

# DAILY M.Y. 2012

**BODYBUILDERS INSTRUCTIONS**



L I G H T   R A N G E

## IVECO

**ISSUE 2012**

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## UPDATE DATA

Section	Paragraph	Description	Revision date
3	Index	Modification to text	October 2012
3	3.4.2	Modification to text	October 2012
3	3.9	Modification to table 3.11 and text	October 2012
3	3.14.3	Modification to text Modification to figure 3.23	October 2012
5	5.4.9	Modification to table 5.19	October 2012
Appendix B	Index	Modification to text	October 2012
Appendix B	B.4.1	Modification to text	October 2012



## Foreword

This publication provides data, specifications and instructions for fitting out and converting vehicles. Its contents are directed at qualified and specialised personnel.

The Bodybuilder is responsible for the project and its execution and must guarantee conformity with the both legal requirements and those given in this publication.

Any modification, conversion or outfitting not listed in this manual and which is not expressly authorised in writing by Iveco shall result in the exclusion of any responsibility for Iveco, and, in particular, where the vehicle is covered by a guarantee, shall result in an immediate lapse of the guarantee.

IVECO is available to provide any information necessary for the work to be performed and to provide instructions for any cases and situations not covered in this publication.

Before commencing any work, it is necessary to:

- check manuals and documentation are at hand for the vehicle model on which work is to be performed;
- ensure that all personal protection devices (goggles, helmet, gloves, shoes etc.), as well as tools and equipment, lifting and transport equipment, etc., are available and in good working order;
- ensure that the vehicle is parked in a safe condition.

When any work has been completed, the conditions of functionality, efficiency and safety required by IVECO must be restored. Contact the Assistance Network if any adjustments or fine tuning of the vehicle are necessary.

The information contained in this publication may not be completely in line with modifications which IVECO may see fit to introduce at any time for technical or commercial reasons, or to ensure vehicles meet new legal requirements.

In the event of disagreement between the information contained herein and the actual vehicle, please contact the relevant Product Manager before performing 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.

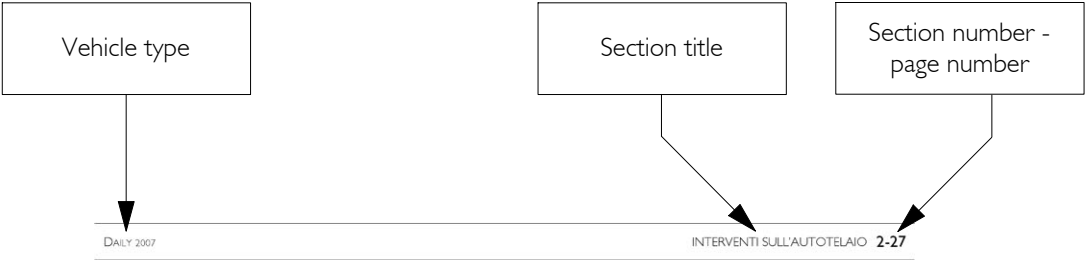


### **Environment protection**

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.

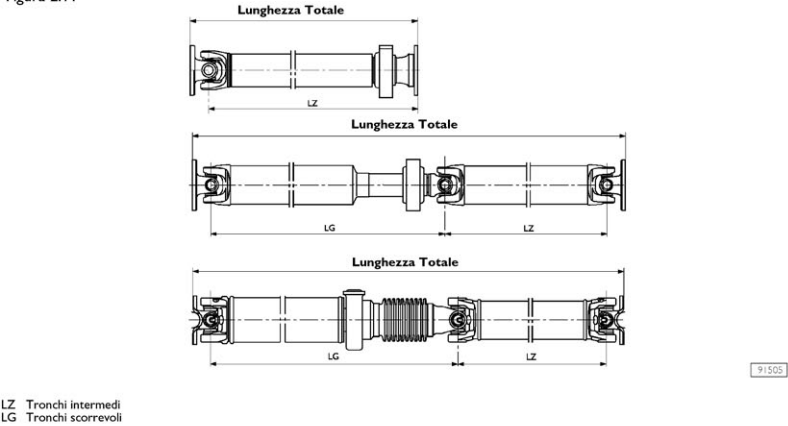
Le indicazioni qui contenute hanno lo scopo di salvaguardare il corretto funzionamento della trasmissione, limitarne la rumorosità ed evitare l'innescio di sollecitazioni trasmesse dal gruppo motopropulsore; ciò non esenta tuttavia l'allestitore dalla responsabilità dei lavori eseguiti.

2.8.1 Lunghezze ammesse

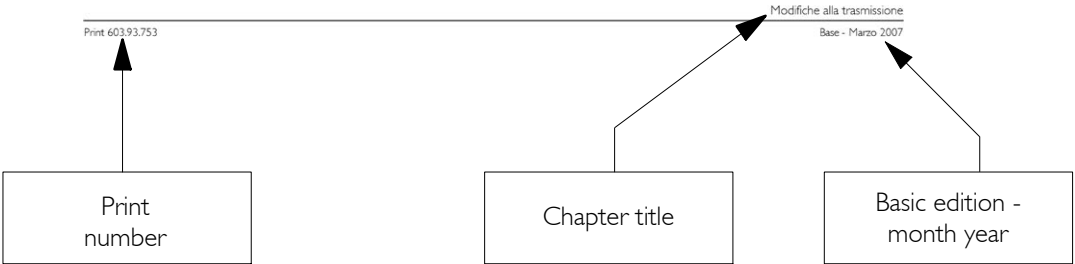
Le massime lunghezze di esercizio realizzabili, sia per i tronchi intermedi che scorrevoli "LG" o "LZ" (ved. Figura 2.11), possono essere determinate in base al diametro esterno del tubo esistente sul veicolo e dal numero dei giri massimo di esercizio (vedere formula) e sono riportate nella Tabella 2.15.

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



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## SECTION I

**General specifications**

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## **I.1 Aim of the requirements**

The aim of this publication is to supply data, specifications and instructions for fitting out and converting original IVECO vehicles in order to guarantee their operation, safety and reliability.

These Requirements also indicate the following for Bodybuilders:

- the quality level to be attained;
- work safety obligations;
- their obligations in respect of objective product liability.

Remember that collaboration with IVECO starts with the assumption that the Bodybuilder will use their technical and organisational capacities to the maximum and that work will be performed in a technically perfect fashion. What follows is by no means exhaustive and is limited to indicating the basic rules and precautions allowing the technical initiative to be developed.

Any faults or defects caused by complete or partial failure to comply with these Requirements shall not be covered by guarantees on the chassis and mechanical assemblies.

## **I.2 Technical documentation available via computer**

The following technical documents are available on the Internet at [www.thbiveco.com](http://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.

## **I.3 IVECO authorisation**

Modifications or conversions listed in and performed with full respect for these Requirements do not require specific authorisation.

On the contrary, the following can be performed only with IVECO authorisation:

- particular modifications of the wheelbase;
- work on the brake system;
- modifications to the steering;
- modifications to the stabiliser bars and the suspension;
- changes to the cab, cab supports, locking and tipping devices;
- changes to the intake systems, engine exhaust and SCR components;
- fitting of retarders;
- fitting of PTOs;
- changing tyre size;
- modifications to coupling devices (hooks, articulations).

## **I.4 Request for approval**

Requests for authorisation, when necessary, must be sent to the relevant IVECO market departments.

The Bodybuilder must supply vehicle data (cab, wheelbase, protrusion, chassis no.) with suitable supporting documentation (drawings, calculations, technical report etc.) illustrating the proposed work, mission and conditions of use for the vehicle. Anything which differs from these instructions must also be highlighted on the drawings.

When work has been finished, the Bodybuilder will then be responsible for obtaining definitive approval from the relevant authorities.

## **I.5 Liabilities**

IVECO authorisation exclusively regards the technical/conceptual feasibility of the proposed modifications and/or outfitting.

The Bodybuilder is therefore responsible for:

- the project;
- the choice of materials;
- the work;
- the project and work meeting any specific requirements supplied by IVECO as well as regulations in force in the country the vehicle is destined for;
- any effects on the vehicle's operation, safety, reliability and, in general, the good performance of the vehicle;
- of the supply of spare parts for a minimum period of 10 years starting with the latest preparation of an order and for all parts and components that are installed.

## **I.6 Legal provisions**

The Bodybuilder must ensure that the finished product conforms, without exception, with all applicable laws both at municipal/autonomous/national level for each country in which it is to be registered or driven (Highway Codes, Official Regulations etc.) and at an international level (European Union directives, UN/Geneva ECE regulations etc.). It must also respect all the requirements concerning accident prevention, instructions for assistance, the environment, etc.

Requirements regarding prevention of accidents or legislative indications given in these Requirements may be considered the most important, but in no case do they replace or eliminate the Bodybuilder's obligation and responsibility to keep themselves correctly informed.

For this reason, IVECO shall not be held responsible for consequences due to errors caused by incorrect understanding or interpretation of any laws in force.

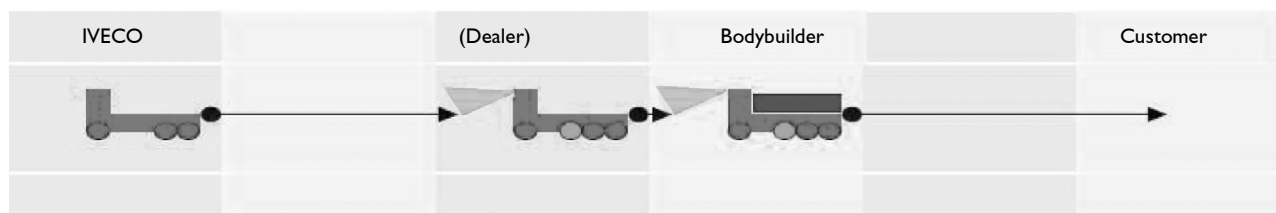
## 1.7 Multi Stage Type Approval - Collaboration (only for EU nations, Switzerland and Turkey)

Annex XVII to Directive 2007/46/EC deals with Multi Stage Type Approval.

This procedure requires each Manufacturer to be responsible for type approval and production conformity of systems, components and "independent technical units" produced or installed on the vehicle by them.

The Manufacturer of the base vehicle is defined as "First stage Manufacturer", while the Bodybuilder is defined as the "Second stage Manufacturer" or later.

Figure 1.1



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A specific contract, known as a "Technical Agreement" must be drawn up on the basis of this Directive between IVECO (Manufacturer of the base vehicle) and a Bodybuilder who intends to apply for Multi Stage Type Approval; this details the contents and reciprocal obligations.

Consequently:

- a) IVECO has the responsibility to make available, in agreed form, type-approval documentation (EC/ECE type approval) and technical information necessary for correct realisation of the outfitting and/or conversion of the vehicle (manuals, drawings, specifications);
- b) the Bodybuilder has the following responsibilities:
  - design and realisation of modifications on the base vehicle received from IVECO,
  - re-attainment of type approval for systems previously approved when such type approvals must be updated due to modifications made to the base vehicle,
  - ensuring all national/international laws and regulations are complied with for all modifications performed, in particular as regards the country which the vehicle is destined for,
  - presenting the modifications made to a technical service for evaluation,
  - appropriate documentation of modifications made, giving clear evidence that the aforementioned laws and regulations have been respected (e.g. type-approval/testing documentation).

Before signing the Technical Agreement, IVECO reserves the right to visit the Bodybuilder in order to ensure they are qualified to perform the outfitting/conversion requested by the agreement.

The contents of the Technical Agreement can be evaluated in detail upon request to the person responsible for relations with Bodybuilders in the relevant market.

## **I.8 Guarantees**

A guarantee that work has been performed to required standards must be given by the Bodybuilder who realised the superstructure or modifications to the chassis, in full respect of the requirements listed in these Directives.

IVECO reserves the right to declare void its own warranties for the vehicles where:

- unauthorised outfitting or conversions have been performed;
- an unsuitable frame has been used for the required conversion or application;
- the regulations, specifications and instructions which IVECO provides for work to be performed correctly have not been respected;
- original spare parts or components made available by IVECO for specific operations have not been used;
- safety requirements are not respected;
- the vehicle is used for any other purpose than that for which it was designed.

## **I.9 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 regulations on product responsibility, but also to ever increasing quality requirements, new organizational forms in the various sectors and the never-ending drive for greater efficiency.

IVECO therefore consider that Bodybuilders should have:

- organization charts for functions and responsibilities;
- quality objectives and indicators;
- technical design documentation;
- process documentation, including testing;
- product improvement plan, obtained also with corrective actions;
- after sales service;
- staff training;

ISO 9001 certification, while not obligatory, is considered by IVECO to be extremely important.

## 1.10 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.



**Structures and devices applied to the vehicles must conform to current requirements for accident prevention and safety regulations in each Country where the vehicles are to be used.**

All technical precautions must also be taken to avoid functional faults and defects.  
Compliance with these regulations will be the responsibility of the manufacturers of the structures and devices.



**Seats, upholstery, seals, protective panels etc. can represent a potential fire hazard if exposed to an intense heat source.**

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

## 1.11 Choice of material to use: Ecology - Recycling

The choice of materials to be used must be carefully considered in the study and design phase also from an ecological and recycling point of view.

In this regard, the following should be kept in mind:

- the use of materials which are damaging to health, or in any case potentially hazardous is forbidden, for example those containing asbestos, lead, halogen additives, CFCs, cadmium, mercury, hexavalent chromium etc.;
- it is recommended to use materials which produce a limited quantity of waste when worked and which allow easy recycling after their first use;
- mutually compatible components should be used for composite synthetic materials, also providing for potential use with salvaged components. Arrange for markings required by current regulations;
- batteries contain substances which are very damaging to the environment. The Service Network can be contacted when replacing batteries they are equipped for correct disposal of old batteries in full compliance with the law.



**In order to comply with directive 2000/53 EC (ELVs), IVECO forbids installation of components containing lead, mercury, cadmium and hexavalent chromium; exceptions are made for the cases allowed for by Annex II of this directive.**

## **I.12 Vehicle management c/o Bodybuilder**

### **I.12.1 Acceptance of the chassis**

Bodybuilders receiving a chassis/vehicle from IVECO or a Dealer must perform a preliminary check, notifying them of any missing accessories or damage ascribable to the transporter.

### **I.12.2 Maintenance**

To keep the chassis/vehicle in full working order even when in the workshop for an extended period, maintenance operations set out for pre-established times may be necessary.

The expenses for performing these operations are borne by whoever owns the vehicle at that time (Bodybuilder, Dealer or Customer).



**If the vehicle is not to be used for an extended period, it is recommended to disconnect the battery's negative terminal in order to maintain optimum charge.**

### **I.12.3 Delivery of the vehicle to the final Customer**

Before delivering the vehicle, the Bodybuilder must:

- prepare your execution (vehicle and/or equipment) and check its functionality and safety;
- perform the checks laid out in the Pre-Delivery Inspection (PDI) list available from the IVECO network for the items regarding the work performed (obviously the other items in the ODI will remain the responsibility of the Dealer as per guarantee booklet);
- measure the voltage of the batteries using a digital multimeter (2 digit decimal), bearing in mind that:
  - a) the optimum value is 12.5 V,
  - b) between 12.1 V and 12.49 V, the battery must be trickle charged,
  - c) with values lower than 12.1 V the battery must be changed.

The batteries must be maintained at regular intervals (refer to IVECO Std 20-1812 and/or IVECO Std 20-1804) until delivery to the Customer/Dealer in order to avoid problems such as insufficient charge, short circuit or corrosion.

IVECO reserves the right to invalidate the battery guarantee if the required maintenance procedures are not respected.

- perform (in the case of vehicle conversion) an on-the-road functional test. IVECO Service must be notified of any defects or snags in order to check if there are valid conditions for insertion in the PDI expenses;
- prepare and deliver to the end Customer the necessary instructions for servicing and maintenance of the conversion and any additional components installed;
- record the new data on the plates provided;
- give confirmation that the jobs done correspond to the indications supplied by the vehicle Manufacturer and to the legal requirements;
- draft a warranty the regards the modifications introduced.



