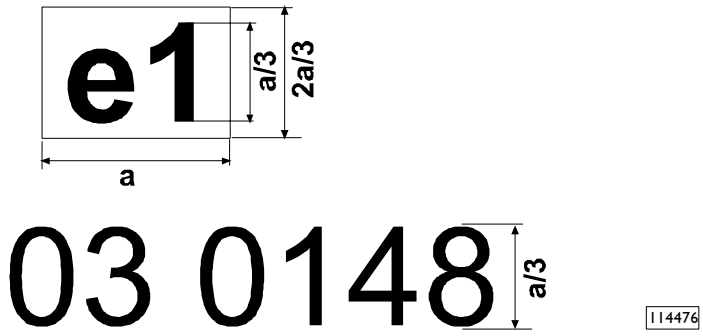
Table 2.12

Type of emission	Type of transducer	Type of disturbance	Type of detector	Frequency range and limits acceptable by noise in dBuV/m									Unit of measure
				150KHz 300KHz	530KHz 2 MHz	5.9MHz 6.2MHz	30 -54 MHz	68-87 MHz mobile services only	76-108 MHz broadcast only	142-175 MHz	380-512 MHz	820-960 MHz	
radiated	Aerial at a distance of 1 metre	Broad-band	Nearly peak	63	54	35	35	24	24	24	31	37	dBuV/m
radiated		Broad-band	Peak	76	67	48	48	37	37	37	44	50	
radiated		Narrow-band	Peak	41	34	34	34	24	30	24	31	37	
conducted	LISN d 50 ohm/ 5 uH / 0, 1 uF	Broad-band	Nearly peak	80	66	52	52	36	36	Not applicable			dBuV
conducted		Broad-band	Peak	93	79	65	65	49	49				
conducted		Narrow-band	Peak	70	50	45	40	30	36				

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

The following is an example of the type of marking specified by the current European directive governing electromagnetic compatibility in the automotive industry:

Figure 2.22



a ≥ 6 mm

If in any doubt, call the IVECO Service Network.

These levels are granted only if the system comes from "IVECO Spare Parts" or it has been certified as per ISO, CISPR, VDE international regulations.

In 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.

Two-way radio systems

The most frequent applications include:

- amateur receiver-transmitter units for CB (City Band) and 2m bands.
- receiver-transmitter units for cellular telephones.
- GPS receiver and satellite navigation units.

The selection of the aerial to be installed in of remarkable importance to ensure max performance to receiver and transmitter equipment. It shall be of very good quality and installed with utmost care, even the mount position is of essential importance, as it determines the aerial efficiency, therefore its transmission range.

Therefore, the SWR (Stationary Wave Ratio), gain and generated electromagnetic field characteristics must be ensured within predefined limits, while impedance, efficient height, efficiency, orientability parameters are contained in manufacturer's technical card.

The installation of 2m amateur CB sets, mobile phones (GSM) and satellite navigation systems (GPS) must be carried out without tampering with the vehicle system.

Any additional power lines must be installed in accordance with the correct sizing of the cables and protection.

These units must be type-approved according to the applicable legal requirements and must be of the fixed type (non portable) type. The use of non type-approved receiver-transmitter units or supplementary amplifiers might affect the correct operation of standard on-board electrical/electronic devices, with adverse effects on vehicle and/or driver safety.

Amateur equipment for CB and 2m band.

The installation of 2m amateur CB sets, mobile phones (GSM) and satellite navigation systems (GPS) must be carried out without tampering with the vehicle system.

Any additional power lines must be installed in accordance with the correct sizing of the cables and protection.

The systems must be legally type-approved and fixed (not portable). Install the transmitting part in a flat, dry area separate from the electronic components of the vehicle, away from humidity and vibrations.

The aerial must always be placed on the outside of the vehicle, if possible on a broad metal base fitted as upright as possible with the connection lead facing downwards, observing the Manufacturer's installation instructions and warnings (see Figure 2.23).

- The SWR must be as close as possible to one. The recommended value is 1.5, while the maximum acceptable value must not in any case be greater than 2.
- The **AERIAL GAIN** values must be as high as possible and ensure sufficient spatial uniformity, normally with deviations from the average value in the order of 1.5dB in the typical CB radio band (26.965-27.405 MHz).
- The RADIATED CAB FIELD value must be as low as possible. We suggest < 1 V/m as a quality target. In any case, the value must not exceed limits imposed by current European guidelines (see note).
- The aerial must therefore always be located outside the passenger compartment.

The Massif is equipped with composite material roofs and cannot therefore perform the equipotential reference function.

It is advisable to consider the following guidelines to ensure that the radio-cable-aerial is working effectively and assess whether the aerial is adjusted:

1) If the SWR is higher on low channels than high channels, extend the aerial.

2) If the SWR is higher on high channels than low channels, shorten the aerial.

After adjusting the aerial, it is advisable to re-check the SWR on all channels.

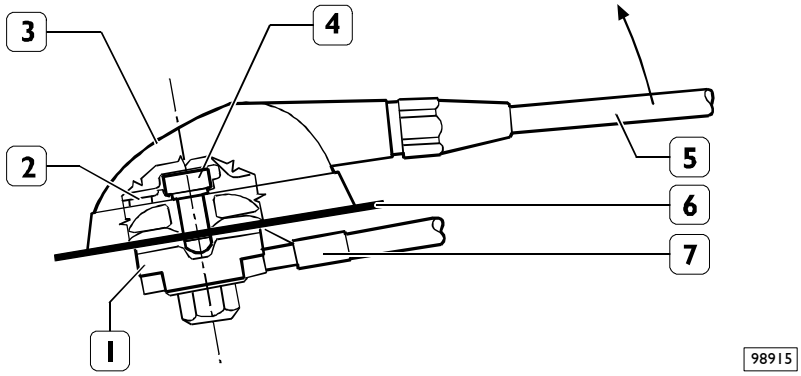
Cables involved in the installations should be connected and positioned taking care to:

- Use a top-quality, low-loss coaxial antenna cable with the same impedance as the transmitter and the antenna. (see Figure 2.24).
- The coaxial cable run must be at a suitable distance (minimum 50 mm) from pre-existing wiring (TV, radio, telephone, amplifiers and other electronic devices) to prevent interference and malfunctioning. Ensure the minimum distance from the metallic structure of the cab. Cable installation on the left or right-hand side is preferable.
- Clean the lower part of the hole made in the body for installing the antenna in fixed position so that the antenna support is perfectly connected to the vehicle earth.
- The coaxial cable connecting the antenna to the radio must be fitted with the utmost care. Avoid curves or bends which can pinch or distort the cable. Avoid tangling. Shorten the wire as much as possible. Remember that any imperfections in the coaxial cable will cause severe interference for the radio transmitter.

- It is essential to make an additional hole for the passage of the cable. Take precautions to preserve the bodywork (rustproofing, sheaths, etc).
- Ensure a good connection with the vehicle earth both at the base of the antenna and at the device fixing to ensure maximum power transfer.

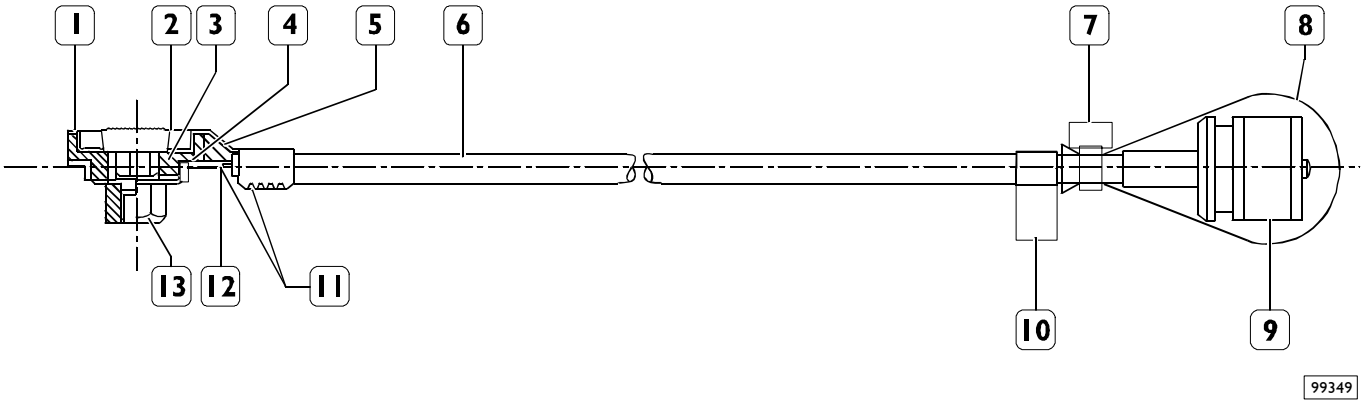
The typical installation positions of transmitting equipment are on the dashboard - in the gearbox area.

Figure 2.23



1. Antenna support - 2. Gasket (P/N for spares 244614) - 3. Fixed joint cover (P/N for spares 217522) - 4. Fixing screw M6x8.5 (torque to 2 Nm) - 5. Antenna (spare P/N for complete rod 675120) - 6. Roof - 7. Antenna extension lead

Figure 2.24



1. Antenna connector - 2. Ground wire - 3. Insulator - 4. Signal wire - 5. Capacitor (100pF) - 6. Cable RG 58 (characteristic impedance = 50 Ω) - 7. Clamp - 8. Protective cap - 9. Connector (N.C. SO - 239) transceiver side - 10. Test executed sticker - 11. The 100pF capacitor must be soldered on the lower pin and crimped to the ground braid - 12. The lower pin must be soldered to the core conductor of the cable - 13. Nut

Two-way systems for GSM/PCS/UMTS mobile phones

The installation of 2m amateur CB sets, mobile phones (GSM) and satellite navigation systems (GPS) must be carried out without tampering with the vehicle system.

Any additional power lines must be installed in accordance with the correct sizing of the cables and protection.

The devices must be legally type-approved and fixed (not portable). Install the transmitting part in a flat, dry area separate from the electronic components of the vehicle, away from humidity and vibrations.

- The **SWR** must be as close as possible to one. The recommended value is 1.5, while the maximum acceptable value must not in any case be greater than 2.
- The **AERIAL GAIN** values must be as high as possible and ensure sufficient spatial uniformity, normally with deviations from the average value in the order of 1.5dB in the 870-960 MHz band and 2 dB in the 1710-1880MHz band.
- The **RADIATED CAB FIELD** value must be as low as possible. We suggest < 1 V/m as a quality target. In any case, the value must not exceed limits imposed by current European guidelines.

The aerial must always be placed on the outside of the vehicle, if possible on a broad metal base fitted as upright as possible with the connection lead facing downwards, observing the Manufacturer's installation instructions and warnings (see Figure 2.23).

The Massif is equipped with composite material roofs and cannot therefore perform the equipotential reference function.

Follow the precautions below when connecting and arranging the wires:

- use a top quality cable particularly as concerned to the protective shielding.
- The cable route must be at a suitable distance (minimum 50 mm) from pre-existing wiring. Ensure the minimum distance from the metallic structure of the cab. Avoid excessively pulling or pinching the cable. Installation on the left or right-hand side is preferable.
- Never shorten or extend the coaxial antenna cable.
- It is essential to make an additional hole for the passage of the cable. Take precautions to preserve the bodywork (rustproofing, sheaths, etc).
- Ensure a good connection with the vehicle earth both on the base of the antenna and at the device fixing to ensure maximum power transfer.