### I.13 Vehicles identification

The commercial designation of IVECO vehicles is not the same as the type approval (homologation) designation. Two types of commercial designation are shown below with the meaning of the codes used:

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

Class	Rear wheels	GVW (t)	Version
L	single	2.8 – 3.3	- Truck
S	single	3.5	D Crewcab 6+1
C	twin	3.5 – 7.0	V Van
			C Combi
			CV City Version
			SV Semi-Windowed Van
			CA Cab without rear wall
			CC Chassis
			CCS Lightened chassis
			A Automatic
			CNG CNG engine

Suspension
- mechanic
/P pneumatic

### I.14 Trademarks and logos

Factory branding, marks and names must not be altered or removed from their original positions, since the originality of the vehicle's image must be protected.

Application of branding for the conversion or outfitting must be authorised. If present, they may not be placed immediately next to IVECO branding.

IVECO reserves the right to withdraw branding and markings whenever the outfitting or transformation should bear characteristics which do not conform with those required; the Bodybuilder shall take full responsibility for the vehicle in this case.

#### Instruction for added assemblies

The Bodybuilder must provide necessary instructions for servicing and maintenance of additional installed components/assemblies upon delivery of the vehicle.

All units making up a single order must be equipped with components of the same brand, model and quality.

## **I.15 Dimensions and masses**

### **I.15.1 General specifications**

The vehicle dimensions and permitted weights on the axles are shown on the drawings, on the technical descriptions and more generally on the documents on the IVECO official website. The kerb weights refer to vehicles with standard equipment. Special equipment may involve considerable modification to the weight and its distribution on the axles.

#### **Weighing the chassis**

It must be remembered that variations in mass of  $\pm 5\%$  for 29L, 35S, 35C models and  $\pm 3\%$  for 40C to 70C models are possible. 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;
- position of the rear under run-bar.

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

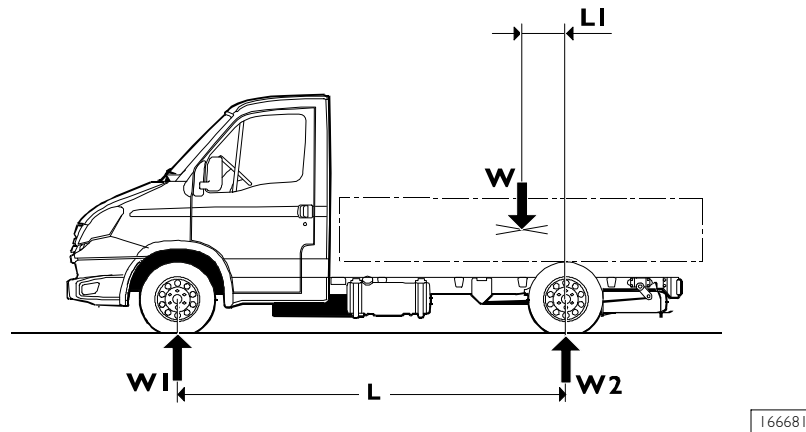
Positioning of lights and side mirrors is normally expected for widths up to 2350 mm.

### 1.15.2 Determining the centre of gravity of the body and payload

#### Positioning on the longitudinal plane

The examples given below may be used to determine the position of the superstructure's centre of gravity and the payload. The technical documentation specific to each model (chassis cab drawing) give the positions permitted with the vehicle in its standard form. The masses and positioning of the single components of the vehicle are given in the chassis and weight distribution diagram.

Figure 1.2



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

$W$  = Body + payload (kg)

$W_1$  = Reaction to portion of  $W$  bearing on front axle (kg)

$W_2$  = Reaction to portion of  $W$  bearing on rear axle centre line (kg)

$LI$  = 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 40C13 vehicle with a wheelbase of 3,450 mm with:

1. GWW = 4,200 kg (permitted maximum: 1,900 kg on the front and 3,100 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  $W = 4,200 - 1,955 = 2,245$  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 2,245 kg.  $W_1 = 1,900 - 1,340 = 560$  kg will affect the front axle, while the remaining  $W_2 = 2,245 - 560 = 1,685$  kg will affect the rear axle.

Thus, the following will be obtained:

1.  $W_1 = 560$  kg
  2.  $L = 3450$  mm
  3.  $W = 2245$  kg
- $L_1 = W_1 \times L / W = 860$  mm

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

In terms of the effects of dividing the payload on the axles, consider that it is evenly distributed, with the exception of cases where the shape of the loading bed would result in it being distributed differently.

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

When creating the superstructure or containers, loading and unloading systems for goods must be created which avoid excessive variations on the payload distribution and/or excessive loads on the axles, with instructions supplied for end users if necessary.

Figure I.3

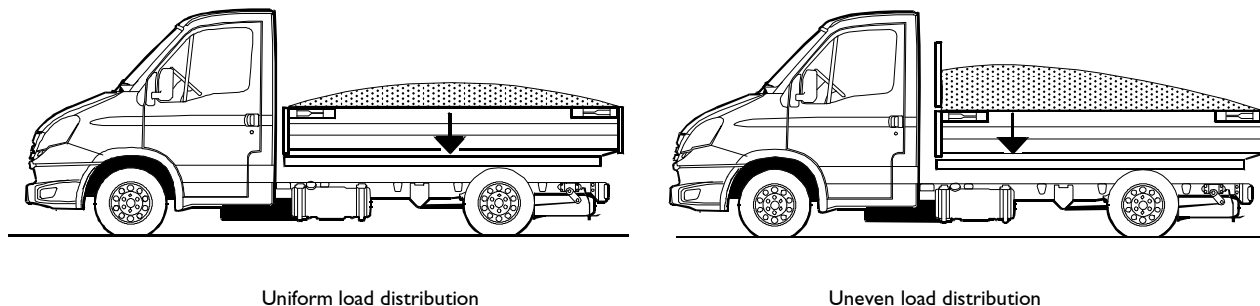
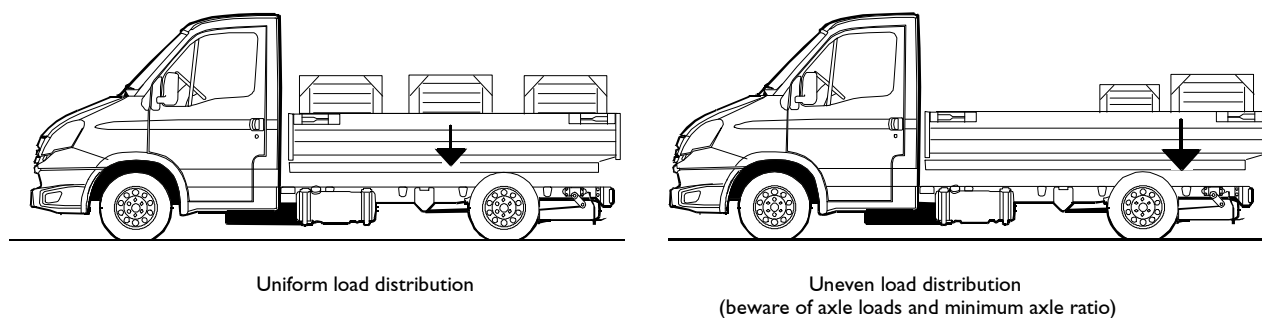


Figure I.4



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### Height of centre of gravity

For chassis cab and unladen vehicles, the height of the centre of gravity is given on the specific technical documentation for each model (chassis cab diagram).

When the vehicle is complete with a superstructure and fully laden, this height must comply with the maximum values permitted by national or international regulations, particularly ECE Directive 13 on longitudinal stability and ECE Directive 111 on transverse stability while in motion.

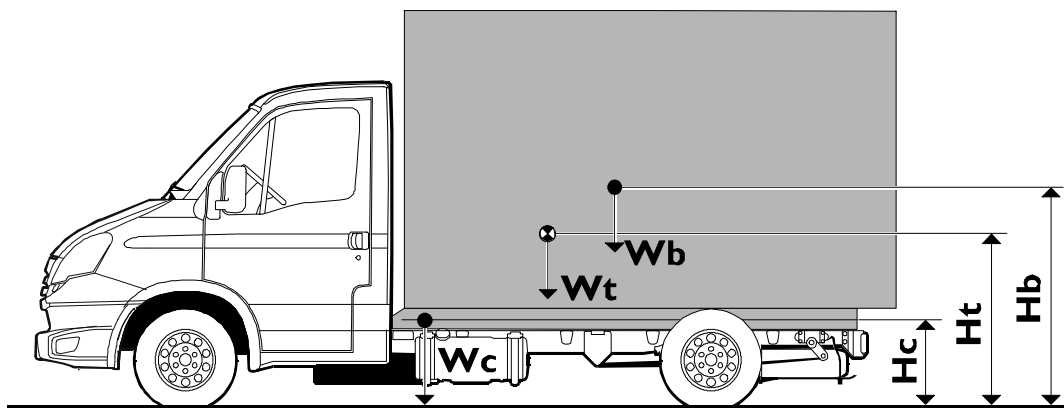
The following cases may arise:

- a) fixed loads
- b) mobile loads
- c) loads that involve high aerodynamic actions

a) Fixed loads:

Check when fully laden:

Figure I.5



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$$H_t = \frac{W_c \cdot H_c + W_b \cdot H_b}{W_c + W_b}$$

$$H_b = \frac{(W_c + W_b) \cdot H_t - W_c \cdot H_c}{W_b}$$

$W_c$  = Chassis cab vehicle kerb weight

$H_c$  = Height of centre of gravity of chassis cab vehicle (laden condition)

$W_b$  = Body and payload

$H_b$  = Height of centre of gravity of body and payload in relation to ground

$W_t$  = Vehicle weight when fully loaded

$H_t$  = 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  $W_b$  use only the vehicle unladen weight (The position for  $H_c$  will depend on the load and deflection of the suspension).

The following table shows the maximum approximate heights indicating the overall centre of mass (payload + body and/or equipment), with reference to the vehicle's transverse stability.

Table I.1

Models	Centre of mass height (mm)
29L	1400
35S	1500
35C (front transverse leaf spring)	1800
35C (front longitudinal bar) - 40C	1900
45C - 50C	1950
60C - 65C - 70C	2050

b) Mobile loads

In specifications where the load may move laterally when cornering (e.g. suspended loads, liquid transport, animal transport, etc.), dynamic transverse forces may be generated that are high enough to affect vehicle stability.

With reference to regulation ECE 111, particular attention must therefore be paid:

- to defining the height of the centre of gravity of a converted vehicle that is fully laden;
- to evaluating dynamic thrust and lateral movement of the centre of gravity;
- in considering (for liquids) the density;
- to recommending due caution in driving behaviour.

Any cases that are difficult to assess must be submitted to IVECO for approval.

c) Loads that involve high aerodynamic actions

To conversions characterised by large height and surface area (e.g.: vehicles with large advertising panels); the height of the centre of thrust determined by high winds must be calculated very carefully.



**Even with a low centre of gravity, a converted vehicle presenting a high side area may not guarantee sufficient transverse stability and may be exposed to the danger of rolling over.**

Particular attention must therefore be paid;

- to defining the height of the centre of gravity of a converted vehicle that is fully laden;
- to evaluating aerodynamic thrust;
- to recommending due caution in driving behaviour.

Any cases that are difficult to assess must be submitted to IVECO for approval.

### Using stabiliser bars

The application of supplementary or reinforced stabiliser bars, spring reinforcements or rubber parts (with respect to point 2.1.1) may allow higher values for the height of the payload CG, to be defined for each individual case.

Work must be carried out after careful evaluation of the characteristics of the conversion, the wheelbase and the division of transverse forces on the suspension, generally regarding both the front and the rear. Work on the front axle may be necessary with loads concentrated behind the cab (e.g. cranes) or with highly rigid superstructures (e.g.: van bodies).

### I.15.3 Observing the permitted weights

All limits given in IVECO documentation must be respected. 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.

Special attention must be paid to vehicles with loads concentrated on the rear protrusion (e.g. cranes, tail lift, trailers) and to vehicles with short wheelbase and high CG.

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**NOTE** Correct transverse division of loads must be ensured when positioning auxiliary units and the superstructure. A variation of  $\pm 4\%$  of nominal load is permitted for each wheel (50% of the corresponding axle load, e.g.: permitted load on axle 3000 kg, 1440 to 1560 kg load permitted for each wheel) respecting what is permitted by the tyres, without compromising the vehicle's braking characteristics and stability.

Unless specifically stated otherwise for individual vehicles, the weight on the front axle must be considered to have a minimum value of 28% of the actual weight of the vehicle (whether with uniformly distributed loads or with loads concentrated on the rear overhang or derived from a possible trailer).

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#### Variations in the permissible weight

Special dispensations for maximum allowable masses may be given for special uses; nevertheless, precise usage limitations and in some cases compulsory reinforcements to the vehicle have been established for these cases.

If these dispensations should exceed legal limits they must be Authorised by the Relevant Authorities.

When requesting authorisation, the following must be indicated:

- 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 of permissible vehicle weight (downrating) may require work on some components such as the suspension and brakes and may require new weight calibration for the braking corrector; in these cases the necessary indications can be supplied.

## **I.16 Instructions for correct operation of vehicle components and accessibility**

When converting vehicles or installing any type of equipment, no alterations must be made which would compromise correct operation of the vehicle assemblies and components in their various work conditions.

For example:

- free access must be guaranteed to points requiring inspection, maintenance or periodic checks (e.g. replacement of battery, access to air suspension compressor) and, with closed superstructures, appropriate compartments and hatches must be available;
- the possibility to remove the various assemblies for servicing must be maintained. Work on the transmission/clutch or adjustments (e.g. suspension bars) must be possible without removing important elements of the added structure;
- cooling (grille, radiator, air passages, cooling circuit etc.), fuel supply (position of pump, filters, tubing diameters etc.) and engine air intake must not be altered;
- soundproofing panels must not be altered or removed in order not to change the approved noise emission levels. Whenever openings are to be made (e.g. for the passage of longitudinal chassis members), they must be re-closed using materials with fire- and sound-proofing characteristics equivalent to the original materials;
- adequate brake and battery case ventilation must be maintained (in particular for vans);
- when positioning mudguards and wheel arches, free movement of rear wheels must be guaranteed, also when used with snow chains;
- when the conversion is finished, the vehicle's headlights must be checked in order to ensure they are correctly adjusted. Proceed according to the indications given in the use and maintenance manual for adjustment;
- the Bodybuilder must carefully choose the positioning of any loose elements (e.g. spare wheel, chocks) so as to ensure they are safely and accessibly positioned in full respect of any national regulations.

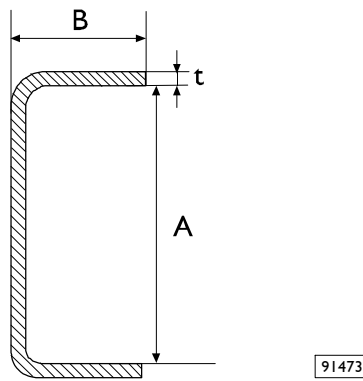


## I.17 Conventions

The following conventions are used in this document:

- **Wheelbase:** distance between the centre line of the steering axle and that of the rear axle.  
This definition differs from the definition of wheelbase indicated in EC Directives.
- **Rear overhang:** distance between the centre line of the rear axle and the rearmost point of the chassis side members.
- **Dimensions A, B and t of the chassis section:** see the figure.

Figure I.6





## SECTION 2

**Chassis modifications**

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## 2.1 General standards regarding changes to the chassis

Keep the following in mind:

- **welding is absolutely prohibited on the load bearing structures of the chassis** (with the exception of what is specified in paragraphs 2.2.3, 2.4, and 2.5);
- **drilling is not permitted on the side member wings** (with the exception of what is specified in paragraphs 2.2.3, 3.1.1 and 3.1.4.3);
- if it is permitted to make changes to the connections implemented with rivets, they may be replaced with flanged head screws and nuts or with class 8.8 hexagonal head screws with the next highest diameter and nuts with loosening prevention systems. Screws larger than M12 must not be used (maximum hole diameter 13 mm), unless otherwise specified;
- if connections are restored that use screws, it is mandatory to check the suitability of the screws before reusing them and to tighten them to a suitable torque;



**If safety components are reassembled, it is prohibited to reuse already used screws and it is mandatory to tighten to the specifically specified torque (contact the Service Network for information about the value).**

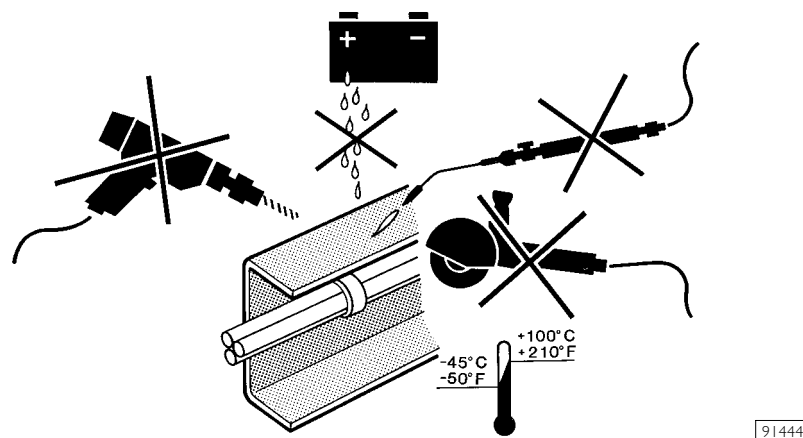
- if safety components are reassembled and when rivets are replaced with screws, the closure of the connection must be rechecked after driving approx. 500 - 1000 km.