The typical installation positions of equipment are on the dashboard - in the gearbox area.

GPS antenna cable and navigation system installation

Correct and careful assembly of GPS antennas in the vehicle is extremely important for correct operation and maximum performance.

The antennas should if possible be fitted in a concealed position where they cannot be seen.

Arranging the GPS antenna is a delicate matter. The power of the signal received from the satellite is very weak (approximately 136dBm), so any obstacle can effect quality and performance of the receiver.

- The **SWR** must be as close as possible to one. The recommended value is 1.5, while the maximum acceptable value must not in any case be greater than 2 in the GPS frequency range (1575.42 ± 1.023 MHz).
- The **AERIAL GAIN** values must be as high as possible and ensure sufficient spatial uniformity, normally with deviations from the average value in the order of 1.5dB in the 1575.42 ± 1.023 MHz band.

The GPS antenna must be installed in a position ensuring maximum visibility of the sky.

The minimum angle of visibility must be 90°. Sky visibility must not be obscured by objects or metallic structures. The installation position must be horizontal.

The ideal location for the GPS antenna is under the plastic dashboard in the middle and at the base of the vehicle windscreen.

Do not install the antenna under any type of metallic structure in the cab.

Position the GPS antenna at a distance which is not less than 30 cm from another antenna.

Follow the precautions below when connecting and arranging the wires:

- use a top quality cable particularly concerning the protective shielding.
- The wire course must be at a suitable distance (minimum 50 mm) from pre-existing wiring. Ensure the minimum distance from the metallic structure of the cab. Avoid excessively pulling or pinching the cable. Installation on the left or right-hand side is preferable.
- Never shorted or extend the coaxial antenna cable.
- It is essential to make an additional hole for the passage of the cable. Take precautions to preserve the bodywork (rustproofing, sheaths, etc).
- Ensure a good connection with the vehicle earth both on the base of the antenna and at the device fixing to ensure maximum power transfer.

The installation of 2m amateur CB sets, mobile phones (GSM) and satellite navigation systems (GPS) must be carried out without tampering with the vehicle system.

Any additional power lines must be installed in accordance with the correct sizing of the cables and protection.

The devices must be legally type-approved and fixed (not portable). Install the transmitting part in a flat, dry area separate from the electronic components of the vehicle, away from humidity and vibrations.

The Massif is equipped with composite material roofs and cannot therefore perform the equipotential reference function.

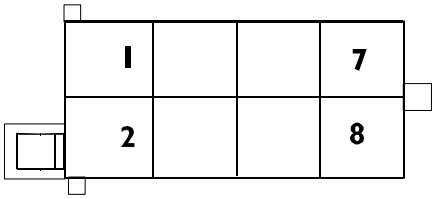
Installation of IVECO original radio

The radio comes in a single configuration:

- Radio with CD+MP3 player

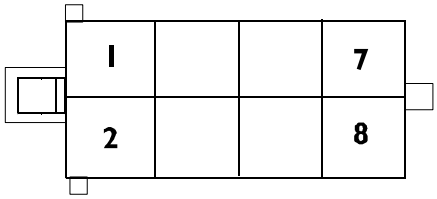
If the original radio is not present, an aftermarket radio may be fitted.

Figure 2.25



Connector A

View of cable input



Connector B

View of cable input

A1	Vehicle speed signal
A2	Reverse
A3	Handbrake
A4	+30
A5	Free
A6	+ lighting
A7	+15
A8	Earth

B1	+ Right rear speaker
B2	- Right rear speaker
B3	+ Right front speaker
B4	- Right front speaker
B5	+ Left front speaker
B6	- Left front speaker
B7	+ Left rear speaker
B8	- Left rear speaker

2.16.3 Additional equipment

If the devices are to be powered using a voltage different from that of the system, this must be obtained using an appropriate DC/DC 12-24V converter/inverter that is not provided. The power leads must be a short as possible, avoiding the presence of coils (twisting) and maintaining a minimum distance from the reference surface.

When installing devices that could interact with other electronic systems, namely: Air conditioners, telematics and speed limiters, contact IVECO in order to optimise the application.

NOTE **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 tests can be carried out using on-board diagnostic ECUs (Electronic Control Units) or IVECO service.**

IVECO reserves the right to void vehicle warranty if work is carried out in a way which does not comply with IVECO directives.

Using receiving-transmitting devices not approved or fitting auxiliary amplifiers may seriously affect correct operation of the electric/electronic units fitted to the vehicle, with adverse effects on the vehicle and/or driver safety.

Any damage to the system caused by the use of receiving-transmitting units not approved or the addition of auxiliary amplifiers shall not be covered by the warranty.

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.

In any case we recommend that the increase in the capacity of the batteries should not exceed 20 to 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.

Supplementary batteries

The addition of an auxiliary battery to the vehicle circuit shall provide for a separate recharging system, which shall be integrated with the vehicle one. In this case, auxiliary batteries with the same capacity as the original ones should be provided, to ensure correct recharging of all the batteries.

In the event that an auxiliary battery is to be installed:

- in the passenger compartment;
- the following batteries can be used:

a) recombination batteries (AGM or gel)

b) traditional batteries.

In both cases, the battery must be completely separated from the occupants in the vehicle. A suitable air tight container could be used in case of:

- vapour escape (e.g. in case of alternator voltage regulator failure);
- battery explosion;
- electrolyte leaks, even in case of vehicle overturning.

In the event that type **a)** batteries are used:

- a vent to the passenger compartment exterior shall be provided.

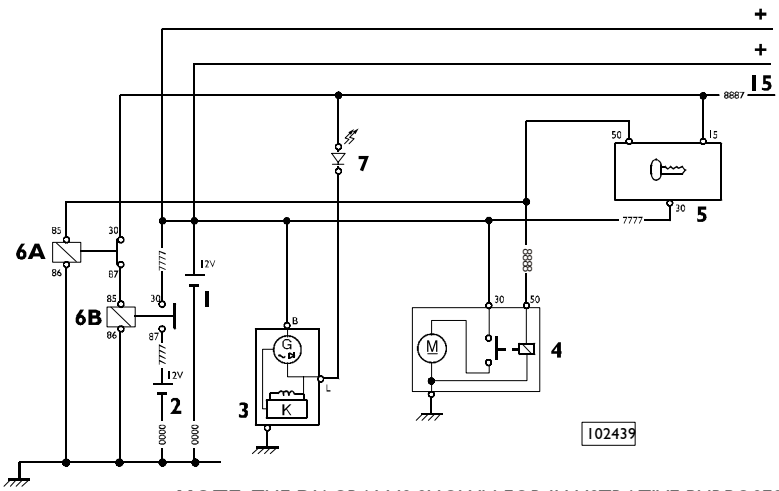
In the event that type **b)** batteries are installed, the batteries shall be equipped with:

- a cover with a system for blowing the gas off to the outside, fitted with tube for conveying the acid spray to the outside;
- a flame anti-return system by means of a porous pellet (flame arrester).

Moreover, gas escape shall take place far from points liable to spark ignition as well as mechanic/electric/electronic members and parts. The exhaust shall be positioned in such a way that vacuum shall not be generated inside the battery.

Ground connection of the added battery shall be made by using a cable of adequate section, as short as possible.

Figure 2.26



NOTE. THE DIAGRAM IS SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

1. Standard battery - 2. Auxiliary battery - 3. Alternator with built-in regulator - 4. Starting motor - 5. Ignition key - 6. Remote-control switches - 6BProper remote-control switch dimensioning based on only the loads powered by the auxiliary battery (2) - 7.No battery recharge warning light

The protection of all lines downstream of all batteries must be guaranteed under all possible failure conditions. Lack of a protection may be dangerous for people and constitute a risk of fire.

Auxiliary alternators

The vehicle's electric system has been designed to supply the necessary power to the installed pieces of equipment. Both the specific protection and correct cable dimensioning are ensured for all the pieces of equipment, within the context of their own functions.

The addition of auxiliary pieces of equipment shall provide for suitable protections and shall not overload the vehicle system.

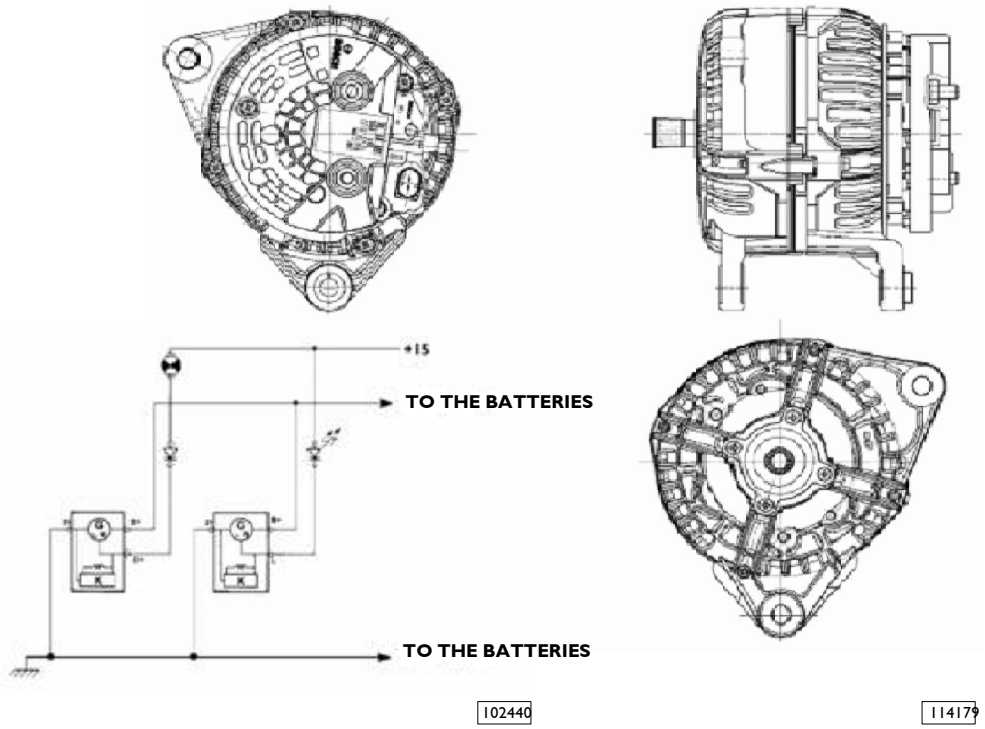
In the event that an extra battery has to be used in parallel to the standard one, it is recommended that a heavy duty alternator is used or an auxiliary alternator is fitted.

The auxiliary alternator shall be of the type equipped with Zener-diode rectifiers, to avoid possible damage to the installed electric/electronic pieces of equipment owing to accidental battery disconnection. Moreover, every single alternator shall feature a warning light or LED signalling failed battery recharge.

The auxiliary alternator shall feature the same characteristics as the standard one, and the cables shall be properly dimensioned.

In the event that modifications other than the ones described in this manual need be made to the system (e.g. adding several batteries in parallel), the operation shall be carried out together with the IVECO experts.

Figure 2.27



NOTE. THE DIAGRAM IS SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

2.16.4 Current drawing

Precautions

The points where current can be drawn and the instructions to be followed are described below.
Protection fuses MUST be used and fitted next to the point where the power is taken.
The added cables shall be protected by running them inside special sheathes or corrugated pipes. They shall be installed in accordance with the instructions given in paragraph 2.16.5.

CBA voltage supply (on battery)

Figure 2.28

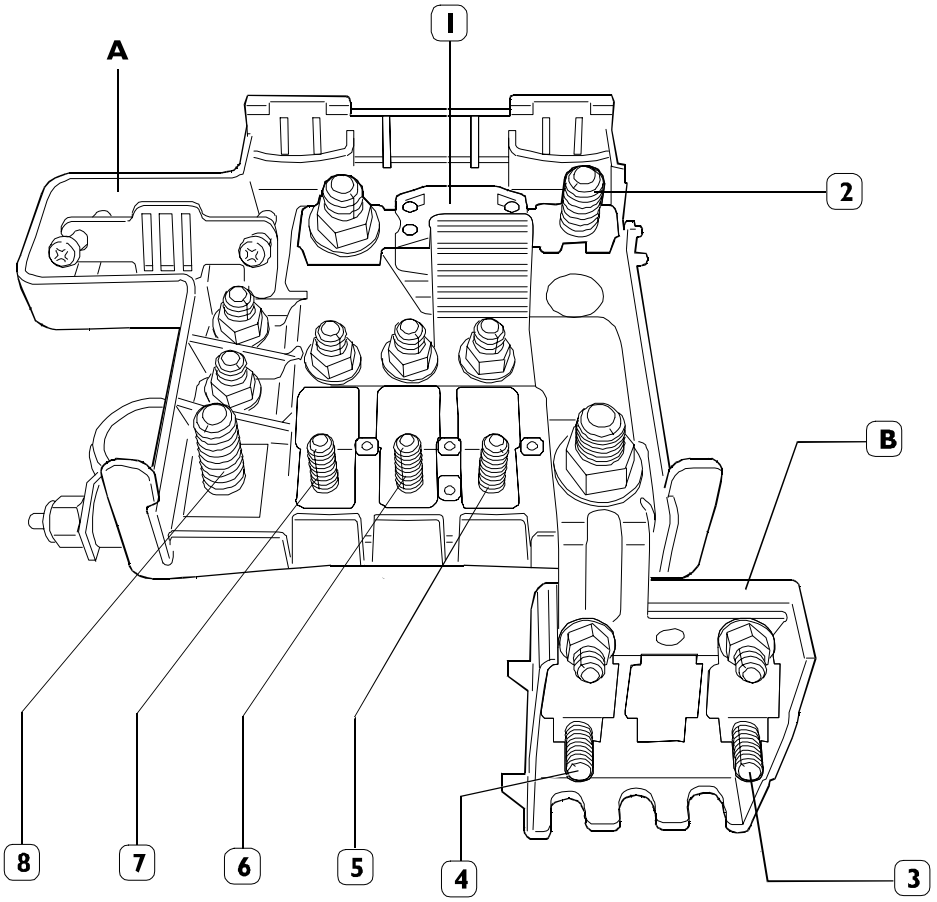


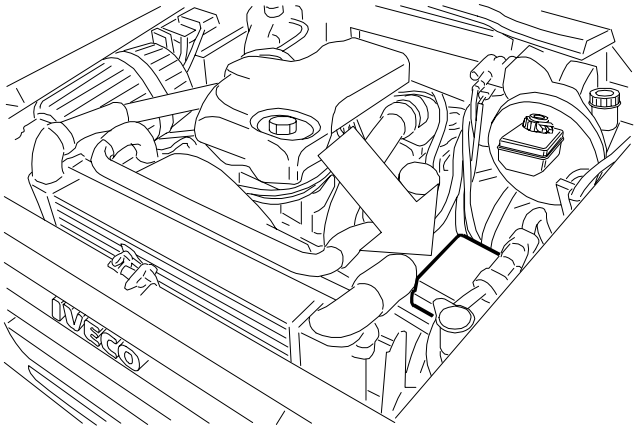
Table 2.13

Ref.	Name	Description	Capacity
A	CBA	Control unit on battery	-
B	CFO	Fuse control unit option	-
1	F1	Mega-fuse (starter and alternator)	500 A
2	-	Connection with starter and alternator	-
3	F7	Front and rear air conditioning protection fuse	40 A
4	F5	Key discharge relay protection fuse	40 A
5	F4	Fuse for pre-heating control unit protection	60 A
6	F3	Protection fuse for diesel preheating/engine solenoid/+ 30 diagnosis/fuel pump/IE fuel system	60 A
7	F2	Fuse for maxi fuse module supply on engine comp. Interconnection control unit	50 A
8	-	Winch supply connection	-

Fuse and relay box in engine compartment

The control unit is located in the engine compartment next to the EDC control unit as shown in the figure.

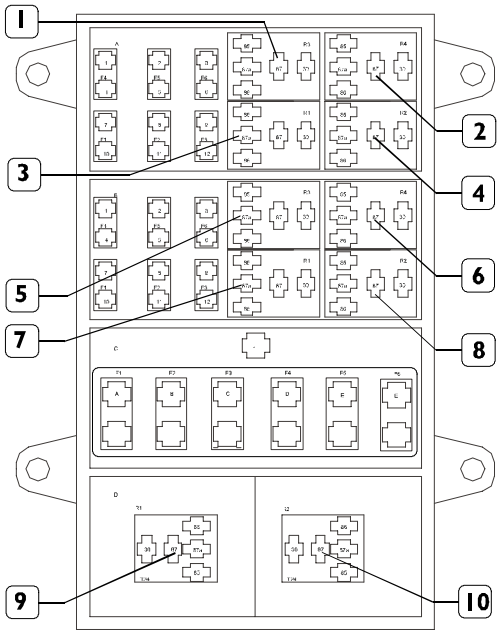
Figure 2.29



119921

Relays (viewed from wiring side)

Figure 2.30



123909

Table 2.14

Ref. Relay	Relay symbol	Amp rating	Function
1	A - R3	20 A	A/C SHUT OFF
2	A - R4	-	
3	A - R1	20A	Compressor
4	A - R2	-	
5	B - R3	20 A	Diesel heating
6	B - R4	20 A	Fuel pump
7	B - R1	20 A	Engine fan
8	B - R2	30 A	Differential lock
9	C1	30 A	Key discharge relay
10	C2	30 A	IE fuel system relay

Fuses and maxi fuses

View of wiring input side

Figure 2.31

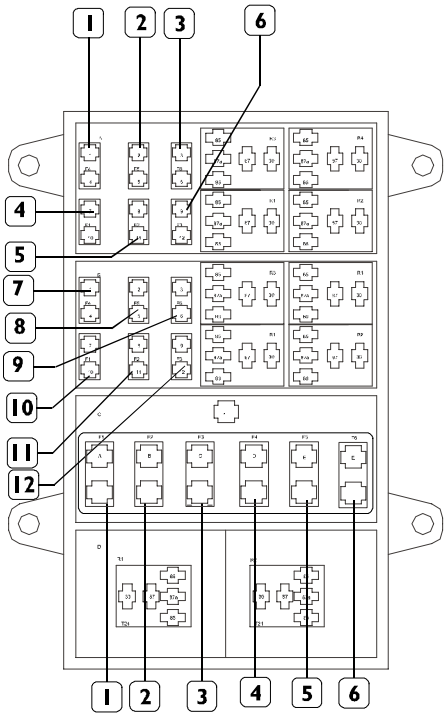


Table 2.15

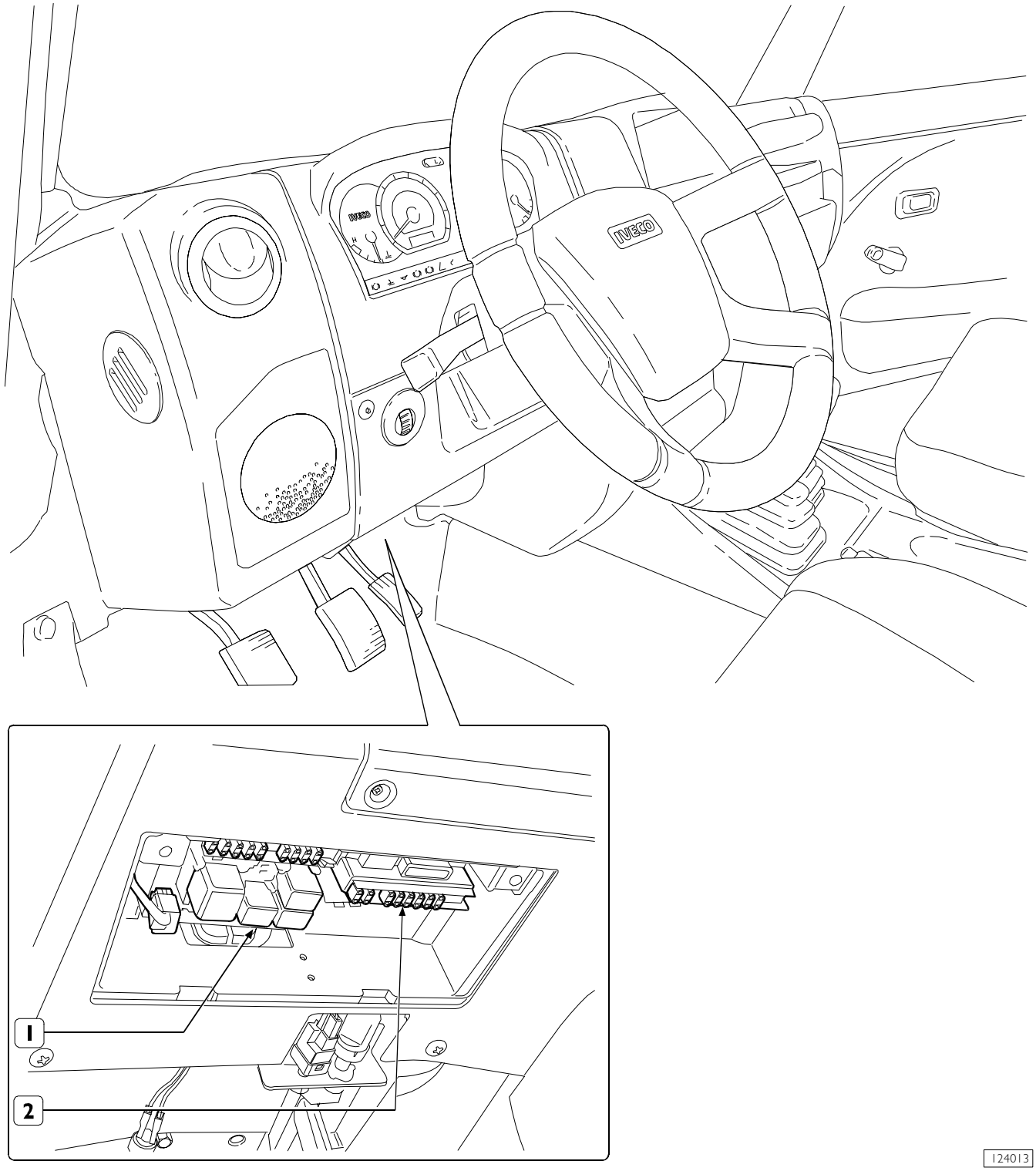
Fuse Ref.	Use	Nominal capacity	Name
1	+15 for trailer	15 A	AF4
2	-	-	AF5
3	+15 for blow by heating	7,5 A	AF6
4	+15 for debimeter and centre detecting water in diesel filter	10 A	AF1
5	+15 for EDC control unit (PIN K-28)	5 A	AF2
6	EDC control unit power supply	25 A	AF3
7	Diesel preheating power supply	10 A	BF4
8	Fuel pump power supply	15 A	BF5
9	EDC control unit power supply (PIN K-1)	10 A	BF6
10	Engine fan (Baruffaldi electromagnetic coupling)	15 A	BF1
11	+30 diagnostic connector	5 A	BF2
12	EDC control unit service power supply	15 A	BF3