### 2.1.1 Particular precautions



**During welding, drilling, grinding and cutting operations near brake pipes or electric cables, take suitable precautions to protect them, disassembling them if necessary (follow the instructions provided in chapters 2.15 and 5.4).**

Figure 2.1



### Precautions for the alternator and the electric/electronic components

In order to prevent damage to the rectifier with diodes, the batteries must never be disconnected (and the disconnecting switch must not be opened) while the engine is running.

If the vehicle must be started by means of towing (which is strongly advised against), make sure that the battery is charged and connected in order to provide the ECU engine control unit with the minimum operating voltage.

If the battery must be charged, it must be disconnected from the vehicle circuit. If the engine must be started using external charging devices, do not use the "start" function (if the equipment has this function) in order to prevent peaks of current that could damage the electric and electronic components.

The start-up must only be carried out using an external battery carriage, being careful to respect the polarity.

### Ground connections

In general, the vehicle's original ground connections must not be changed. If it is necessary to move these connections or create additional ground points, use the holes already existing in the chassis if possible, being careful to:

- remove mechanically, through filing and/or with a suitable chemical product, the paint from both the chassis and terminal sides, creating a contact surface that is smooth and even;
- apply suitable paint with high electric conductivity between the terminal and the metal surface (e.g. zinc based paint Part number IVECO 459622 from the company PPG);
- connect the ground within 5 minutes of applying the paint.

For signal level ground connections (e.g.: low absorption sensors or devices), do not use the standardised IVECO points "m1" (on the engine block, near the starter motor) or "m2" and make the ground connections of the signal cables on points separate from the power cables and cables used as radiofrequency shields.

For electronic equipment, avoid making ground connections between devices in a linked manner, foreseeing individually wired ground connections, optimising the length (prefer a shorter path).

### Braking and electrical system

For more information about the braking and electrical systems, see chapters 2.15 and 5.4.

#### 2.1.2 Characteristics of the material to be used when modifying the chassis

When making changes to the vehicle chassis (all models and all wheelbases) and when applying reinforcements directly on the side members, the material to be used must comply with what was used originally for the chassis with regard to quality (Table 2.1) and thickness (Table 2.2).

If it is not possible to find material that has the indicated thickness, material may be used with the next highest standard thickness.

Table 2.1 - Material to be used when making changes to the Standard IVECO chassis I5-2110 and I5-2812

Steel name		Ultimate tensile strength (N/mm <sup>2</sup> )	Yield strength (N/mm <sup>2</sup> )	Elongation (%)
IVECO	FEE420	530	420	23
Europe	S420MC			
Germany	S420MC			
UK	S420MC			

N.B. For 70C vehicles only, the material must be FEE490 with:

- Ultimate tensile strength 610 N/mm<sup>2</sup>
- Yield strength 490 N/mm<sup>2</sup>
- Elongation 19%



Table 2.2 - Section dimension and thickness of the chassis

Class	Type	Wheelbase [mm]	Chassis rear overhang [mm]	A x B x t section wheelbase area side member [mm]	A x B x t section rear overhang area side member [mm]
29L - 35S	truck	3000	920	144 X 56 X 3	94 X 56 X 3
		3450	1355		
		3750	1665		
		3950 (camper)	1825		
	van	3000 short overhang	840		
		3000 long overhang	1240		
		3300	1460		
		3950	1825		
35C	lightened camper	3750	1665	144 X 56 X 3	94 X 56 X 3
		3950	1825		
35C-50C	truck	3000 (1)	1240	174 X 70 X 4	114 X 70 X 4
		3450	1355		
		3750	1665		
		4100 (1)	1715		
		4350	1885		
		4750 (2)	2350		
35C - 40C	van	3000 short overhang	840	174 X 69 X 3	114 X 69 X 3
		3000 long overhang	1240		
		3300	1460		
		3950	1825		
45C - 50C	van	3000 short overhang	840	174 X 70 X 4	114 X 70 X 4
		3000 long overhang	1240		
		3300	1460		
		3950	1825		
60C - 65C - 70C	truck	3450	1355	174 X 69 X 5	174 X 69 X 5
		3750	1665		
		4350	1890		
		4750	2350		
	van	3950	1825		

(1) = only 35C - 40C

(2) = only 45C - 50C

### 2.1.3 Stress on the chassis

In no case it is allowed to exceed the following stress values under static conditions:

Table 2.3

Range	Static stress permitted on the chassis $\sigma$ amm (N/mm <sup>2</sup> )	
	Road use	Off-road use
Daily	120	80

In any case, comply with the most restrictive limits defined by national regulations.

Welding operations cause a deterioration of the material characteristics, therefore, when checking the stress in the thermally altered area, consider a reduction of approx. 15% of the resistance characteristics.

## 2.2 Drills on the chassis

When it is necessary to fit auxiliary parts or assemblies to the chassis, the existing holes made in the factory should be used if possible.



**Drilling the flanges of the vehicle side members is strictly prohibited, with the exception of what is indicated in paragraph 3.3.1.**

In special cases (application of brackets, angle irons, etc.) where new holes have to be drilled, these holes shall be made on the vertical rib of the side member and shall be accurately burred and bored.

### 2.2.1 Hole positioning and dimensions

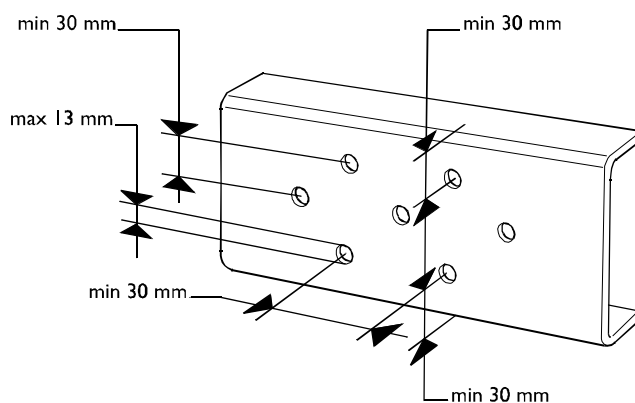
The new holes shall not be drilled in the areas subjected to greater stress (e.g. spring supports) and areas where the side member section changes.

The diameter of the holes should be suitable for the thickness of the panel and must not exceed 13 mm (unless otherwise specified). The distance of the hole axis from the edges of the side member must not be less than 30 mm, and the axes of the holes must not be between them, or less than 30 mm with respect to the existing ones.

The holes must be offset, as shown in the Figure 2.2.

The original drilling diagrams must be followed when moving spring supports or cross members.

Figure 2.2



102420

### 2.2.2 Screws and nuts

In general, it is recommended to make connections of the the same type and class as those foreseen for similar fastenings on the original vehicle (Table 2.4).

Screws of class **8.8** and **10.9** must be hardened and tempered and, for applications with diameter  $\leq 6$  mm, it is recommended to use stainless steel parts.

The foreseen coatings are Geomet and galvanisation. If the screws are subjected to welding, the Geomet coating is not recommended.

If space permits, use screws and nuts with a flanged head.

Use nuts with loosening prevention systems and remember that the tightening torque must be applied to the nut.

Table 2.4 - Screw resistance classes

Resistance class	Use	Ultimate tensile strength (N/mm <sup>2</sup> )	Yield strength (N/mm <sup>2</sup> )
<b>4.8</b>	Non-load bearing screws	400	320
<b>5.8</b>	Low resistance screws	500	400
<b>8.8</b>	Medium resistance screws (cross members, cut resistance plates, brackets)	800	640
<b>10.9</b>	High resistance screws (spring mounts, stabilizer bars and shock absorbers)	1000	900

### 2.2.3 Welds

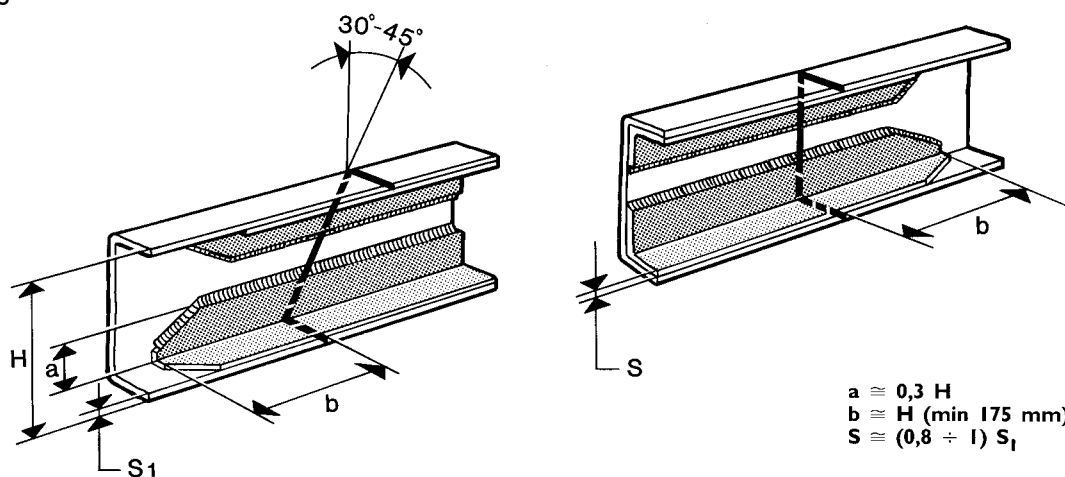


**The welds must only be made by qualified personnel with suitable equipment, and always to professional standards (see standard EN 287). Any operation performed that does not comply with the instructions provided by IVECO could seriously damage the on-board systems, jeopardise vehicle safety and cause damage not covered by the warranty.**

Welds are permitted:

- in side member joints, when lengthening and shortening;
- when applying angular reinforcements in the area involved with the side member modification, as specified below (see Figure 2.3).

Figure 2.3



91448

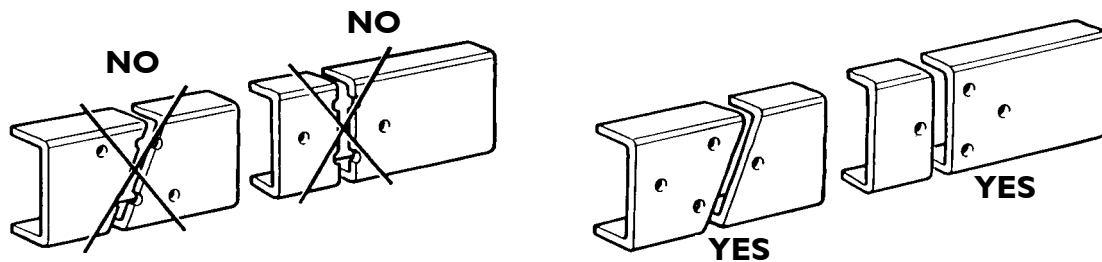
In the event of electrical arc welding, observe the following instructions to protect the electric components and electronic control units:

- before disconnecting the power cables ensure there are no active electric users;
- if an electric circuit breaker (main switch) is present, wait for it to complete the cycle;
- disconnect the battery negative pole;
- disconnect the positive battery pole without grounding it, and DO NOT short circuit it with the negative pole;
- disconnect the connectors from electronic control units and proceed carefully, avoiding touching the pins of control unit connectors;
- if welds are to be made near an electronic control unit, disconnect the control unit from the vehicle;
- connect the welding machine ground directly to the piece to be welded;
- protect the plastic pipes from heat sources, removing them if necessary;
- when welding near leaf springs or air springs, protect their surfaces appropriately from welding sprays;
- avoid touching the spring leaves with the electrodes or pliers.

### Welding procedures

- a) Carefully remove any paint and traces of oxidation from the parts of the chassis involved with the welding as well as those that must be covered with reinforcements.
- b) Cut the side members with a slanted or vertical cut. The side members must not be cut at the points where the chassis contour and width changes or where stress is greater (e.g. spring mounts). The separation line must not involve the holes on the side member (see Figure 2.4).

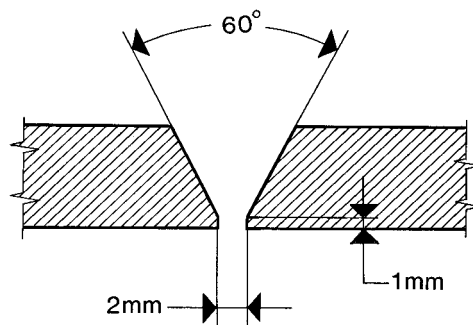
Figure 2.4



91446

- c) Make a 60° V shaped chamfer on the parts to join on the inner side of the side member along the entire length of the area to be welded (see Figure 2.5).

Figure 2.5



91447

- d) Perform arc welding with several passes using carefully dried basic electrodes. Avoid current overload; the weld must be free from marginal cuts and waste material.
- e) Repeat in the other direction and make the weld as specified in point d).
- f) Allow the side members to cool slowly and uniformly. They must not be cooled using an air jet, water or another method.
- g) Grind off the excess material.
- h) Apply angular steel reinforcements on the inside, with the same specifications as the steel used in the chassis. The approximate minimum dimensions are specified in Figure 2.3.  
The reinforcements may only be secured on the vertical rib of the side member and may be implemented with welding beads, false spots, screws or rivets (also Huck rivets).  
The welding bead section and length, as well as the number and arrangement of false spots, screws or rivets, must be suitable to transmit the bending and cutting moments of the section.
- i) When the work is completed, protect with rust proofing (see paragraph 2.3.2).

### 2.2.4 Closing holes by welding

When making new holes, and if they are too close to already existing holes (see Figure 2.2), the latter can be closed by welding them.

To ensure that this operation will be successful:

- smooth the external edge of the hole;
- apply a strip of copper inside the side member to retain the weld material;
- perform the welding on both sides of the side member and remove the residues.

In order to close holes with a diameter greater than 20 mm, rounded washers can also be used, welding on both sides.

## 2.3 Rust protection and paint

**NOTE** All components assembled on the chassis must be painted according to IVECO Standard I8-I600 colour IC444 RAL 702I 70/80 gloss.

### 2.3.1 Original vehicle components

Table 2.5 shows the protection and painting classes required for the original vehicle components; Table 2.6 shows the classes for non painted or aluminium parts and Table 2.7 shows the parts for the painted classes.

Table 2.5 - Class of protection - IVECO Standard I8 - I600 (Table I)

Class	Part requirements	Examples of involved parts
A	Parts in direct contact with atmospheric agents.	Body - Rear-view mirrors - Windscreen wipers - Sun visor metal structure - Metal bumper - Cab hook-up lock - Door stop device - Body fixing elements (screws, bolts, nuts, washers), etc.
B B2	Parts in direct contact with atmospheric agents with mainly structural characteristics, in direct view.	Chassis and relative parts, including fastening elements. Parts under the grille (class B). Running boards outside the cab.
B1		Only for rear and front axles
C	Parts in direct contact with atmospheric agents, not in direct view.	Engine and relative parts
D	Parts not in direct contact with atmospheric agents.	Pedal assemblies - Seat frames - Fastening elements - etc., installed inside the cab.

**NOTE** The parts must be supplied only with cataphoresis or a rust inhibitor (Table III). The enamel will be applied during the chassis finishing phase.