Table 2.16

Maxi fuses ref.	Use	Nominal capacity	Name
1	Differential lock	30 A	MF1
2	Trailer control unit	20 A	MF2
3	Ignition/startup switch	30 A	MF3
4	-	-	MF4
5	Front-rear windows	40 A	MF5
6	ABS	30 A	MF6

Fuse and relay control unit on dashboard

Figure 2.32



1. Fuse carrier and relay on the dashboard - 2. Fuse box and OBD tap

Relays (viewed from wiring input side)

Figure 2.33

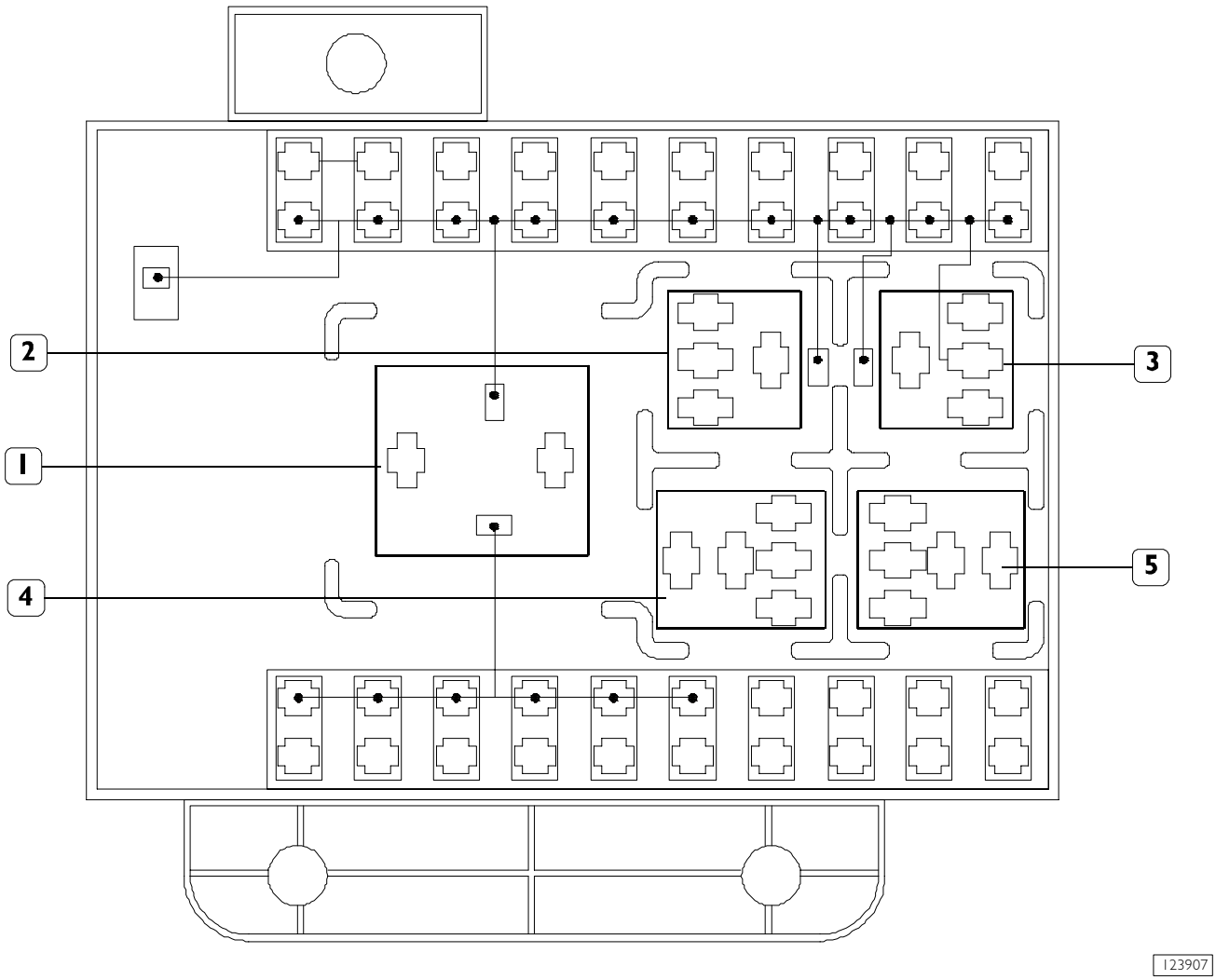


Table 2.17

Ref.	Function	Name
1	Maxi key unload relay	T21
2	Heated rear window relay	T22
3	Power point relay	T23
4	Fog lamp relay	T24
5	Low beam relay	T25

Fuses (viewed from wiring input side)

Figure 2.34

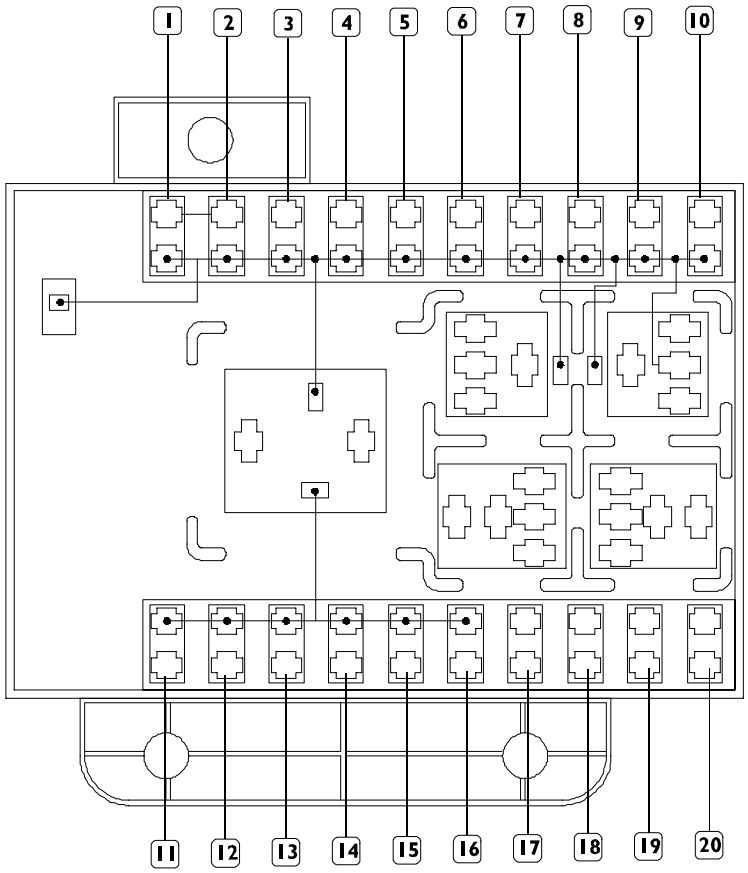


Table 2.18

Ref.	Use	Nominal capacity	Name
1	Free	-	F54
2	Free	-	F63
3	High beam lights	25 A	F56
4	Alarm	10 A	F62
5	Door lock	20 A	F60
6	Radio/Navigator (+30)	15 A	F78
7	Instruments (+ 30)	7,5 A	F61
8	Courtesy lights	7,5 A	F65
9	Power supply to Right control stalk (+30)	15 A	F66
10	Horn/ Hazard lights	15 A	F80
11	Brake light circuit	10 A	F55
12	Power supply to Left control stalk	10 A	F57
13	Rear fog light circuit	10 A	F67
14	Reversing light circuit	10 A	F69
15	Ignition-operated services	7,5 A	F77
16	Free	-	F79
17	Radio	10 A	F58
18	Cigar lighter	10 A	F68
19	Power point	20 A	F59
20	Heated rear window	15 A	F64

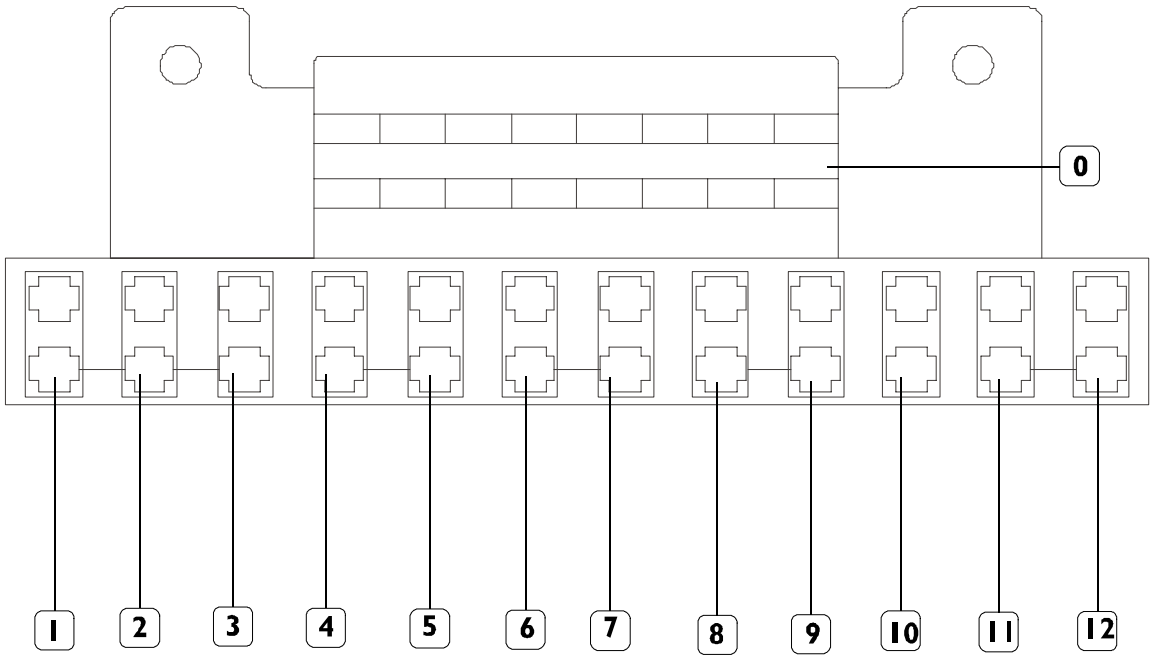
Legend for fuse colours:

Red = 10A
Blue = 15A
Yellow = 20A

Fuse box and EOBD socket

Front view

Figure 2.35



	Function	
0	OBD tap	-

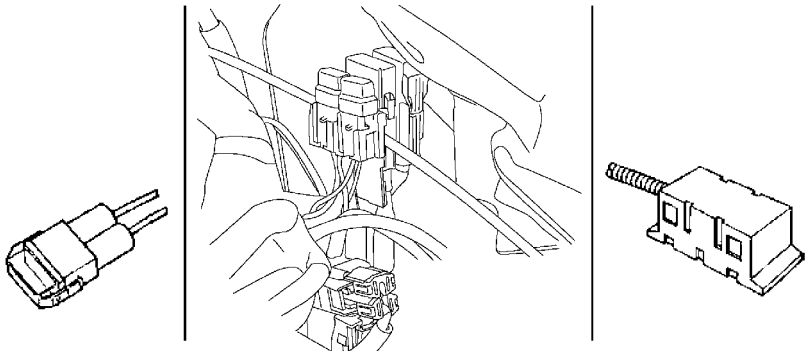
Table 2.19

Fuses	Use	Nominal Capacity	Symbol
1	Left front sidelight/right tail light/left numberplate light	10 A	F36
2	Write front sidelight/left tail light/right numberplate light	10 A	F34
3	Foglamp	15 A	F32
4	Right low beam	10 A	F31
5	Left low beam	10 A	F30
6	Right high beam	10 A	F29
7	Left high beam	10 A	F28
8	Interior fan	20 A	F26
9	Windscreen wash/wipe and rear window wash/wipe	15 A	F24
10	Rear power windows	30 A	F22
11	Left front power windows	20 A	F20
12	Right front power windows	20 A	F18

Maxifuse and megafuse fuses

Fuse holder are available at the IVECO shops, to protect high-absorption current drawing.
They shall be positioned (as near the battery drawing terminal as possible) by the body builder depending on the space available on the vehicle.