Table 2.6 - Various unpainted, aluminium parts and components - IVECO Standard I8 - I600 (Table IV)

Type of protection		IVECO standard	Classes					
			A	B - B1 - B2	C	D		
Stainless steel <sup>[1]</sup>		18-0506	yes	-	-	-		
Geomet (■■■)	GEO 321-8	18-1101	yes	-	-	-		
	GEO 500-8							
	GEO 321-8 PM							
	GEO 321-8 PML							
	GEO 321-8 PL							
	GEO 500-8 PL							
	GEO 321-5		-	yes			-	-
	GEO 500-5							
	GEO 321-5 PM							
	GEO 321-5 PML			yes Class B1 wheel studs				
	GEO 321-5 PL							
	GEO 500-5 PL							
Galvanisation (■■)	FE/ZN 12 II	18-1102	-	-	yes	yes		
	FE/ZN 7 IV		-	-	yes	yes		
	FE/ZN 12 IV							
	FE/ZN 7 IV LUB		-	yes	yes	yes		
	FE/ZN 7 IV S							
	FE/ZN 12 IV S							
Aluminium	Anodic oxidation	18-1148	yes	yes	yes	yes		
	Painting	See Table III	yes					

<sup>[1]</sup> Coupling with other metal materials must not cause a "pile effect".

(■■) Coatings free of hexavalent chromium.

(■■■) Coatings free of chromium salts.



Table 2.7 - Painted parts - IVECO Standard I8 - I600 (Table III)

Cycle phase description		Classes					
		A	B [8]	BI [5]	B2	C	D
MECHANICAL SURFACE CLEANING[1]	Sandblasting/shotblasting	-	yes ★	-	yes ★	yes ★	yes ★
	Brushing	yes ★					
	Sanding						
PRETREATMENT	Iron phosphating (only for ferrous materials that are not previously coated)	-	yes ★	-	yes ★	yes ★	yes ★
	Zinc phosphating ☆	yes					
CATAPHORESIS	High thickness (30-40 μm)	yes [2]	yes ★ [6]	-	yes ★ [6]	yes ★ [9] [6]	yes ★ [6]
	Medium thickness (20-30 μm)	yes [3]			-		
	Finishing acrylic (>35 μm)	-					
RUST PROOFING	Bi-component (30-40 μm)	-	yes	-	yes	yes ★ [9]	yes ★
	Single-component (30-40 μm)		-	yes	-		
STONE RESISTANT BOTTOM	Single (130 °C) or bi-component (30-40 μm)	yes [3]	-	-	-	-	-
ENAMEL	Single (130 °C) or bi-component (30-40 μm)	yes	yes ★	-	-	yes ★	yes ★ [7]
	Powders (40-110 μm)	yes [4]					
	Single-component at low temperature (30-40 μm)	-	-	yes			

[1] = Operation to be performed if there are shearing burrs, oxidation, welding scraps, laser cut surfaces.

[2] = Two-layer body cycle.

[3] = Three-layer body cycle.

[4] = As an alternative to single or bi-component enamel only for body parts (windscreen wipers, rear-view mirrors, etc.).

[5] = Rear and front axles only.

[6] = Exclusions of parts that cannot be immersed in pretreatment or paint baths as their functionality could be jeopardised (e.g.: mechanical parts).

[7] = Only if the colour is defined on the drawing according to I.C.

[8] = For fuel tanks in ferrous or precoated plate.

[9] = Only parts to be installed on the engine.

☆ = For galvanised plate or aluminium, specific phosphates must be used.

★ = Alternative products and cycles for the same phase, providing they are compatible with the parts to be treated.

### 2.3.2 Added or modified parts

All the vehicle parts (body, chassis, equipment, etc.) that are added or that are changed must be protected against oxidation and corrosion.

Areas without protection are not accepted on ferrous materials.

Tables 2.8 and 2.9 indicate the minimum treatments to which the modified or added components must be subjected when it is not possible to protect them using the same protection used for the original components. Different treatments are permitted providing that the same oxidation and corrosion protection is guaranteed.

Do not use powder enamels directly after degreasing.

Parts in light alloy, brass and copper are not protected.

Table 2.8 - Added or modified painted parts

Cycle phase description	Class
	A - B - D (1)
Mechanical surface cleaning (including the removal of burrs/oxidation and cleaning cut parts)	Brushing/sanding/sandblasting
Pretreatment	Degreasing
Rust proofing	Bi-component (30-40 µm) (2)
Enamel	Bi-component (30-40 µm) (3)

(1) = Changes on rear axles, front axles and engine (classes B1 and C) not permitted

(2) = Preferably epoxy

(3) = Preferably polyurethane.

Table 2.9 - Added or modified unpainted or aluminium parts

Type of protection	Class	
	A - B (1)	D
Stainless steel	yes	-
Geomet		-
Galvanising (1)	-	yes

(1) = Free of hexavalent chromium.

### 2.3.3 Precautions

#### a) On the vehicle

Suitable precautions must be taken to protect the parts for which paint may be harmful for conservation and operation:

- rubber or plastic flexible pipes for pneumatic and hydraulic systems;
- gaskets, parts in rubber or plastic;
- propeller shaft and power take-off flanges;
- radiators;
- shock absorber, hydraulic or pneumatic cylinder stems;
- air bleeder valves (mechanical units, air tanks, thermostarter preheating tanks, etc.);
- fuel sediment filter;
- plates, acronyms.

If painting is necessary after disassembling the wheels, proceed as follows:

- protect the wheel rim contact surfaces on the hubs and the stud/fixing nut contact areas;
- ensure suitable protection for the brake discs.

Electronic components and modules must be removed.

#### b) Engines and their electrical and electronic components

Suitable precautions must be taken to protect:

- engine and vehicle wiring, including ground contacts;
- sensor/actuator side and wiring side connectors;
- sensors/actuators on the flywheel, on the flywheel rev sensor support bracket;
- the plastic and metal pipes in the entire diesel circuit;
- the complete diesel filter base;
- the electronic control unit and its base;
- the entire inner part of the soundproofing cover (injectors, rail, pipes);
- the common rail pump with regulator;
- the vehicle's electrical pump;
- the tank;
- the front belt coil and relative pulleys;
- the power steering pump and relative pipes.



**When the painting operation is complete and before drying in the oven (max. temperature 80 °C), all the parts that may be harmed by exposure to heat must be removed or protected.**

## 2.4 Modification of the wheelbase

### 2.4.1 General information



**Any change to the wheelbase that involves the electrical circuits and/or the relocation of the electrical/electronic components requires approval and must be performed in compliance with the instructions in chapter 5.4.**

In general, the wheelbase must be changed by working on a standard production wheelbase that is as close as possible to the one to be created.

If permitted by the dimension of the superstructure, it is preferable to create wheelbases that are equal to those foreseen by normal production, as this makes it possible to use original propeller shafts and predefined cross member positions.

Please note that if you want to create a size that is smaller than the approved minimum or greater than the approved maximum, authorisation must be requested from IVECO.



**For vehicles equipped with an ESP system, see paragraph 2.15.3.**

### 2.4.2 Authorisation

The wheelbase may be changed without specific IVECO approval only when:

- implementing one of the lengths foreseen in the catalogue for the type of vehicle to be transformed;
- replicating the structure (side member section; number, type and positions of the cross members), the circuits and systems on the standard chassis corresponding to this length.

If both these conditions do not exist simultaneously, with which the diagram of the transformed chassis is identical to the diagram of an original chassis, the change must be submitted for approval.

The workshop that makes the transformation must provide sufficient guarantees from a technological and control point of view (qualified personnel, suitable operating processes, etc.).

The work must be carried out in compliance with these directives, in accordance with suitable regulations and adaptations, as well as proper precautions (e.g. check the need to reset the control unit parameters, positioning of the exhaust pipe, compliance with the minimum tare on the rear axle, etc.) foreseen for corresponding original wheelbases.

### 2.4.3 Influence on steering

In general, lengthening the wheelbase has a negative influence on steering characteristics.

When required by regulations, do not exceed the limits required for the swing-out radius, the forces on the steering wheel and the relative inscribability times (e.g. ECE Regulation or EC Directive in force).

Table 2.10 specifies the maximum wheelbase lengthening values possible with standard steering, the maximum load permitted on the front axle and the required tyres for the vehicle.

If longer wheelbases are necessary, specific approval must be requested and measures must be adopted to improve steering, such as the reduction of the maximum load on the front axle or the creation of an offset with lower values.

Also the use of a supplementary pump must be authorised, whereas for the subsequent installation, a specialised company must be used.

Table 2.10 - Maximum permitted wheelbase elongation

Model	Front suspension	Maximum wheelbase (mm)
29L, 35S	Transverse	4100
35C, 40C, 45C, 50C	Transverse (maximum permitted 1800 kg)	4100
35C, 40C, 45C, 50C	Torsion bar (maximum permitted 1900 kg)	4750
60C, 65C, 70C	Torsion bar	4750

#### 2.4.4 Influence on braking

In general, shortening the wheelbase has a negative influence on braking characteristics.

Table 2.11 shows the limits for wheelbase modification. Check with the IVECO - Homologation & Technical Application department about the conditions (brake cylinders, minimum tares, technically permissible weights, tyres, height of the centre of gravity) with which these values are permitted.

Table 2.11 - Braking, limits for wheelbase modification

Model	Version	Wheelbase	
		Minimum (mm)	Maximum (mm)
29L, 35S	Truck, van	3000	3950
35C, 40C	Truck, van	3000	4100
45C, 50C	Van	3000	4750
45C, 50C	Truck	3450	4750
60C, 65C, 70C	Truck, van	3300	4750



**In the case of vehicles equipped with an ASR system, the setting data must be updated.**

#### 2.4.5 Procedure

To obtain a good result, proceed as follows:

- position the vehicle so that the chassis is perfectly flat, using suitable stands;
- disconnect the propeller shafts, the brake system pipes, wiring and anything else that could prevent the work from being performed correctly;
- identify the reference points on the chassis (e.g. pilot holes, suspension mounts);
- mark the reference points with a light punching line on the upper wings of both side members, after checking that the connecting one is perfectly perpendicular to the vehicle's longitudinal axis;
- if moving the suspension mounts, identify the new position using the previously determined references;
- check that the new dimensions are identical on the left and right sides; the diagonal check, for minimum lengths of 1500 mm, must not detect deviations greater than 2 mm;
- make the new drill holes using the mounts and cross member plates as a mask if other equipment is not available;
- fasten the mounts and the cross members using rivets or screws; if screws are used, ream the holes and use calibrated screws, class 10.9, with nuts with loosening prevention systems; if their dimensions permit it, flanged head screws and nuts can be used;
- if cutting the chassis (to be carried out according to the instructions on page 2-11, point b) determine a second line of reference points so that the area to be worked on is contained between these and the previous ones (ensure a minimum distance of 1500 mm after the operation is complete). Move the points relative to the cutting area inside the two lines of reference, proceeding according to the instructions in paragraph 2.2.3;

- before welding check that the side members, including any part that was added, are perfectly aligned and then perform the control measurement on the two sides and diagonally, as previously indicated.
- Apply the reinforcements according to the instructions in paragraph 2.2.3.

### Additional information

- Protect the surfaces from oxidation as specified in paragraph 2.3.2.
- Restore the braking and electrical systems according to what is specified in chapters 2.15 and 5.4.
- For operations on the transmission, follow the instructions in chapter 2.8.

## 2.4.6 Checking chassis stress

When lengthening the wheelbase, in addition to providing local reinforcement in corresponding of the side member joint, the fitter must also foresee reinforcements in order to create, for the entire wheelbase length, resistance modules of a section no less than what is foreseen by IVECO for the same wheelbase or the next highest one. Alternatively, if permitted by local regulations, larger sized sections of the sub-frame may be adopted.

The fitter must check that the stress limits required by national regulations are observed. The stress may not exceed the stress on the chassis in the original wheelbase, in the case of a uniformly distributed load and with the chassis considered as a beam placed in correspondence of the suspension mounts.

If elongation is done starting from a longer original wheelbase, the reinforcements must be provided in function of not only the amount of elongation but also of the type of bodywork that is created and the vehicle use.

## 2.4.7 Cross members

The need to use one or more cross members depends on:

- the amount of the elongation;
- the position of the transmission support;
- the welding area;
- the point of application of the forces coming from the superstructures;
- conditions of vehicle use.

If there is a supplementary cross member, it must have the same characteristics of the ones already on the chassis (resistance to bending and torsion, material quality, connections to side members, etc.).

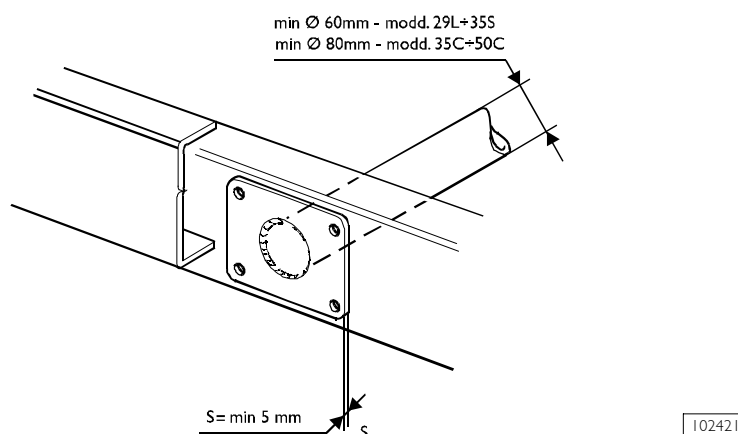
Figure 2.6 shows an implementation example.

An additional cross member must be provided for extensions greater than 600 mm.

In general, the distance between the two cross members must not exceed 1000 ÷ 1200 mm.

The minimum distance between two cross members, particularly for "heavy duty use" must not be less than 600 mm; this limitation excludes the "light" cross member for transmission and shock absorber support.

Figure 2.6



### 2.4.8 Chassis reinforcements

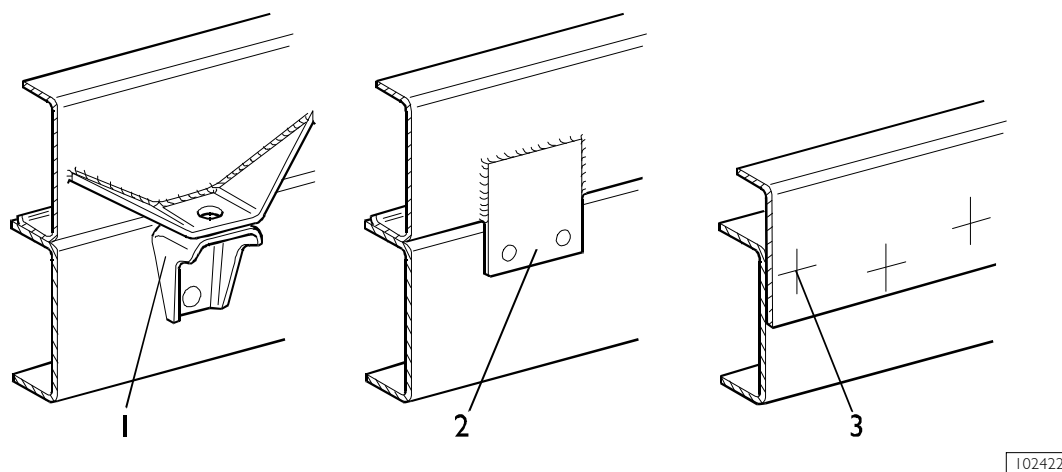
Figure 2.7 shows some examples of solutions that can be implemented.

The reinforcements must be continuous and must involve the entire length of the vehicle chassis to the cab. For their connection to the side member, in the case of an angular section, rivets or screws with a resistance class of 8.8 must be used; the diameter and distribution must make it possible for the section to provide the foreseen contribution to resistance.

In the rear overhang area, and for about half of the wheelbase (in any case no less than 2 m from the front axle) it is recommended to make a shear-resistant connection.

Bending stresses must be foreseen on the transformed chassis that are no greater than those on the chassis of the original vehicle, in the corresponding sections.

Figure 2.7



1. Bracket - 2. Plate - 3. Screws or rivets

To prevent consequences on the resistance of the original sections, it is not permitted to apply reinforcement plates directly on the wings of the side members using holes filled with welding.

Alternatives may be authorised by IVECO only when demonstrated requirements exist, connected to the subsequent phase of installing the superstructure.

In these cases, due to the deterioration caused by welding, it is a good idea to consider a reduction in material characteristics of approx. 15%.

When sizing the reinforcements use the material suggested in Table 2.1 and the static stress values on the chassis specified in Table 2.3 may not be exceeded.