Figure 2.36

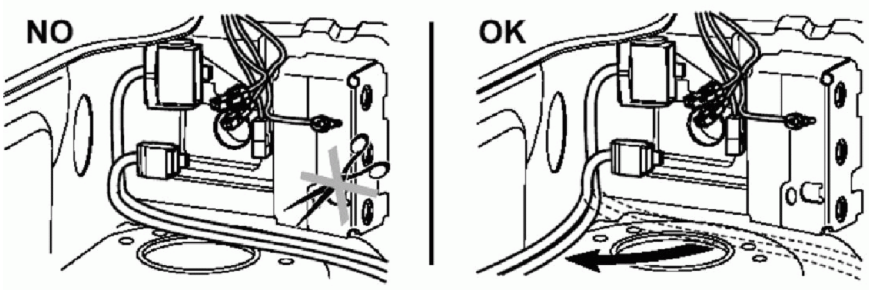


Capacity	IVECO ref. no.	Cable section
KIT 40A	4104 0110 KZ	10 mm^2
KIT 60A	4104 0111 KZ	10 mm^2

Capacity	IVECO ref. no.	Cable section
KIT 100A	4104 0112 KZ	25 mm^2
KIT 125A	4104 0113 KZ	35 mm^2
KIT 150A	4104 0114 KZ	50 mm^2

It should be pointed out that the current intensity shall, when grouping several cables, be reduced compared with the rated value of one single cable in order to compensate for smaller heat dispersion.
As regards the vehicles the engines of which are frequently started, in the presence of current drawing and short engine rotation time (e.g. vehicles equipped with refrigerating bodies), the battery shall be recharged at regular intervals in order to ensure efficiency of the same.
The connections with plugs and terminals shall be of the protected, weather-proof type. Components of the same type as the one originally fitted to the vehicle shall be used.
In the event that units and assemblies (various components, etc.) need be relocated due to special body building or vehicle conversion, such relocation shall be permitted providing:
In the event that a component has be installed just next to the route of a cable belonging to the original system, or a cable route needs be changed, the same can be relocated provided that its integrity is maintained (cuts shall not be made).

Figure 2.37



Any damage caused by the failure to comply with the procedure shall not be covered by the warranty.

2.16.5 Additional Circuits

These must be separated and protected by a fuse from the vehicle's main circuit.
The cables utilised must be of a size that is suitable for the relative functions and must be well insulated. They must also be suitable protected in sheaths (not PVC) or routed though flexible conduits in the case of a plurality of functions (we recommended the use of polyamide type 6 plastic for flexible conduits) and they must be correctly installed in a place where they are protected from impact and heat sources. Take care to avoid any chaffing with other components, particularly with live edges of the bodywork. The transit of these cables through structural components (cross members, profiles, etc.) must be executed using suitable cable glands or protections; firstly the cables must be secured separately with insulated cable clamps (e.g. made of nylon) at adequate intervals (approx. 200 mm).
In the case of external panels use a suitable sealant on both the cable and on the panel, to avoid the risk of infiltration of water, dust, or fumes.
Establish suitable distance between electrical wiring harnesses and other components as follows:
- 10 mm from static components;
- 50 mm from moving components (minimum distance = 20 mm);
- 150 mm from components that generate heat (e.g. engine exhaust).

Wherever possible it is good practice to follow a different cable route for signal cables interfering at high absorbed intensity (e.g. electric motors, solenoid valves) and signals that are susceptible to low absorbed intensities such as sensors, maintaining in any event a position as close as possible to the metal structure of the vehicle in both cases.
Plug and terminal connections must be protected, resistant to weathering, and executed using components of the same type as those utilised originally on the vehicle.
Use cables and fuses with the characteristics shown in the following table in accordance with the current draw:

Table 2.20

Max. continuous current [1] (A)	Cable cross-section (mm^2)	Fuse capacity [2] (A)
0 ÷ 4	0.5	5
4 ÷ 8	1	10
8 ÷ 16	2.5	20
16 ÷ 25	4	30
25 ÷ 33	6	40
33 ÷ 40	10	50
40 ÷ 60	16	70
60 ÷ 80	25	100
80 ÷ 100	35	125
100 ÷ 140	50	150

[1] For uses of more than 30 seconds.
[2] Depending on the position and hence the temperature that may be reached in the housing, choose fuses that can be loaded to up to 70% - 80% of their maximum capacity.

The fuse must be connected as close as possible to the current take-off point.

Precautions

- Incorrect installation of electrical accessories may affect occupant safety and cause severe damage to the vehicle.Contact IVECO if you have any questions.
- Avoid coupling with signal transmission cables (e.g. ABS), for which a preferential path has been defined for electromagnetic requirements (EMI).
  It should be noted that when grouping several cables together, in order to compensate for the lower heat dispersal capacity current intensity must be reduced with respect to the nominal value of a single cable.
- In vehicles subject to frequent engine starts, in the presence of power draws with limited engine running times (e.g. vehicles with refrigerated bodies) periodic battery charges are required to maintain optimal efficiency.

2.16.6 Operations to adjust overhang

If the length of the wires on the chassis are modified to accommodate the new overhang, a watertight joint must be used with the same specifications as those used on the standard vehicle. Components used - such as wires, connectors, terminals, ducts etc. - must be the same type as those used originally and must be fitted correctly.

As far as electronic control device function is concerned, no joins are permitted: the cable must be rep laced by a new cable with the same specifications as that used on the vehicle, and of appropriate length.

2.16.7 Provision for trailer

If the tail-lights are repeated on the trailer, fit the vehicle with a 13-pin trailer point.

It is not permitted to connect directly to the original equipment tail-light lights. Connection to the original vehicle tail-lights could cause current overloads that will be indicated by the on-board computer as operating faults.

If it is necessary to make changes to the system other than those described in this manual (e.g. inclusion of LED lights), the operation must be carried out in conjunction with Iveco.

a) Trailer socket added by the bodybuilder (no parts Kit currently available)

b) Factory-installed trailer connector (optional item 06520)

If the vehicle is ordered complete with the trailer connector, the full circuit will be delivered, which is made up of the electronic control unit (already fitted into place), the set chassis cable and the 13-pole connector.

Table 2.21

13-pole connector pin	Cable no.	Description	Remarks
1	1120	Rear left indicator bulb	1 bulb (21 W, 12 V)
2	2283	Rear fog light power supply	2 bulbs (21 W, 12 V)
3	0000	Ground	-
4	1125	Rear right indicator bulb	1 bulb (21 W, 12 V)
5	3335	Front left/rear right sidelights; left licence plate light; left clearance light	1 bulb (5 W, 12 V)
6	1175	Brake light power supply	2 bulbs (21 W, 12 V)
7	3334	Front right/rear left sidelights; right licence plate light; right clearance light	1 bulb (5 W, 12 V)
8	2268	Reversing light power supply	1 bulb (21 W, 12 V)
9	7777	After fuse F23 on the CVM	Battery positive
10	8879	After fuse F16 on the CVM	Ignition-operated positive
11	0000	Ground	-
12	6676	Trailer connection signal (ground)	
13	0000	Ground	-

2.16.8 Side Marker Lights

The local or EC standards in force in some countries lay down that the vehicles specially manufactured by the body builders should be fitted with side marker lights on the overall length of the vehicle itself.

The external body builders shall take care to make the connections and install the lights on the respective added structures (boxes, vans, etc.).

Special systems must be used, with relays and protection is appropriately sized in order not to overload the light circuit.

2.17 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.

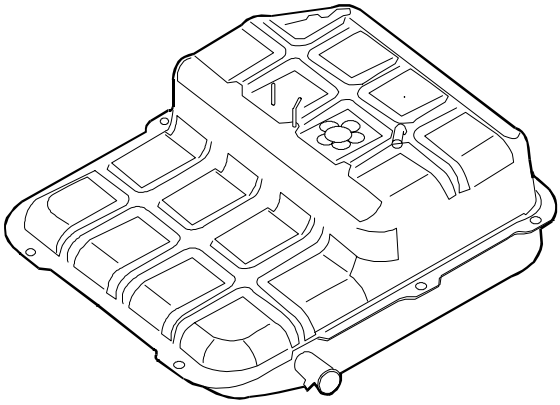
In order to limit the torsional stresses on the vehicle chassis, we recommend that the plate be fitted where there is a cross member, particularly in the case of heavy units.

A similar procedure should be adopted when fitting additional units such as tanks, compressors etc. When positioning them, due consideration must be given to the distribution of the weights (see point 1.13). Adequate ground clearance must be ensured with due consideration given to the operation of the vehicle.

Any new holes that are necessary for the relocation must be made in the web of the sidemember in accordance with the specifications given in point 2.3 taking care to use existing holes as much as possible.

Fuel tank

Figure 2.38



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The use of fuel tanks other than the original tanks will lead to incorrect readings for fuel reserve, fuel consumption, range etc. on the control panel.

The new electrical systems architecture will process the fuel gauge level signals by associating the emptying concept as for the fuel tank original fitted.

Fuel tanks are subjected to homologation.

2.18 Retarder Installation

Not applicable to the vehicle.

2.19 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 450 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) keeping the same connection with the chassis as 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 the original resistance and stiffness specifications (so as to comply with local government regulations, if any). The company carrying out the modification / installation must where required, submit the necessary document demonstrating compliance with legislation in force at the time.

In the event that a different under run-bar has to be fitted, compliance with the standards and regulations in force must be checked. Test certificates and documentation must, where required, be submitted to the respective government agency.

2.20 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 instructions given in the first two steps shall also be followed when wheelboxes have to be executed.

2.21 Mudflaps

If legally required, unless already fitted ex-factory, the bodybuilder must ensure that the complete vehicle is fitted with mud flaps. When fitting these all regulations (e.g. dimensional etc) must be complied with.

2.22 Side Guards

Not applicable.

2.23 Chocks

Bodybuilders must take care to identify an arrangement that complies with local regulations. The new positioning must offer characteristics of reliability and safety and also be easily accessible for operation by the user.

Side Guards

Chocks

SECTION 3

Fitting supersctructures

Index

Page

NOTE The following general instructions complement the general instructions given in the general regulations in Chapter 1.

3.1 Construction of the Subframe

The purpose of an 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:

3.1.1 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 shall have good weldability characteristics and limits not lower than valoes (1) shown in Table 3.1.

Should the stress limits require it (e.g. crane applications), 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 properties of certain materials that are considered in some of the applications indicated below are as follows.