In any case, comply with the most restrictive limits defined by national regulations.

### 2.4.9 Changes to the transmissions

To check the permitted changes, refer to chapter 2.8.

## 2.5 Change of the rear overhang

### 2.5.1 General information

When changing the rear overhang, keep in mind the impact this has on the effects of the distribution of useful load on the axles, with respect to the loads specified by IVECO (see chapter 1.15). It is necessary to comply with the limits specified by national regulations as well as the maximum distances from the rear structure edge and the heights off the ground, defined for the towing hook and the under-run protection. The distance from the chassis end to the rear edge of the superstructure must not normally exceed  $350 + 400$  mm.

If it is necessary to move the rear cross member fixed with screws, it is necessary to maintain the same type of standard connection (number of screws, dimensions, resistance class).

If a towing hook is to be applied, sufficient distance (approx. 350 mm) must be left between the rear cross member and the nearest one for possible hook assembly and disassembly operations.

If the work is done up to professional standards and in accordance with the instructions provided here, the originally defined towable weight can remain unvaried.

The party who carries out the work is responsible for it.

### 2.5.2 Authorisation

The rear elongations of the chassis as well as shortening to a value shorter than what is foreseen standard for each model, if implemented according to the instructions provided here, do not need to be specifically authorised.

For vehicles intended for special use, where load distribution is predefined and fixed, the rear overhang can be lengthened with values greater than 60% of the wheelbase, providing that they comply with the conditions set forth in Paragraph 1.15.3, Directive EEC 97/27 and the relative national implementations with regard to the swing-out radius.

### 2.5.3 Shortening

When shortening the rear overhang of the chassis, the last cross member must be moved forward.

When the rear cross member results as being located too near to an existing one, the latter can be removed if it is not involved with the suspension mounts.



**For vehicles equipped with an ESP system, see paragraph 2.15.3.**

### 2.5.4 Elongation

The possible solutions, based on the amount of elongation, are shown in Figures 2.8, 2.9 and 2.10.

Also a straight cut is permitted for the chassis. The minimum dimensions of the reinforcements to be applied to the area involved with the change, are specified in Figure 2.3.

Figures 2.8 and 2.9 show the solution foreseen for elongations that do not exceed  $300 + 350$  mm; in this case the reinforcement angle bars, which also provide a connection between the cross member and the chassis, must have the same thickness and width of the original connection plate. The connection between the cross member and plates, which was originally implemented using rivets, can be done using 8.8 class screws with the next highest diameter, and nuts with loosening prevention systems.



**For vehicles equipped with an ESP system, see paragraph 2.15.3.**



The solution foreseen for elongations greater than 350 mm is shown in Figure 2.10.

Figure 2.8

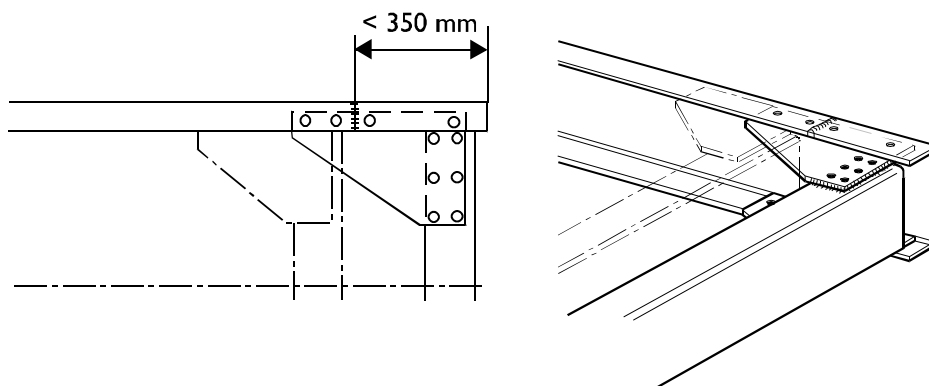


Figure 2.9

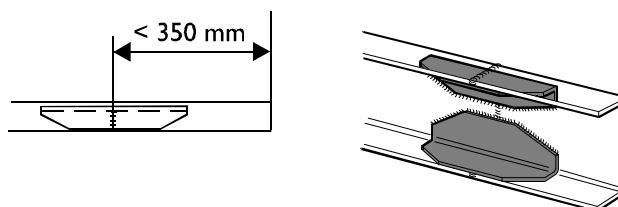
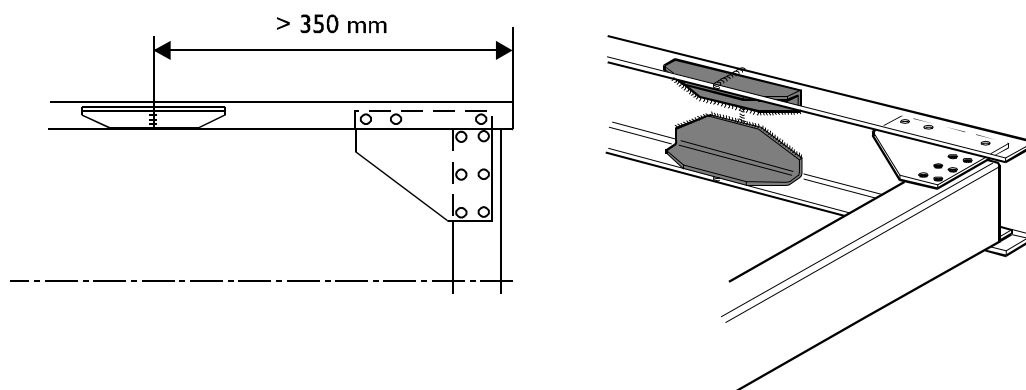


Figure 2.10



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If the amount of the elongation is considerable, it is necessary to assess on a case by case basis if a supplementary cross member is needed in order to ensure suitable torsional rigidity for the chassis. A supplementary cross member, with the standard characteristics, must be inserted when the distance between the two cross members is greater than 1200 mm.

## 2.6 Application of the towing hook

### 2.6.1 Adjusting the vehicle for towing

The transformation from a non-towing version to an approved towing version is permitted without the specific need for authorisation by IVECO.

A vehicle that is not originally setup for towing can be adjusted for this purpose by adding a specific "towing section", which means inserting the assembly of components that are indicated in the type-approval documentation of the towing version (chassis cross member, electrical coupling joint, towing hook, chronotachograph, etc...).

Please note that the assembly of the chronotachograph, based on current regulations, may only be performed by the IVECO service Network.

### 2.6.2 Precautions for installation

The towing hook must be suitable for the permitted loads and must be type-approved by national standards.



**Since it is an important element with regard to safety, the towing hook must not be modified.**

When fastening the hook to the cross member, it is necessary to comply with the requirements of the hook manufacturer as well as the limitations determined by current regulations (minimum spaces for the electrical system joint and brake joint, maximum distance between the hook pin axle and rear edge of the superstructure, etc.).

If the hook attachment flange does not have drill holes suitable for the existing ones on the rear vehicle cross member, changing the drill holes on the latter may be authorised after applying suitable reinforcements.

The fitter is obliged to create and install the superstructure in a manner that makes it possible to perform the necessary manoeuvres and check the hook without obstacles or danger.

Freedom of movement must be guaranteed for the trailer drawbar.

### 2.6.3 Hook types

The types of available hooks are:

- a) ball
- b) pin (automatic)

Pin hooks may only be installed on the truck version and if a suitable cross member is used.

If not supplied directly by IVECO, both types must be type-approved in compliance with current standards.

Table 2.12 contains data for the towing hooks available on the production line.

Table 2.12 - Type-approved hooks

Type	Class	D (kN)	D <sub>C</sub> (kN)	V (kN)	EC type-approval no.
GS500	A50-X	22.5	-	25.0	AND 11*94/20*0533*00
GA381	S	22.5	-	25.0	AND 11*94/20*1613*01

### 2.6.4 Towing hook for central axle trailers

A trailer is defined as a central axle type when it has one or more axles close to each other.

Particularly due to the effect of the vertical dynamic loads, with this type of trailer, the rear vehicle cross member is subjected to significant stress.

For the same reason, a suitable towing hook is needed.

The values of the towable weights and the permissible vertical loads are specified in the technical documentation of the hook manufacturer and are indicated on the production plate (see DIN 74051 and 74052).

Towing hooks with special approvals and load and weight values above those specified in the above standard can also be used. However, these hooks can have constraints connected to the type of trailer used (e.g. drawbar length). Furthermore, these may require additional reinforcements for the tow cross member, as well as a larger sub-frame section.

The DC and V values of the mechanical attachment device suitable for central axle trailers are defined by the following formulas:

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

$$V = a \cdot \frac{X^2}{L^2} \cdot C$$

$D_c$  = representative value of the hook class (kN). It is defined as the theoretical force of reference for the horizontal force between the towing vehicle and the trailer;

$g$  = gravity acceleration ( $9.81 \text{ m/s}^2$ );

$T$  = maximum weight (t) of the towing vehicle;

$T+S$  = maximum weight (t) of the towing vehicle including, if necessary, the vertical load of the central axle trailer;

$R$  = maximum weight (t) of the trailer;

$S$  = value of the static vertical load (t) that, under static conditions, is transmitted to the attachment point.

$S$  must be  $\leq 0.1 \cdot R \leq 1000 \text{ kg}$ ;

$C$  = sum of the maximum axial loads (t) of the central axle trailer with maximum load; is equal to the maximum weight of the central axle trailer decreased by the vertical static load ( $C = R - S$ );

$V$  = value of the dynamic vertical theoretical load (kN);

$a$  = equivalent acceleration in the attachment point; in function of the rear suspension of the tractor, use the following values:

-  $a = 1.8 \text{ m/s}^2$  for pneumatic suspensions;

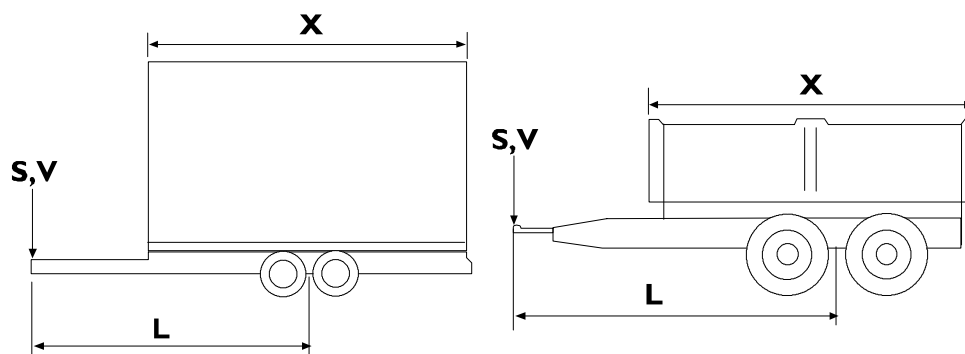
-  $a = 2.4 \text{ m/s}^2$  for other types of suspensions;

$X$  = length of the load surface (m);

$L$  = theoretical length of the drawbar (distance between the centre of the drawbar eye and the middle line of the trailer axle) (m);

$X^2/L^2 \geq 1$  if the result is lower than the unit, use value 1.

Figure 2.11



132088

Length of the loading surface of the trailer and the theoretical length of the drawbar

The following table shows the maximum permitted values of S for the tow cross members in production, for central axle trailers.

Table 2.13

Model	Maximum S (kN)
29L	14
35S, 35C, 40C	14
45C, 50C, 60C, 65C, 70C	14

#### Calculation example for the attachment device class for central axle trailers

Considering a 65C15 vehicle with a maximum weight of 6250 kg that must tow a central axle trailer weighing 3500 kg with  $S = 250$  kg, length of the loading surface of 5 m and theoretical drawbar length of 4 m.

Therefore from the data

1.  $S = 0.25$  t
2.  $C = R - S = 3.5 - 0.25 = 3.25$  t
3.  $(T + S) = 6.25 + 0.25 = 6.5$  t
4.  $X^2 / l^2 = 25 / 16 = 1.5$

the following is obtained:

$$D_c = 9.81 \times (6.5 \times 3.25) / (6.5 + 3.25) = 21.3 \text{ kN, and } V = 1.8 \times 1.5 \times 3.25 = 8.8 \text{ kN}$$

### 2.6.5 Rear cross member in a lowered position

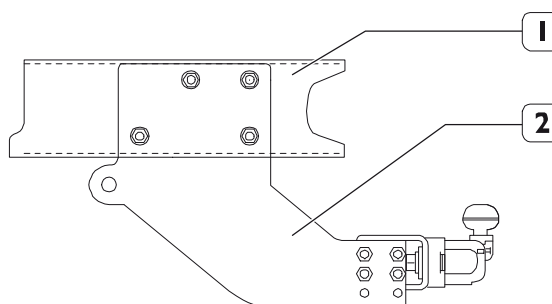
When it is necessary for the tow hook to have a lower position than what is originally foreseen, IVECO can release authorisation to lower the attachment of the original cross member or to apply a supplementary cross member, which is the same as the original one, in a lowered position.

Figure 2.12 shows an implementation example.

The connection of the cross member in the new position must be implemented in the same way and using screws of the same type (diameter and resistance class) as originally foreseen.

Loosening prevention systems must be used in the connections.

Figure 2.12

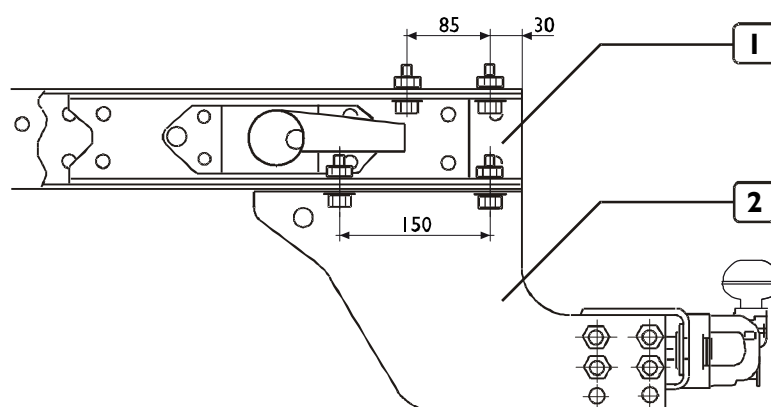


173258

1. Frame side member - 2. Bracket for the lowered cross member

For vehicles with a 3000 mm wheel base, in order to avoid possible interference with parts of the rear suspensions, IVECO provides a different solution that is implemented with specific "C" shaped reinforcements positioned inside the vertical rib of the side members.

Figure 2.13



173259

1. Frame side member - 2. Bracket for the lowered cross member

### 13-pin electrical coupling

If it is not fit during production, it can be retrofitted according to the information provided in paragraph 5.4.4.

### Remarks concerning the useful load

It is necessary to check that the static load on the hook does not cause the permitted load on the axle and on the rear axles of the vehicle to be exceeded and that the minimum weight on the front axle is observed, as indicated in point 1.15.3.

### Increase in the towable weight

For vehicles suited for the IVECO tow, it is possible to assess, in certain cases and for particular uses, the possibility to authorise towable weights that exceed what is normally permitted.

These authorisations contain the conditions for towing and, if necessary, provides information regarding the changes and operations to be implemented on the vehicle: reinforcements to the standard cross member (see Figure 2.12), or assembly of a reinforced cross member when available, or adjustments to the braking system.

The tow hook must be suitable for the new use and its attachment flange must coincide with that of the cross member.

To fasten the cross member to the frame, use flanged head nuts and screws or hexagonal head screws with a minimum class of 8.8.

Use loosening prevention systems.

### Plates

In some countries, standards require a plate to be positioned near the tow device that specifies the maximum towable weight the maximum vertical load permitted.

If not already present, the fitter must implement and position one.

## 2.7 Application of a supplementary axle

The application of a supplementary axle on the vehicle is not foreseen.

## 2.8 Changes to the transmission

The operation on the transmission, after changing the wheelbase, must be done using the transmission diagram of a similar standard vehicle with approximately the same wheelbase.

The maximum slope values of the standard propeller shafts must be observed also for the cases when working on the suspensions and rear driving axle.

In the case of difficulty, contact the IVECO Technical Application department, and send to it a diagram with the length and slope of the new transmission for a homokinetics check.

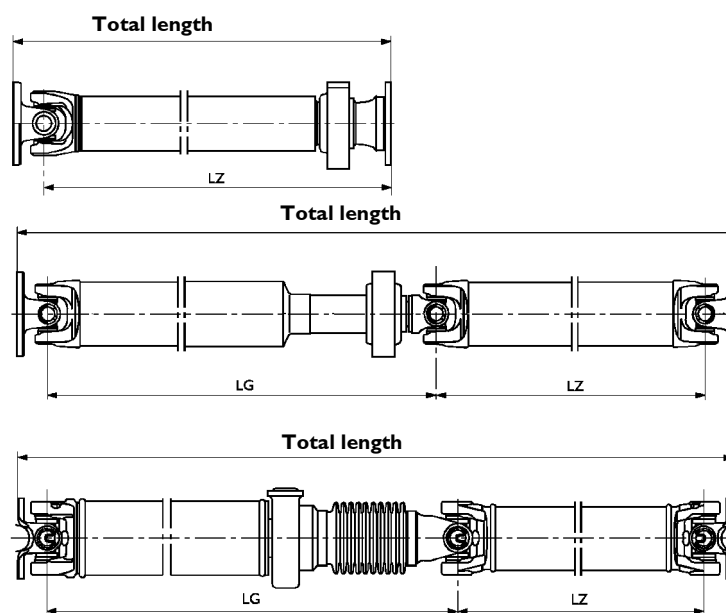
The technical information contained in the manuals of the transmission manufacturers must be used to properly implement and position the sections.

The purpose of the information contained in this manual is to ensure proper operation of the transmission, limit its noise and avoid the triggering of stress transmitted by the power unit. This does not exempt the fitter from his responsibility for the work performed.

### 2.8.1 Permitted lengths

- The maximum operating lengths that can be implemented, both for intermediate sections as well as for sliding sections "LG" or "LZ" (see Figure 2.14), can be determined based on the external diameter of the pipe on the vehicle and by the maximum operating revs (see formula and Table 2.16).  
If the length of the shaft determined in this manner is not sufficient for the change to be implemented, a new section must be inserted that has the same characteristics as those present.
- In some cases a propeller shaft can be used that has a larger diameter, determined (always from Table 2.16) based on the length to be implemented and the maximum operating revs.

Figure 2.14



91505

LZ Intermediate sections  
LG Sliding sections

For the sliding shafts, the length LG must be evaluated between the cross journal centres and with the sliding branch in the intermediate position. Always check both LG and LZ branches.

The maximum operating revs must be deduced from the following formula:

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

$n_G$  = maximum operating revs (rpm)

$n_{\max}$  = motor revs (rpm) at maximum power, see Table 2.14

$i_G$  = gearbox ratio in the highest gear, see Table 2.15

Table 2.14

Engine	Engine code (I)	$n_{\max}$
.11	FIAE348IA*A	3900
.13	FIAE348IB*A	3600
.15	FIAE348IC*A	3900
.15	FICE348IJ*B	3500
.17	FICE348IK*B	3500
.21	FICE348ID*B	3500
.15EEV	FICE348I8*C	3500
.17EEV	FICE348IC*C	3500
.14G	FICE044IA*B	3500

(I) = Check the engine code on the engine plate

Table 2.15

Gearbox	$i_G$
2830.5	0.777
2835.6	0.701
2840.6 - 6AS400	0.791
2850.6	0.685

#### Calculation example for the maximum implementable transmission length

Considering a 35C13 vehicle with a 2835.6 gearbox. The goal is to implement an LZ propeller shaft with an external diameter of 76.2 mm.

From the data

1.  $n_{\max} = 3600$  rpm

2.  $i_G = 0.7$

the following is obtained:

$$n_G = 3600 / (0.70) = 5140 \text{ rpm}$$

This value corresponds, according to Table 2.16, to an implementable length of 1400 mm.

**NOTE** Normally, the cross journal forks belonging to the same shaft must not be rotated.

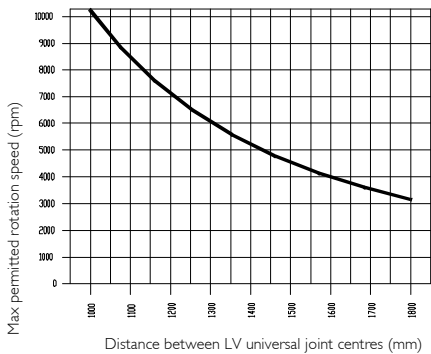


Pipe thickness

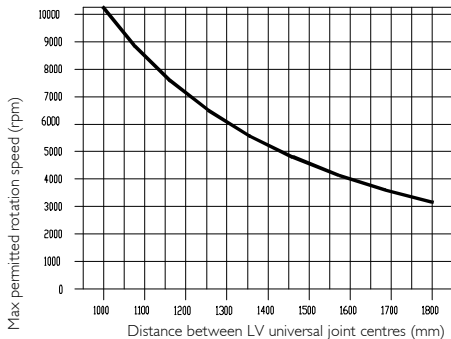
It is normally not possible to indicate a valid pipe thickness.  
In fact, the thickness of the pipe depends on the torque to be transmitted by the original shaft, as well as on the constructive setting of the transmission line (driving torque, ratios in the kinematic chain, load on the driving axle or axles).  
If using a pipe with a larger diameter than the original one, the thickness must be reduced in theory until reaching the same torsional capacity; however also the dimensions of the fork male must be taken into consideration as well as the need for adaptor rings or the dimensions of commercially available pipes.  
The thickness of the pipe must be agreed upon on a case by case basis, depending on the dimensions of the propeller shaft (e.g. dimensions of the universal joint), with the authorised workshops of the propeller shaft manufacturers.  
The minimum operating length (between flanges) must not be less than 600 mm for sliding shafts and 300 mm for intermediate shafts.

Table 2.16 - Implementable transmission characteristics

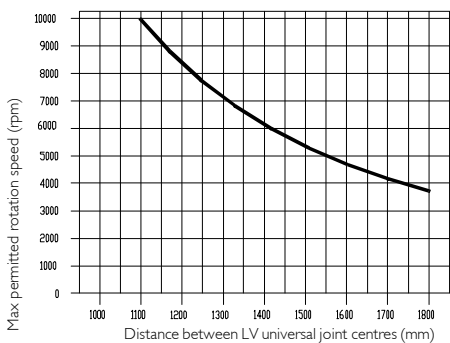
CRITICAL TRANSMISSION SPEED 1410 - PIPE Ø 76,2 x 2,4 mm



CRITICAL TRANSMISSION SPEED 1310 - PIPE Ø 76,2 x 2,11 mm



CRITICAL TRANSMISSION SPEED 1310 - PIPE Ø 88,9 x 1,65 mm



117798



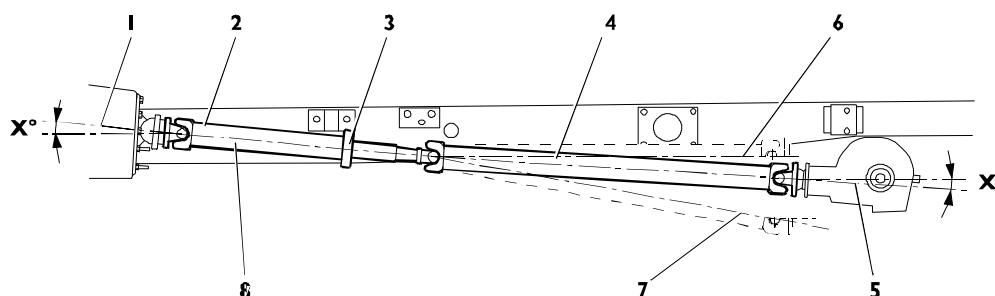
The maximum reachable lengths indicated above refer to the original shafts; foresee smaller lengths (-10%) for the segments obtained by conversion.

## 2.8.2 Section positioning

For transmissions implemented with multiple sections, the individual transmissions must have approx. the same length. In general, the length between an intermediate shaft and a sliding shaft (see Figure 2.15) must not be longer than 600 mm; whereas between the two intermediate shafts this difference must not be greater than 400 mm. In the sliding shafts, there must be a margin of at least 20 mm between the minimum operating length and the maximum closure length.

In compliance with the useful stroke, select a position with the static position in the central area as much as possible.

Figure 2.15



173260

- 1. Engine, clutch, gearbox axis - 2. Sliding articulated shaft - 3. Shaft support -
- 4. Articulated shaft - 5. Rear axle casing camber (static load) -
- 6. Rear axle casing camber (max compression) - 7. Rear axle casing camber (unloaded vehicle) -
- 8. Articulated shaft (sliding) and rear axle casing axis must have the same camber  $x^\circ$  with respect to the horizontal

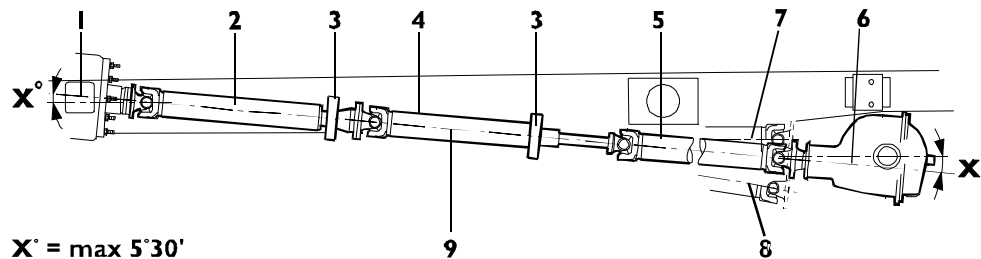
The intermediate shaft and the rear axle casing axis must be aligned.

Their camber may vary a maximum of  $1^\circ$  with respect to that of the engine-clutch-gearbox axis and this can be obtained by placing a wedge between the rear axle casing and the spring.

The maximum rear axle casing camber must be between  $4^\circ$  and  $6^\circ$  ( $5^\circ$  nominal) with respect to the horizontal.

When the lengthening of the wheelbase is considerable it may be necessary to apply a supplementary intermediate section, as shown in Figure 2.16. In this case, make sure that the same camber is created between the engine-gearbox axle, the second intermediate shaft and the rear axle casing axle in a static load condition of the vehicle.

Figure 2.16



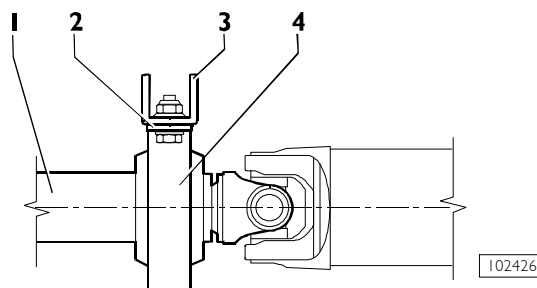
173261

1. Engine, clutch, gearbox axis - 2. Intermediate shaft - 3. Intermediate shaft support - 4. Articulated shaft (sliding) - 5. Articulated shaft (fixed part) - 6. Rear axle casing camber (static load) - 7. Rear axle casing camber (max compression) - 8. Rear axle casing camber (unloaded) - 9. Gearbox, sliding articulated shaft and rear axle casing axis must have the same camber

The elastic supports must be applied using support plates with a thickness of at least 5 mm (see Figure 2.17), connected to the cross members with characteristics similar to what is foreseen by IVECO.

When shortening the wheelbase, the intermediate shafts should be disassembled when the length of the articulated shaft is less than approx. 600 mm.

Figure 2.17



1. Intermediate shaft - 2. Support plate - 3. Base plate - 4. Intermediate shaft support

The considerations made up to this point also apply to vehicles with a separate gearbox.

Furthermore, for these it is usually not possible to shorten the wheelbase beyond the shortest value foreseen standard (e.g.: tilting). It is recommended to use original IVECO transmissions; if this is not possible crude steel pipes can be used that have a yield point no less than  $420 \text{ N/mm}^2$  ( $42 \text{ kg/mm}^2$ ).

Changes to the universal joints are not permitted.

For each change made to the transmission, or part of it, accurate dynamic balancing must be performed subsequently on each of the modified sections.



**As the transmission represents an important component for the purpose of safe vehicle operation, attention must be placed on the requirement that each change made to it must provide a maximum guarantee of safe behaviour. Therefore, these changes should only be made by highly specialised companies that have been qualified by the transmission manufacturer.**

## 2.9 Changes to the air intake and engine exhaust systems

### 2.9.1 Intake

The characteristics of the engine supply air intake systems and exhaust systems must not be made without IVECO authorisation. Any operations must not change the original intake vacuum values and the exhaust counter-pressure values.

Table 2.17 - Maximum permitted counter-pressure at the intake and exhaust at nominal speed and at full load

Engine	Engine code	Counter-pressure at the exhaust (kPa)	Minimum-maximum counter-pressure at the intake (kPa)
.11	FIAE3481A*A	34.5	1 - 9
.13	FIAE3481B*A	37	1 - 9
.15	FIAE3481C*A	37	1 - 9
.15	FICE3481J*B	48	1 - 9
.17	FICE3481K*B	57	1 - 9
.21	FICE3481D*B	57	1 - 9
.15 EEV	FICE34818*C	40	1 - 9
.17 EEV	FICE3481C*C	40	1 - 9
.14G	FICE0441A*B	25	$\Delta P = 2$

The air intake must be positioned to prevent the intake of hot air from the engine compartment or dusty air or water.

The intake compartment must be completely airtight and provided with rubber gaskets that prevent the recirculation of hot air. The gaskets must be of a quality that is able to support a constant temperature of 100 °C with short periods of 120 °C without becoming deformed. The compartment must keep the air passage section effective over the entire path.

Any openings that have to be made in the van bodies must have a useful area no less than approx. twice that of the master section of the pipe upstream of the filter; these openings (example grid holes) must have a minimum dimension to prevent them from being blocked.

Not permitted:

- changing or replacing the original air filter with a filter with an inferior capacity;
- making changes to the body of the silencer;
- carrying out work on devices (injection pump, regulator, injectors, etc.) that could change the proper operation of the engine and have an impact on exhaust gas emissions.

Finally, it must be checked if the system requires a new homologation based on particular national standards (noise, smoke).

### 2.9.2 Engine exhaust

The pipes must:

- be arranged as regularly as possible;
- create curves with angles no greater than 90° and radiuses no smaller than 2.5 times the external diameter;
- not have any constrictions;
- have useful passage sections no smaller than the original ones.

For obvious reasons of safety, sufficient distance must be maintained between the exhaust pipe and the electrical systems; the plastic pipes, the spare wheel (minimum 150 mm), the plastic fuel tank (minimum 100 mm), etc.

Lower values (e.g. 80 mm) can be permitted by adopting suitable sheet metal guards, whereas additional reductions require the use of thermal insulation or the replacement of plastic pipes with steel ones.

## 2.10 Changes to the engine cooling system

The original conditions of proper operation must not be changed, particularly those regarding the radiator, free surface of the radiator, pipes (dimensions and path).

In any case, if transformations are necessary (e.g.: changes to the cab) that require work on the engine cooling system, keep in mind that:

- the useful area for the passage of air for radiator cooling must not be less than what is implemented for vehicles with standard cabs;
- maximum venting of the air from the engine compartment must be guaranteed, making sure that there are no hot air pockets or recirculation of hot air by means of guards and deflectors;
- fan performance must not be altered;
- the possible rearrangement of the water pipes must not impede the complete filling of the circuit (to be done with a continuous flow and without any backups from the filler union) and the regular flow of water; furthermore, this rearrangement must not alter the maximum stabilisation temperature of the water, also under the most demanding conditions of use;
- the path of the pipes must be implemented in order to prevent air pockets from forming (e.g. eliminating siphon bends or by foreseeing suitable bleeding) that could make water circulation difficult;
- check the priming of the water pump when the engine starts and that its subsequent operation at idle speed is immediate (perform a few accelerations if necessary) also with the circuit not pressurised. When controlling, check that the water pump delivery pressure, with the engine at maximum no-load speed, is no less than 1 bar.