Table 3.1 - Material to be used for body manufacturing Standard IVECO 15-2110 and 15-2812

Steel name		Breaking load (N/mm^2)	Yield point (N/mm^2)	Elongation A5
IVECO	FE360D	360 (1)	235 (1)	25% (1)
EUROPE	S235JR			
GERMANY	S235JR			
UK	37/23CR			
IVECO	FEE420	530	420	21%
EUROPE	S420MC			
GERMANY	S420MC			
UK	S420MC			
IVECO	FE510D	520	360	22%
EUROPE	S355J2G3F			
GERMANY	S355J2G3F			
UK	50D			

3.1.2 Section bar dimensions

The table below illustrates the values for the bulk modulus W_x for C-section bars 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). Bars of different sections can be used as replacements for the indicated ones, provided that the bulk modulus W_x and the moment of inertia J_x of the new C-section do not features smaller values.

Table 3.2 - Profiles recommended by IVECO

Strength modulus Wx (cm^3)	Recommended C-section profile (mm)		
16 ≤ W ≤ 19	80 X 50 X 4	80 X 60 X 4	80 X 50 X 5
20 ≤ W ≤ 23		80 X 60 X 5	
24 ≤ W ≤ 26		80 X 60 X 6	
27 ≤ W ≤ 30		80 X 60 X 7	100 X 50 X 5
31 ≤ W≤ 33		80 X 60 X 8	100 X 60 X 5
34 ≤ W ≤ 36		100 X 60 X 6	
37 ≤ W ≤ 41		100 X 60 X 7	
42 ≤ W ≤ 45	80 X 80 X 8	100 X 60 X 8	
46 ≤ W ≤ 52	120 X 60 X 6	120 X 60 X 7	
53 ≤ W ≤ 58		120 X 60 X 8	
59 ≤ W ≤ 65		140 X 60 X 7	120 X 70 X 7
66 ≤ W ≤ 72		140 X 60 X 8	120 X 80 X 8
73 ≤ W≤ 79		160 X 60 X 7	
80 ≤ W ≤ 88		180 X 60 X 8	
89 ≤ W ≤ 93	160 X 70 X 7	180 X 60 X 7	140 X 80 X 8
94 ≤ W ≤ 104		180 X 60 X 8	
105 ≤ W ≤ 122	200 X 80 X 6	200 X 60 X 8	180 X 70 X 7
123 ≤ W ≤ 126		220 X 60 X 7	
127 ≤ W≤ 141		220 X 60 X 8	
142 ≤ W ≤ 160	200 X 80 X 8	240 X 60 X 8	
161 ≤ W ≤ 178	220 X 80 X 8	240 X 70 X 8	
179 ≤ W ≤ 201	250 X 80 X 7	260 X 70 X 8	
202 ≤ W ≤ 220	250 X 80 X 8	260 X 80 X 8	
221 ≤ W ≤ 224	220 X 80 X 8	280 X 70 X 8	
225 ≤ W ≤ 245	250 X 100 X 8	280 X 80 X 8	
246 ≤ W ≤ 286	280 X 100 X 8		
290 ≤ W ≤ 316	300 X 80 X 8		
316 ≤ W ≤ 380	340 X 100 X 8		
440	380 X 100 X 8		
480	400 X 100 X 8		

3.1.3 Aluminium Subframe

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

When the subframe's main function is mainly to distribute the load more evenly while leaving the major loadbearing to the frame, aluminium longitudinal runners can be used having the same dimensions as stated for the steel. Some typical examples are: fixed bodies, vans, tanks with continuous and close spaced bearers or bearers mounted directly over the suspension hanger brackets. Exceptions are those cases where the high stresses on the vehicle's frame demand steel runners of a high dimension or shear-resistant connections.

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

It should be remembered that, when stating the minimum dimensions for the reinforcement runners, besides the admitted limit of stress for the aluminium, the different elastic modulus compared to steel (approx. 7,000 kg/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, when the connection between frame and counterframe guarantees the transmission of shearing forces (connection via plates), a new neutral axis must be defined for the section based on the different elastic coefficients of both materials when checking the stresses at both ends of the single section.

The cooperation request for aluminium definitely means dimensions that are too large and not good value.

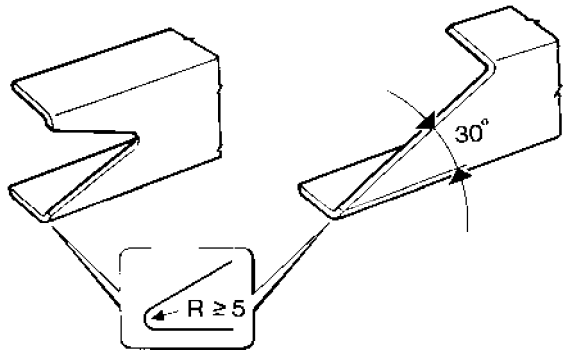
3.2 Elements making up the subframe

3.2.1 Longitudinal Runner Profiles

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

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

Figure 3.1



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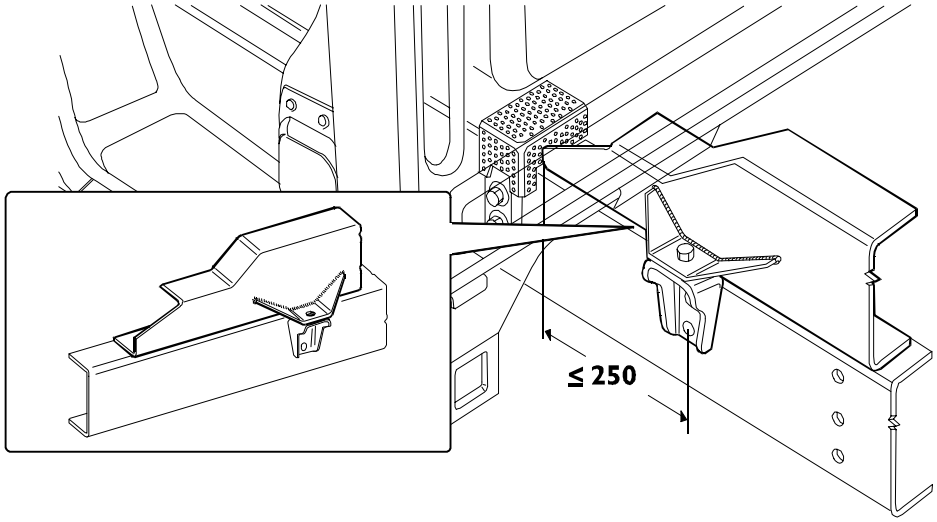
If rear cab suspension components (e.g. with long cabs) do not allow the full section cross-section to pass through, proceed as shown in Figure 3.2. This could require the minimum resistant cross-section to be checked when high front bending moments are present (e.g. with a crane behind the cab that is operating towards the front of the vehicle) and the fastening should not be more than 250 mm away from the front end of the subframe if possible.

Figure 3.2



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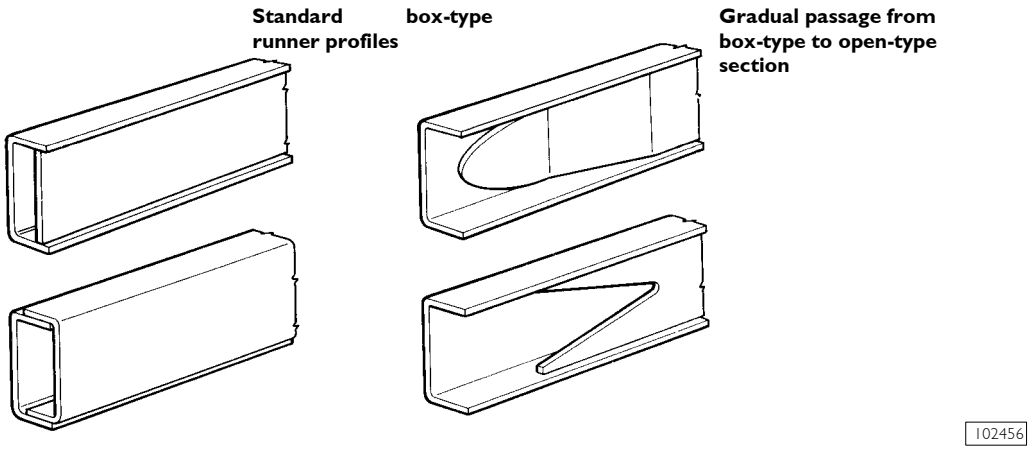
The shape of the section of the runner is determined with due consideration to the function of the subframe and to the type of structure that is above it. It is advisable to use open C-sections if the subframe is supposed to adapt itself elastically to the chassis of the vehicle, and to use box-type 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 Figure 3.3.

Figure 3.3



There must be continuity between the longitudinal runners of the subframe and the vehicle. Where this is not possible, continuity may be restored by fitting cleat plate brackets.

If a rubber antifriction strip is inserted, specifications and thickness must be equal to those originally used by the IVECO in production (hardness 80 Shore, max. thickness 3 mm). The application of antifriction material may prevent abrasive actions which can cause corrosion when materials with a different composition (e.g. aluminium and steel).

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.

3.2.2 Cross Members

An adequate number of cross members, which should be positioned if possible adjacent to the fastenings, are required to brace the two runners of the subframe.

The cross members may be of the open type (e.g. C-type) or, if greater rigidity is desired, of the closed type.

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

Figure 3.4

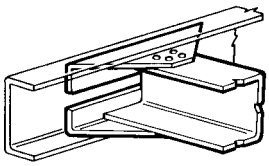
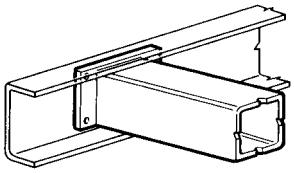


Figure 3.5



Stiffening the Subframe

In the case of certain bodies, the subframe must be additionally stiffened at the rear end.

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

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

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

Figure 3.6

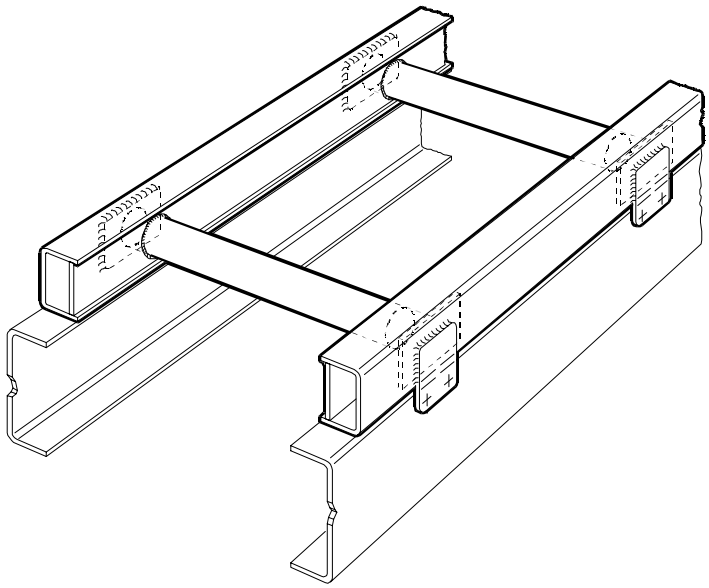


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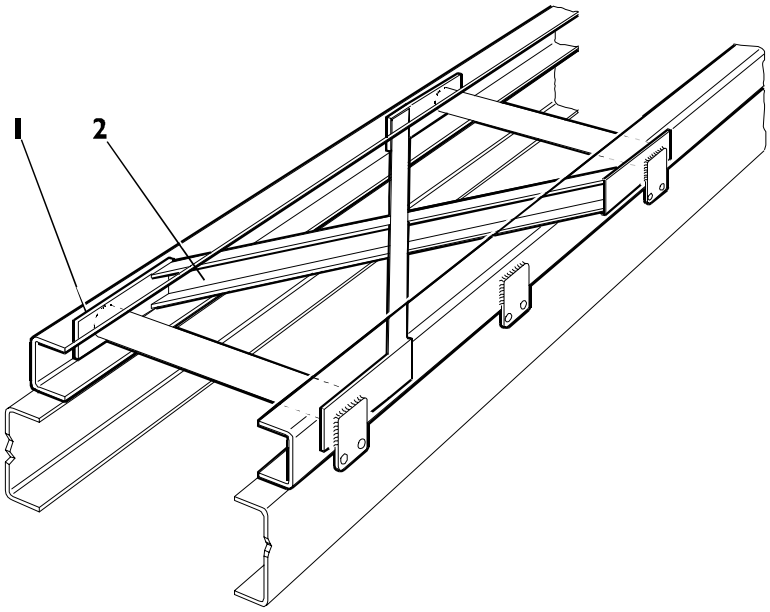
Figure 3.7



1. Subframe - 2. Cruciform

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 a subframe.

3.3 Connections between frame and counterframe

3.3.1 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.

This may be flexible (yokes); use the pre-existing brackets on the vehicle in the case of fixed boxes. The choice must be made based on the type of body that is to be mounted (see points 3.4 to 3.9) analysing the stress forces which the additional equipment that is added transmits to the chassis both under static and dynamic conditions. The number, size and type of securing devices properly subdivided over the length of the subframe, must be such as to ensure a good connection between the chassis of the vehicle and the subframe.

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

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

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

If the body to be installed has characteristics different from those permitted on the original chassis (e.g tipper on a platform body chassis), the bodybuilder will provide the appropriate mountings (e.g. the replacement of brackets by cleat plates in the rear area of the chassis).

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.

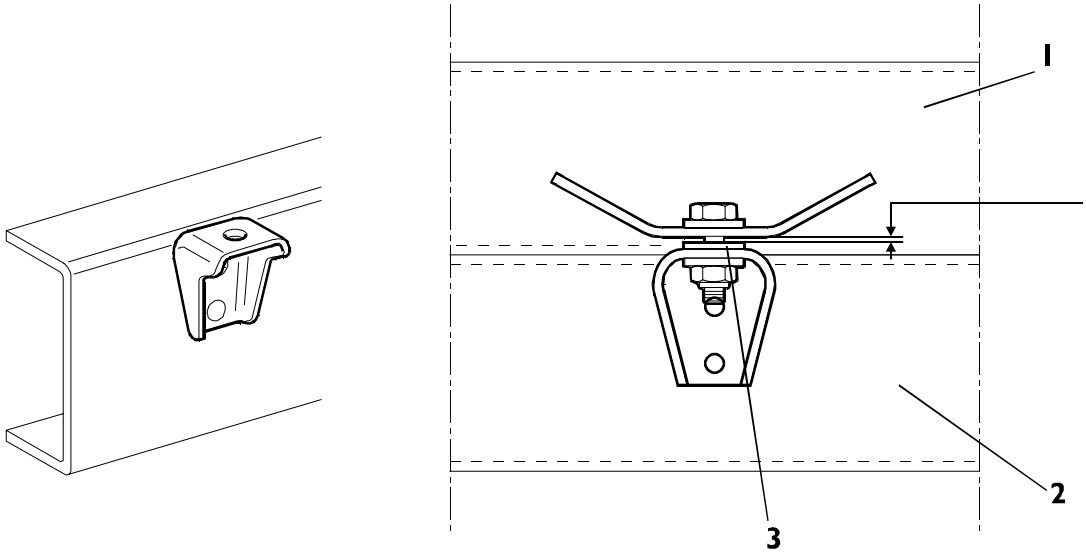
3.3.2 Body Mounting Characteristics

Flexible joints (see Figure 3.8 and 3.9) 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.

3.3.3 Connection with Brackets

Figure 3.8 shows an example of this type of connection.

Figure 3.8



1. Subframe - 2. Frame - 3. Shims

In order to ensure a flexible joint there must be a gap of 1 to 2 mm between the brackets of the frame and those of the subframe before the securing bolts are tightened. Larger gaps are to be reduced by using suitable shims. Using bolts of proportional length improves the flexibility of the connection.

The brackets must be secured to the web of the vehicle's side member only by means of bolts or rivets.

In order to guide and better contain the loads transversally, a slight protrusion of the brackets above the chassis is recommended. When the brackets are fitted flush with the upper flange of the side member, the lateral movement of the body structure must be secured by other means (e.g. using guide plates the chassis connected - see Figure 3.9). When the front connection is of the elastic type, lengthwise securing must be ensured even in the conditions of maximum twisting of the chassis (e.g. off-road).

When the chassis already has factory fitted brackets for the installation of a box-type body, these brackets must be used for the installation of the structure. The brackets fitted to the subframe or to the body must have characteristics of strength not lower than those of the original brackets fitted to the vehicle.

3.3.4 Elastic connections

Connections by means of flexible couplings or blocks are not allowed.

3.3.5 Connection with U-bolts (clamps)

The most important mounting of this type is illustrated in Figure 3.9.

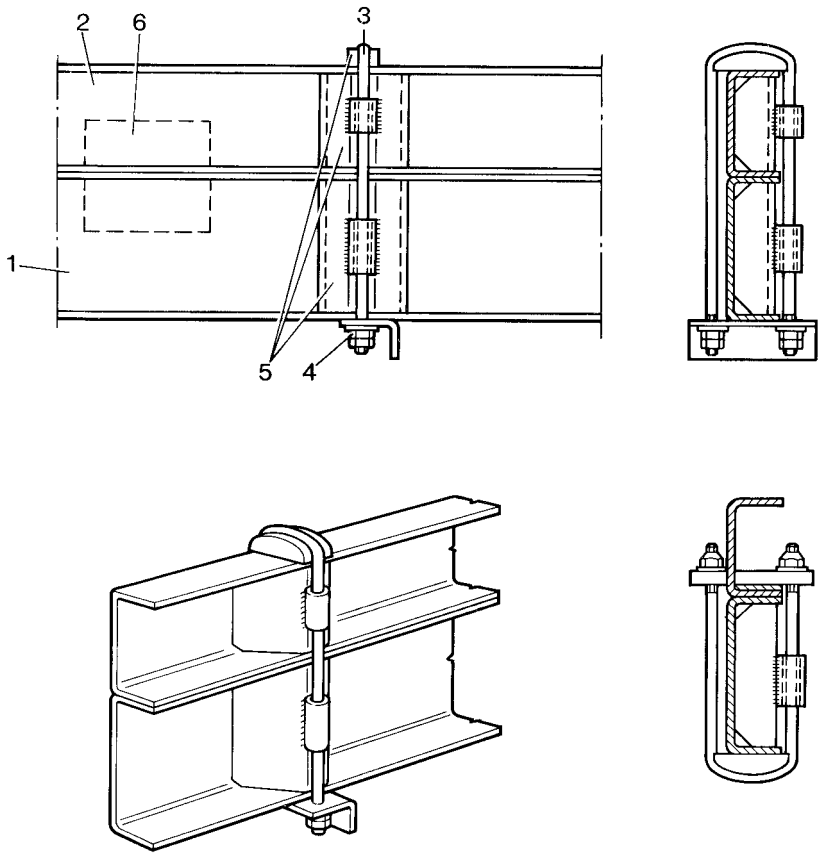
In this type of construction the bodybuilder must place a spacing piece, preferably made of metal, between the flanges of the two side members at the point where the U-bolts are located, in order to prevent the bending of the frames when the U-bolts are tightened.

In order to guide and to better contain transversally the structure that is attached to the vehicle's chassis, this type of joint must be complemented by the addition of plates that are attached to the subframe and chassis as shown in Figure 3.9.

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

For this purpose it is also possible to use bolt-type connections at the rear end of the chassis as illustrated in Figure 3.10.

Figure 3.9



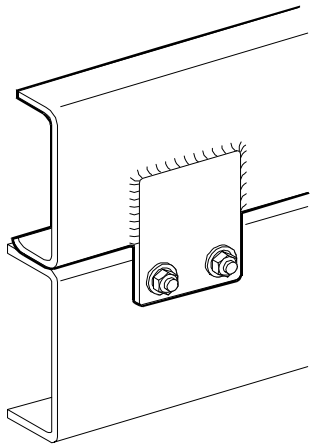
1. Frame - 2. Subframe - 3. U-bolts - 4. Locking with lock nut - 5. Spacers - 6. Cleat plate (where necessary)

NOTE If the contact surfaces between the frame and subframe are not flat, apply shims as appropriate before tightening the yokes and/or u-bolts.

3.3.6 Connection with Plates for Longitudinal and Transverse Fixing (rigid type)

This type of fixing shown in Figure 3.10 is achieved by means of a plate that is welded or bolted to the subframe and is secured to the chassis by means of bolts or rivets. This ensures good reaction to longitudinal and transverse thrust and provides maximum rigidity between the vehicle chassis and the subframe.

Figure 3.10



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

- The plate must 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.
- The use of cleat plates must only be fitted 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 sections shear and bending moments between the chassis and the subframe.
  When all the necessary elements are available these values can be determined accurately by calculation.

The height of the subframe has to be limited as much as possible (e.g., towing centre axle trailers, crane on rear overhang, tail lifts, etc.). Follow the instructions given in Table 3.3 below:

Table 3.3

Chassis / subframe section height ratio	Max. distance between the centre line of the shear-resistant plate (mm) 1)	Models	Min. plate characteristics	
			Thickness (mm)	Screw size (min. 3 screws per plate) 2)
≤ 1.0	500		5	M12 (2 screws per plate)

1) Increasing 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 using spacers, so that longer bolts can be used.

3.4 Fitting Box Bodies

Dimensions and centres of gravity

Check that the weight is correctly distributed, particularly bearing in mind the instructions on the height of the centre of gravity mentioned in chapter 1, taking appropriate constructional precautions to ensure maximum stability of the transported load on the journey.

3.4.1 Fixed boxes

See table in Chapter 1 to find out the volumetric masses required to determine the load distribution.

On standard cab vehicles, intended exclusively for road use, box- bodies are usually fitted on a subframe comprising longitudinal runners and cross members. The minimum dimensions of the longitudinal runners are specified in Table 3.4.

Table 3.4

Models	Minimum reinforcement sectional longitudinal	
	Wheelbase (mm)	Sectional modulus Wx (cm^3)
	2768	21

1) The body structure with its base should be made so that 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 IVECO have not provided the brackets they must be installed according to the specifications given in point 3.3. In order to provide adequate longitudinal restraint when brackets or clamps are used, it is recommended that a rigid connection both sides on the rear overhang is made using either cleat plates or bolts through the upper flange of the side members (see Figures 3.9 and 3.10).

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

In instances where 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 longitudinal thrusts as shown.

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

3.4.2 Tipper boxes

Authorisation must be requested from IVECO for the construction of tipper beds.

3.5 Tractor for half-trailers

No specific bodies for towing semi-trailers are made by IVECO.

3.6 Transport of Indivisible Materials

The transport of indivisible material and of freight whose dimensions exceed normal ones, is regulated in various countries by special legislation.

3.7 Installation of Tanks and Containers for Bulk Materials

It is not permitted to install tank or container for loose materials.