To check the operation of the cooling circuit, it is necessary to consider the supply, breather pipe and circulation of the water, proceeding as follows:

- open the heating system supply cocks and the heater breather pipes;
- fill the circuit with the engine off, with a constant flow of 8 - 10 l/min, until it exits from the filler cap;
- once vented, close the heater breather pipes;
- start the engine and keep it idling for 5 minutes, after which the level of the water in the supply tank must not have gone below the minimum;
- accelerate the engine gradually, checking that the average pressure in the water pump outlet pipes increases gradually, without sudden jumps;
- keep the engine accelerated until the thermostat opens, checking the passage of air bubbles through the transparent pipes installed between :
  - engine output and radiator;
  - supply tank and water pump;
  - engine breather pipe and supply tank;
- 15 minutes after the thermostat has opened, make sure that there are no more bubbles in the circuit;
- with the thermostat open and with the engine idling, make sure that the average pressure in the water pump outlet pipe is 500 mm higher than the water column.

## 2.11 Operations on the suspensions



**Changes to the suspensions and to the springs (e.g. addition of leaves, variations in the camber, etc...) concern the safety of vehicle operation, and therefore must be performed only after IVECO approval.**

In general, work on the parabolic suspensions is not permitted. In the case of vehicles equipped with these types of springs, for special versions or uses and in order to increase suspension rigidity, the application of elastic rubber parts may be authorised. In exceptional cases and for specific uses, the possibility to permit the addition of supplementary leaves on parabolic springs may be assessed; the work must be performed by a specialised spring manufacturer and after IVECO approval.

It is not permitted to use a parabolic spring on one side and a semi-elliptical spring on the other side of the same axle.

On vehicles equipped with the "brake system braking corrector" option, changes to the rear suspension require the corrector to be adjusted (see Chapter 2.15).



**No changes are permitted to suspensions on vehicles equipped with ESP. See Paragraph 2.15.4.**

### Transforming the suspension from mechanical to pneumatic

This type of transformation is **strongly advised against** as it involves components of the suspension and chassis anchoring parts that are essential to the vehicle's active safety.

Any company that still intends to carry out this work must provide IVECO with detailed documentation in order to obtain technical approval.

If non-original components are used, please note that possible approval is issued based on an exclusively design-related evaluation of their characteristics and without carrying out specific tests, unlike what is done when original equipment components are used. Therefore, for this particular type of transformation, IVECO considers itself not liable for anything related to the new component.

#### Camper 35C, wheelbase 3750 mm or 3950 mm, lightened chassis

Subject to IVECO approval, adjustments may be made to the original mechanical suspension by adopting additional, suitably sized bellows.

### Changes to the pneumatic suspension (store van version)

Subject to IVECO approval, adjustments may be made to the original pneumatic suspension.

### **Changes to the rear suspension (vehicles with braking corrector)**

A change to the rear suspension spring characteristics (e.g. no. of leaves, trigger loads, etc.) involves adjusting the braking corrector regulation data. If the vehicle is equipped with ABS, regulation is not necessary.

When the work on the suspensions is due to substantial variations in the loads on the axles or variations in the overall vehicle weight, it may be necessary to adjust the braking forces in order to comply with legal requirements. The necessary indications are included in the authorisations issued by IVECO.

If instead the change in the rear spring characteristics does not involve variations in the load on the axles and in the overall weight, the braking corrector calibration may be changed by an Authorised Workshop.

To avoid changing the vehicle's braking capacity, the "load on the ground/braking pressure" ratio indicated on the specific plate on the corrector must be respected under the various load conditions.

To regulate this ratio, proceed as indicated in point 2.15.2, foreseeing a value corresponding to the rigidity characteristics of the new spring for the load to be applied on hole 9.

If it is not possible to respect this ratio under all load conditions, contact IVECO for a new check of compliance with the legal regulations.

If the data contained on the corrector plate is varied, then the plate must be replaced with another containing the new information.

### **Protection of the air springs**

The body must have a dividing part that protects the air springs and that separates them from the wheels and prevents them from being damaged by sand, mud or rocks.

The divider must leave a free space of 350 mm around the spring and must not block access for inspections and maintenance of also the other suspension components.

## 2.12 Changes to the heating/cooling system

### 2.12.1 Installation of a supplementary heating system

If it is necessary to have a supplementary heating system, it is recommended to use the types foreseen by IVECO.

For vehicles for which IVECO does not foresee these heaters, they must be installed in compliance with the requirements of the equipment manufacturer (e.g. positioning of the heating unit, pipes, electrical system, etc.) and in accordance with the information provided below.

The supplementary heating system must comply with all the applicable national requirements (e.g. tests, particular versions for the transport of hazardous goods, etc.) and must not use vehicle devices subject to the obligation of homologation if this use can have a negative impact on performance.

Keep also the following in mind:

- protect the correct operation of the other vehicle systems (e.g.: engine cooling);
- check that the capacity of the batteries and the power of the alternator are sufficient for the highest current absorption (see Chapter 5.4) and provide a protective fuse on the new circuit;
- for the delivery of the fuel, connect the supply system to a supplementary tank positioned on the pipe returning the fuel to the engine. The direct connection to the vehicle tank is only permitted if it is done independently of the engine power supply and if the new circuit is perfectly sealed;
- define the path of the pipes and the electrical cables (and the positioning of the flexible joints) based on the dimensions and the influence of heat on the various chassis components. Avoid exposures that could be dangerous and use suitable guards as necessary.

The entire positioning of the system must provide good access and permit quick maintenance.

The fitter must provide the necessary instructions for servicing and maintenance.

#### a) Water heaters

When the original vehicle heating and engine cooling circuits are involved (see Chapter 2.10), in order to ensure proper system operation and guarantee the safety of the original one, the following is necessary:

- carefully define the connection points between the added system and the original system, in agreement with IVECO if necessary. The added pipes must be in copper or another alloy that resists the corrosion of the coolant and the coupling sleeves must comply with the requirements of IVECO standard I8-0400;
- foresee a rational positioning of the pipes, avoiding constructions or siphon paths;
- use deaeration valves (bleeding points) to guarantee proper system filling;
- ensure the possibility of completely emptying the circuit, providing supplementary plugs;
- use suitable protections as necessary to limit heat loss.

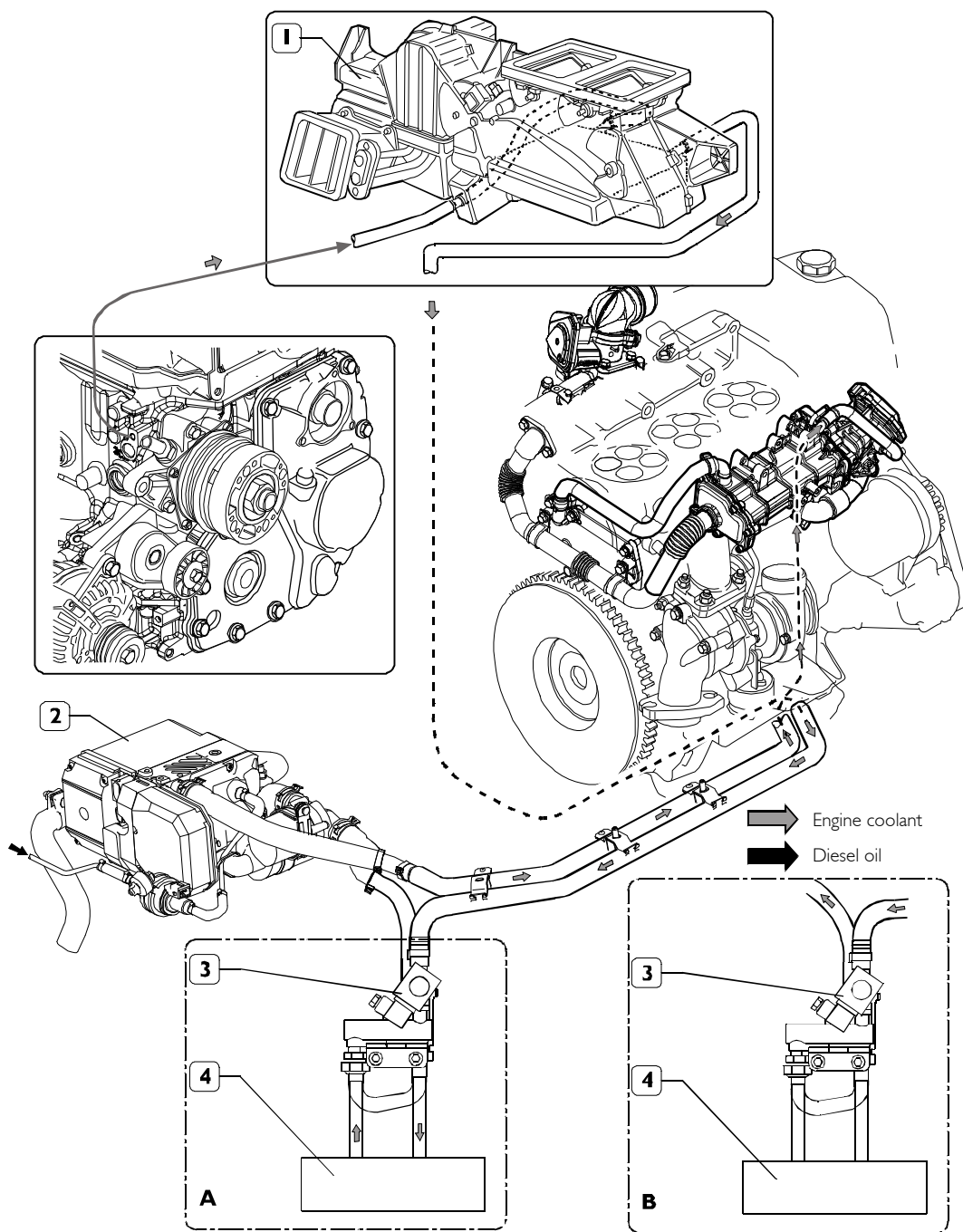
#### b) Air heaters

With these heaters and in the case they are positioned directly in the cab, pay particular attention to the exhaust (to prevent the combustion gas from remaining inside the vehicle) and to the correct distribution of the hot air (to avoid direct flows).



Figure 2.18 shows a diagram of a supplementary heating system with an additional heater.

Figure 2.18



159346

1. Main heater - 2. Optional supplementary heater - 3. Solenoid valve - 4. Additional heater responsibility of the fitter  
A. Open solenoid valve (3) - B. Closed solenoid valve (3)

**NOTE** Heaters (2) and (4) may also be used individually.

### 2.12.2 Installation of an air conditioning system

For the installation of an air conditioning system, it is recommended using the units originally foreseen by IVECO.

If this is not possible, in addition to complying with the particular requirements of the equipment manufacturer, the following is necessary:

- do not alter the proper operation of the vehicle components that may be involved with the operation;
- check that the capacity of the batteries and the power of the alternator are sufficient for the highest current absorption (see paragraph 5.4.6) and provide a protective fuse on the new circuit;
- agree upon the compressor installation methods with IVECO, if applied on the engine;
- define the path of the pipes and the electrical cables (and the positioning of the flexible joints) based on the dimensions and the influence of heat on the various chassis components;
- avoid passages and positions in which the exposure could be dangerous while driving, using suitable guards as necessary;
- pay attention to the entire positioning of the system in order to permit good access and guarantee quick maintenance.

When delivering the vehicle, the fitter must provide the necessary instructions for servicing and maintenance.

Furthermore, in function of the type of system:

#### a) system positioned inside the cab:

- the position of the condenser must not have a negative impact on the original engine cooling characteristics of the vehicle (reduction of the exposed area of the radiator-engine);
- the positioning of the condenser must not be combined with the engine radiator but must be in a specific, suitably ventilated compartment;
- the positioning of the evaporator unit and the blower in the cab (if not directly foreseen by IVECO) must be designed so that it does not have a negative impact on the functionality of the controls and equipment accessibility;

#### b) systems positioned on the cab roof:

- check that the weight of the equipment does not exceed the permitted weight for the cab; The fitter must also define any reinforcements to be applied on the roof panel based on the weight of the unit and the scope of the performed operation;
- contact IVECO in the case of specific applications with compressors that are different from the original type (e.g. refrigerator box).

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**NOTE** Please note that, based on Directive 2006/40/EC on emissions of motor vehicles air conditioning systems, fluorinated greenhouse gas may not be used with the potential of global warming higher than 150 in comparison to that of carbon dioxide.

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## 2.13 Operations on sheet metal

### 2.13.1 General information

All operations on the driving cab must be previously authorised by IVECO.

The changes must not prevent the functionality of the control devices positioned in the area involved with the change (e.g. pedals, linkages, switches, pipes, etc.) nor change the resistance of the weight bearing elements (pillars, reinforcement sections, etc.). Necessary attention must be paid to the operations that could involve the engine air intake and cooling ducts.

If the cab weight has changed, the position of the useful load must be taken into consideration in order to comply with the division of the weights permitted on the axles (see paragraph 1.15.2).

For operations that require the soundproofing panels or internal protections (panels, padding) to be removed, remove as little as possible, being careful to restore the protections as originally foreseen, guaranteeing their original functionality.

Controls and devices (power take-off engagement control, external operating cylinder control, etc.) may be installed in the cab under the following conditions:

- the positioning is rational, precise and accessible for the driver;
- the safety, control and signalling devices foreseen by national regulations have been adopted.

Make sure that the pipes and cables are correctly positioned also in function of cab tilting; use the necessary fastenings making sure to ensure suitable distances from the engine, heat sources and moving components.

Provide the necessary corrosion protection for every change to the structure (see chapter 2.3).

If the body is cut and raw plates are welded, to prevent the ferrous corrosion of the joints, galvanised plates should be used on both surfaces (I.S. 18-1317 class ZNT/F/10/2S or I.S. 18-1318 class ZNT/10/2S), on which a surface protection cycle should be applied.

Carefully position the gaskets and apply sealant in the areas where this protection is required.

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

After working on the body, the fitter must check that the characteristics that comply with the regulatory requirements have been maintained both inside as well as outside.

### 2.13.2 Operations on the cab

Change operations for the creation of specific versions must be carried out very carefully in order to protect the resistance and maintain the functionality and protection of the cab.

When applying units or equipment on the roof panel (e.g. air conditioning systems, spoiler) check that the weight of the equipment does not exceed the permitted weight for the cab. The required limits may be provided upon request, based on the version.

If an opening must be made, the following is necessary:

- foresee union radiuses no smaller than 50 mm;
- do not change any ribs that may be present;
- do not alter the curvature of the roof.

#### Installation of a spoiler or a baggage compartment

Upon request, versions created by IVECO based on its own designs and checks are available.

If installing "kits" of another origin, comply with the specific indications provided by the manufacturer.

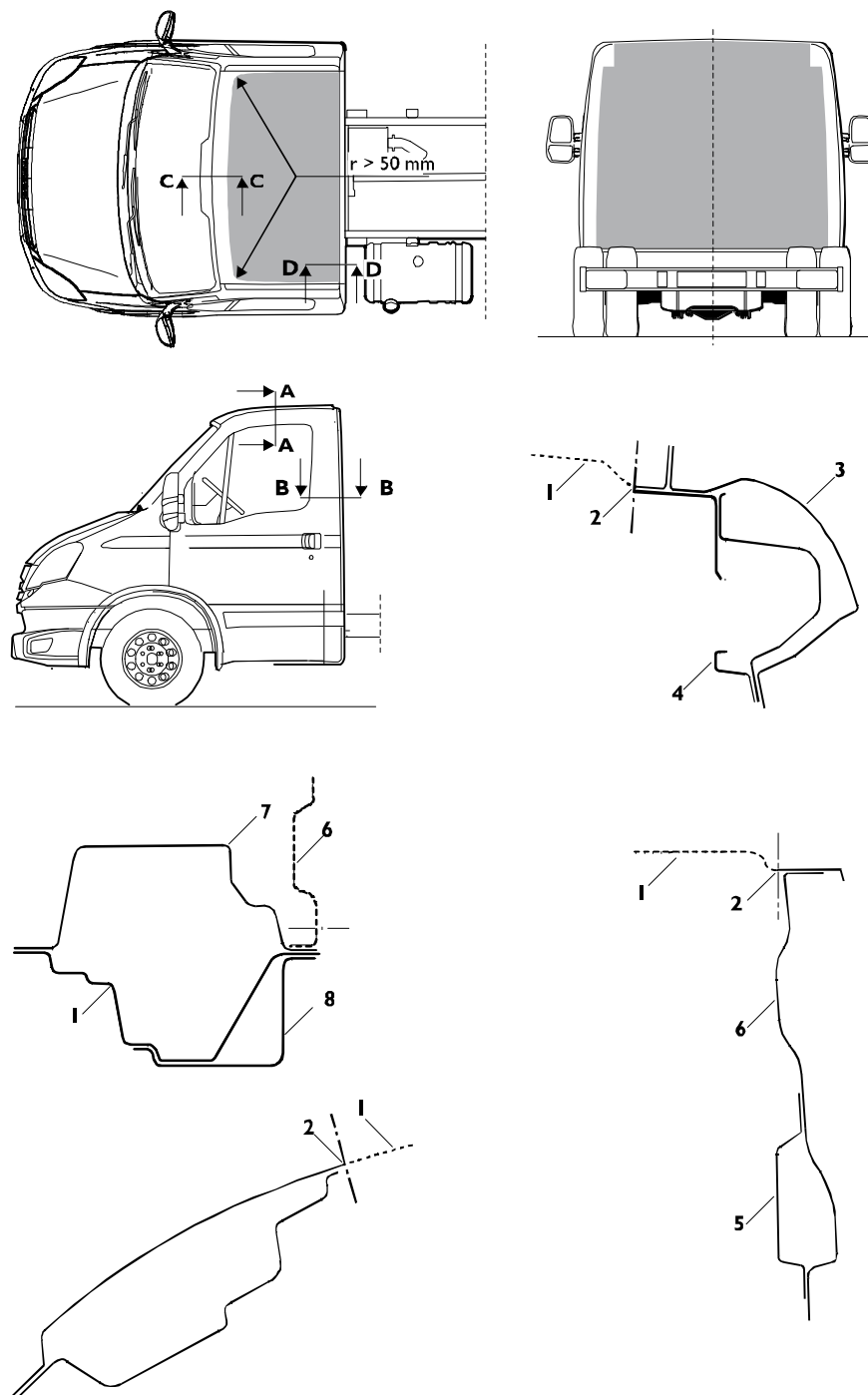
If foreseen by national standards, these installations must be checked by the responsible approval bodies.