3.8 Installation of cranes

Authorisation must be requested from IVECO for the construction of cranes.

3.8.1 Crane Behind the Driver's Cab

Authorisation must be requested from IVECO for the construction of cranes behind the cab.

3.9 Installation of Tail Lifts

The installation of load flaps is not allowed.

3.10 Recovery Vehicles

Authorisation must be requested from IVECO for the construction of roadside rescue vehicles.

3.11 Municipal, Fire-fighting and Special Services

Authorisation must be requested from IVECO for the construction of vehicles for municipal use.

3.12 Installation of front snowploughs

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.

The functional characters and possible use of the original items located at the vehicle front (e.g. towing hook) must not be affected. Otherwise the body builder must provide for similar items in accordance with the safety standards and regulations.

An increase of the maximum load permitted on the front axle may, on request, be approved for most of the IVECO models, when the latter are used as snowploughs and driven at moderate speed.

Compliance with the requested load must be documented and guaranteed by the bodybuilder that carries out the installation.

3.13 Winch Installation

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

- on the front of the frame (front installation);
- on vehicle chassis behind the cab;
- between vehicle side members, centre or displace on one side;
- on the end of the frame.

The installation should be performed so as not to interfere with operation of units and components of the vehicle and with respect to maximum loads allowed on the axles and following the company directions. Fixing the winch unit and relevant drive components must conform to the directions given at point 2.3 ensuring the reinforced areas are not locally limited to the mounting area (see point 2.17) taking into consideration the rope operations and in particular, its transverse component(s) when the winch is pulling sideways.

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 (tipping bodies, crane etc.).

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 the battery and alternator.

All safety requirements, national and EC regulations must be complied with.

3.14 Special body conversions

3.14.1 Installing an aerial platform

Authorisation must be requested from IVECO for the construction of area platforms.

Installation of front snowploughs

SECTION 4

Power take-offs

4.1 General Specifications

The installation of power take-offs is not currently permitted.

4.2 Power Take-off from Gearbox

The installation of power take-offs from the speed control is not currently permitted.

4.3 Power Take-off from Transfer Box

The installation of power take-offs from the torque converter is not currently permitted.

4.4 Power Take-off from Drive line

The installation of power take-offs from the transmission is not currently permitted.

4.5 Power Take-off from Engine

The installation of power take-offs from the engine is not currently permitted.

4.6 PTO management

The installation of power take-offs is not currently permitted.

SECTION 5

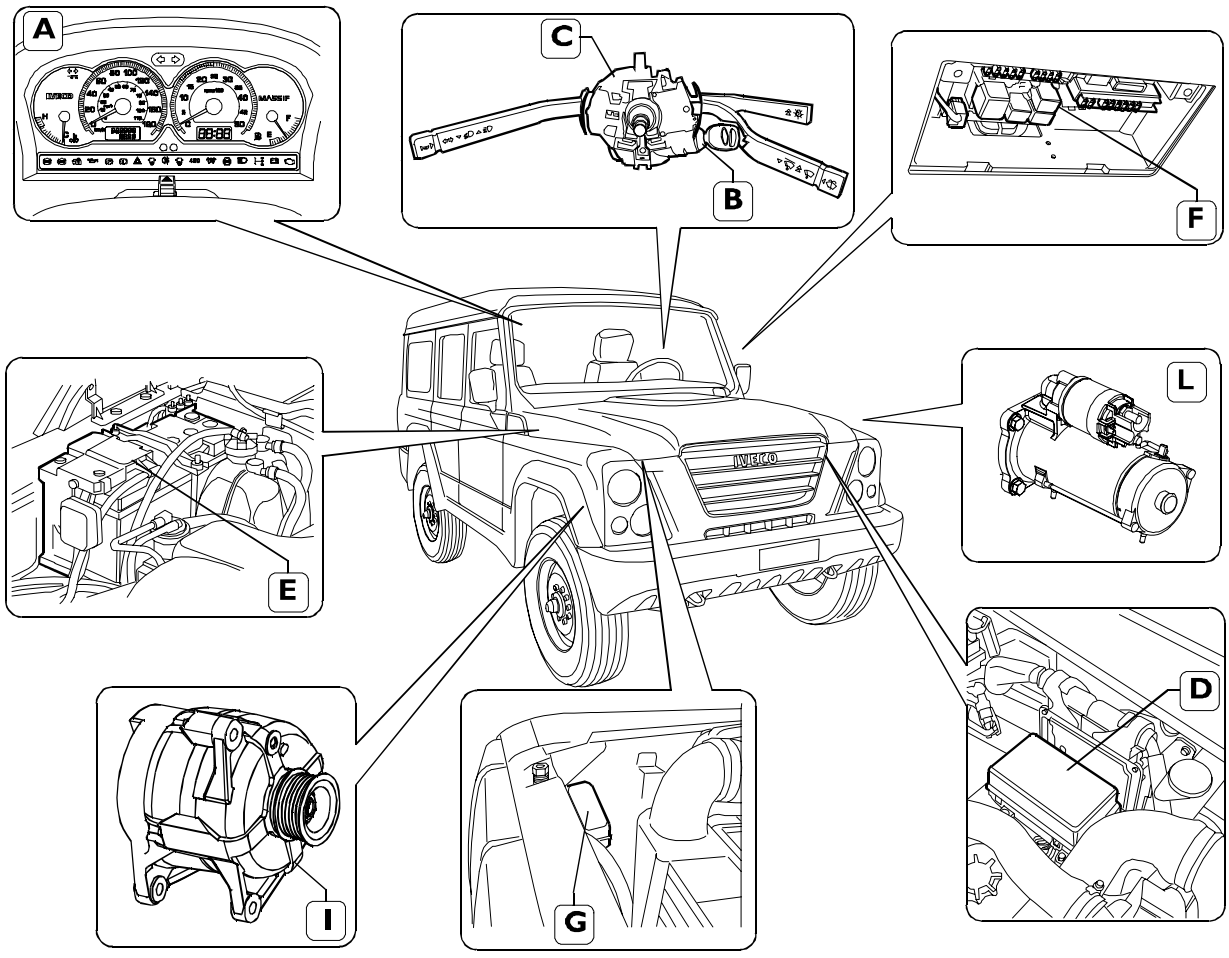
Specific information and instructions

5.1 Electronic system

The following shows the location of the electronic control units and connectors that can be installed on the vehicle.

Devices or electrical circuits must not be connected directly to the control units described below. It is only possible to use the connectors listed in the following paragraphs.

Figure 5.1



A. Instrument panel - B. Key switch - C. Power Steering - D. Engine comp. interconnection control unit - E.. Battery with CBA and CFO - F. Fuse panel and relay under the dashboard - G. Fuse panel and relay for air conditioning - I. Alternator - L. Starter

5.2 Bodybuilder connectors

The installation of a connector for assemblers is not foreseen at present.

5.3 Electronic control units

5.3.1 Precautions to be taken with the installed electronic control units

To avoid carrying out wrong operations that may somehow permanently damage or deteriorate the operation of the control units fitted to the vehicle, the following instructions should be observed.

- In case of actions to the taken on the chassis, which require electric arc welding, the following shall be done: disconnect the cable from the positive terminal of the battery and connect the same to the chassis ground; remove the connector form the control units; remove the control unit form the chassis (in case of welds made quite near the control unit); make the welds by using direct current; ground the welding machine as near the welding point as possible; do not lay the battery cables parallel to the vehicle's electric cables.
- Do not remove and/or connect the connectors from the control units when the engine is running or the control units are powered.
- Remove the electronic control units if temperatures higher than 80 °C are reached when carrying out special operations.
- Make sure, after carrying out any maintenance operation requiring battery disconnection, that the terminals are properly connected to the poles when the battery is connected again.
- Do not disconnect the battery when the engine is running.
- Do not use a battery charger to start the engine.
- Disconnect the battery from the vehicle's on-board network if the battery needs charging.

Warnings

When installing devices such as the ones listed below (which may interact with the other electronic system originally fitted to the vehicle, i.e. ABS, EDC, etc.), contact IVECO in order to optimize the applications:

- Retarders
- Auxiliary heaters
- Power take-offs
- Air conditioners
- Automatic gearboxes
- Speed limiters
- Anti-theft systems
- Mobile phone systems, etc.
- compressors for refrigerating systems.

Note

As regards all the operations that may cause interactions with the basic system, it is recommended that diagnostic checks are carried out, in order to verify correct execution of the system.

Please be reminded that IVECO reserve the right to have its own vehicle warranty forfeited in the event that operations not consistent with the IVECO directives and instructions are carried out on the vehicle.

Refer to the specific workshop manuals for more information on the vehicle's electric system.

The vehicles are equipped with sophisticated electric/electronic systems that manage the vehicle operation.

Any operation carried out on the electric system (e.g. removing the cable harnesses, making additional circuits, replacing pieces of equipment, fuses, etc.) by following procedures not conforming to the IVECO directives and instructions or performed by unskilled operators may cause serious damage to the vehicle's on-board systems (e.g. electronic control units, wiring, sensors), thus affecting driving safety. Carrying out wrong operations on the vehicle's electric system will cause major damage (e.g. short-circuits with possible fire and vehicle destruction) that is not covered by the contractual warranty.

Do NOT make any modification or connection to the CAN lines, which must not be tampered with for any reason whatsoever. Any diagnostic and maintenance operations shall be carried out only by qualified operators and by making use of IVECO-certified equipment.

The battery shall always be disconnected prior to carrying out any operation on the vehicle's electric system. To ensure correct battery disconnection, the negative pole shall be removed first, then the CBA shall.

Use only fuses featuring the characteristics specified for the function at issue; never use oversized fuses; replacement shall be made only after the trouble is eliminated and both the keys and the auxiliary devices are turned OFF.

NEVER USE FUSES WITH HIGHER CAPACITY THEN THE PRESCRIBED ONE.

Once the operations have been completed on the vehicle, resume (in the event that operations have been carried out on the electric system) the original conditions of cables (routes, protections, clamps). The cables **must not** come into contact with metal surfaces of the structure which may affect its intactness.

NOTE Any deviation from the assembling directives shall require written authorization from IVECO. Failure to comply with the above prescriptions will cause the warranty to become null and void.

5.3.2 Repositioning ECUs

IVECO recommends to avoid modifications which entails moving ECUs. Follow the instructions below if repositioning ECUs is unavoidable:

- ECUs must be positioned on the chassis or in the cab and secured with a fastening similar to the original one (i.e. bracket). To avoid malfunctions, the ECU in the chassis must not be turned (e.g. to avoid water ingress). Consequently, the original orientation must be preserved.
- las centralitas no deben montarse en el contra bastidor;
- the cover must always be refitted;
- avoid subjecting ECUs to knocks from debris and stones from the road when travelling.

5.3.3 Disconnecting ECUs

Operations which do not comply with the instructions specified by IVECO or made by non qualified personnel can cause severe damage to on-board systems, effect driving safety and correct operation of the vehicle and cause considerable damage which is not covered by warranty.

Follow the instructions below carefully before disconnecting an ECU:

- turn the ignition key to off, if it is inserted;
- switch off the additional heaters and wait for the end of the cooling down cycle (the warning light in the button will go out);
- turn on the map reading lights located in the middle of the header rail;
- open the TGC (Master current relay), where fitted, with the switch arranged in the cab. The map reading lights will go out when the circuit breaker is open;
- isolate the battery by disconnecting the battery cables: disconnect the negative terminal first followed by the positive terminal;
- disconnect the ECU.