#### Operations on the roof panel and the rear wall of the cab

If it is necessary to remove the rear wall and partially the roof panel (e.g. caravan versions), the following instructions must be observed:

- make the cut as shown in Figure 2.19, being careful to comply with the minimum union radiuses;
- eliminate the structure relative to the rear cross member on the roof panel level;
- create a structure able to guarantee that the pillars will not be deformed to maintain the efficiency of the upper safety belt connections;
- for this structure, foresee resistance at a compression of at least 800 daN;
- create the connection with the new structure following the general instructions provided above.

Figure 2.19



173262

1. Roof panel - 2. Cutting limit area - 3. Side headlining - 4. Door compartment ring - 5. Rear internal cross member -  
6. Rear wall - 7. Rear door compartment trim - 8. Side trim

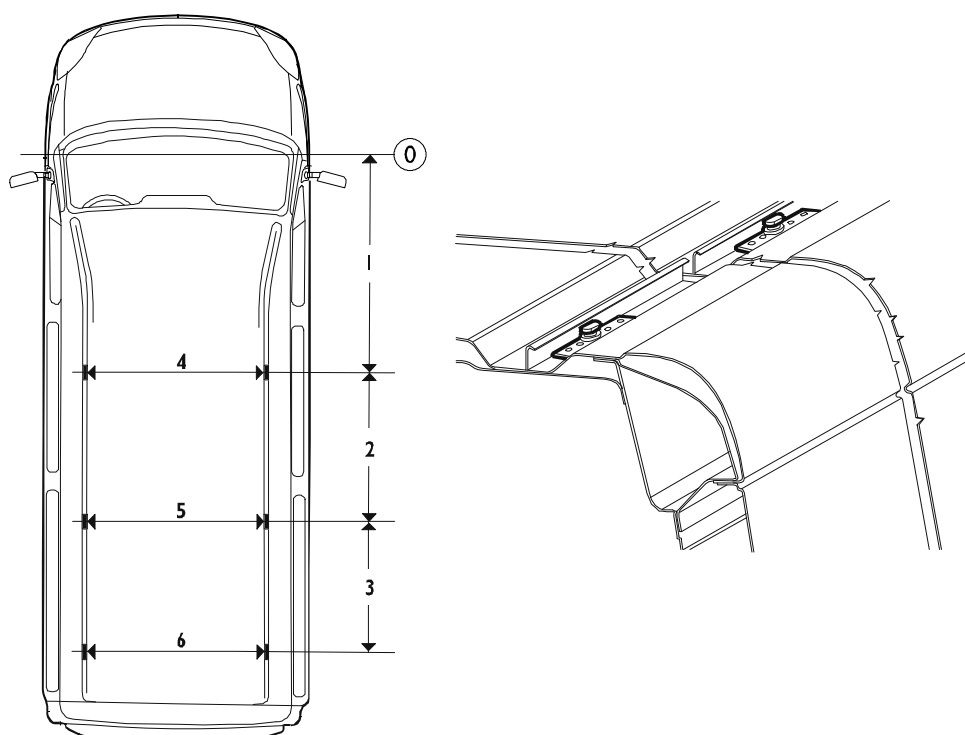
### 2.13.3 Operations on the body (vans and combi)

#### Installation of baggage compartments

Installation must be carried out using fixing devices specifically provided on the roof panel (low roof and medium roof versions), taking the following into account:

- the fastening element must involve the baggage compartment anchoring device and ensure resistance against longitudinal and transversal thrusts. 3+3 fastening elements are provided for all wheel bases;
- in order not to change the vehicle's stability in curves, the load must not exceed a total value of 150 kg;
- the permitted weight on each fastening element must not exceed 25 kg.

Figure 2.20



140847

Table 2.18

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

## Operations on the roof panel

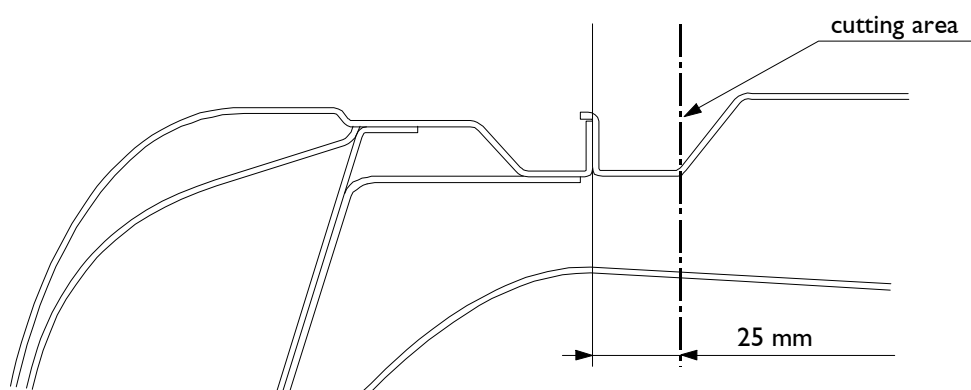
### a) Application of a translucent roof

On vehicles not originally equipped with one,, the translucent roof (available from IVECO Parts) can be installed as follows:

Table 2.19

Component	Part number	Quantity
Translucent roof	500360077	1
Cross member	500360079	2
Support	500360089	2

Figure 2.21



102772

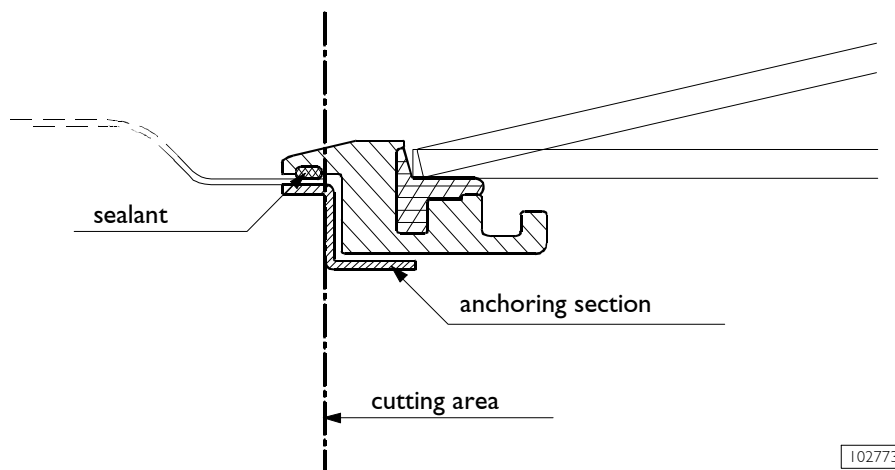
- cut the roof panel approx. 25 mm from the original connection area with the body (see Figure 2.21);
- weld the four structural elements mentioned above (cross members and supports) to the body using the 25 mm tab that was left when cutting;
- carefully place the translucent roof on the structural elements;
- glue the translucent element using suitable products and being careful not to leave cracks that communicate with the outside.

**b) Installation of a hatch**

A hatch may be installed on the roof panel, providing that the operation does not involve the hoops and that the seal and resistance of the modified part is guaranteed.

Figure 2.22 shows an installation example.

Figure 2.22





**c) Changes to roof panel height**

In production, three roof panel versions are available with respective internal heights equal to:

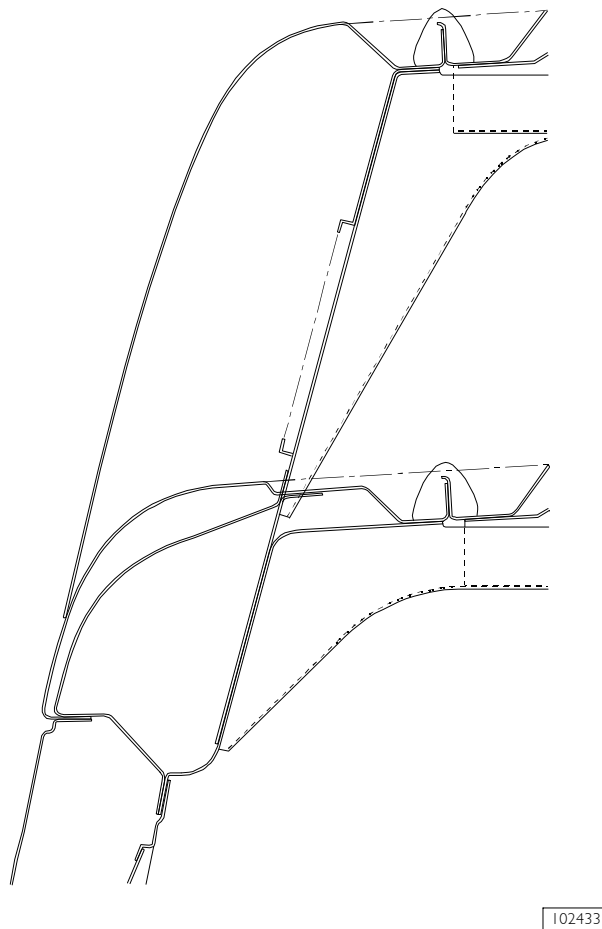
- low roof           = 1595 mm
- medium roof     = 1900 mm
- high roof         = 2100 mm

Changing the height of the roof panel is a very complicated and onerous operation: therefore, this operation must be limited to the medium and high roof versions that have the same structure as the roof panel.

Figure 2.23 shows the cross section of two versions where it is possible to see that the roof panel is a unified structure.

To permit the correct connection with the original roof panel, the fitter must ensure suitable operations on the hoops of the side panel.

**Figure 2.23**



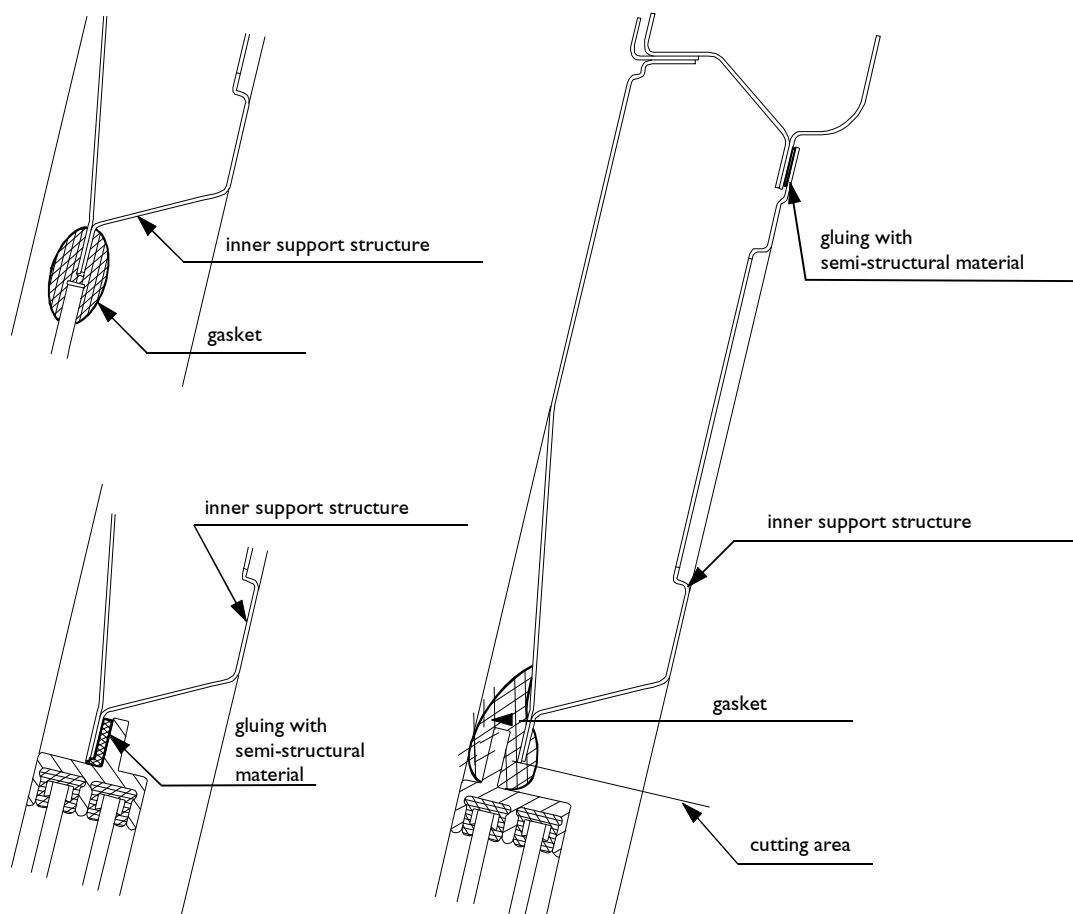
102433

#### d) Opening of side windows

The opening of windows in vans requires the specific precautions and techniques specified below.

- Cut the plate being careful to maintain a section with a minimum width of:
  - 15 mm (in the case of glass fixed with a gasket);
  - 20 ÷ 25 mm (in the case of glass fixed by gluing).
- Create an internal support structure (see Figure 2.24), in order to ensure the necessary resistance and create the connection as shown in the figure.
- Remove the pillar in the window area, providing suitable reinforcement to the base node.

Figure 2.24



102434

#### e) Internal shelves

Internal shelves must be created so that they are sufficiently rigid and are self-supporting.

The lower support must concern the floor support structure (longitudinal cross members and sections) and be implemented in order to distribute the load uniformly.

The anchoring on the side structure, implemented without creating preload effects, may involve:

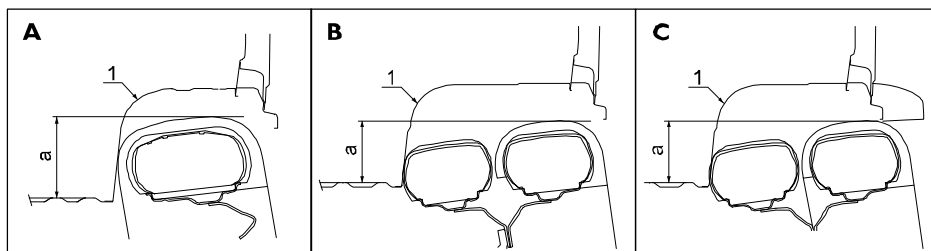
- the boxed pillars, where drill holes are present;
- the upper connection fixing elements.

### Operations on the structure and the floor

In addition to the instructions and precautions suggested up to this point, please remember:

- when drilling holes on boxed sections, areas where stress is more concentrated must be avoided (A and B pillars, in particular);
- the holes for anchoring to the floor must be protected and sealed against the infiltration of water, dust and exhaust gas;
- the possible lowering of the rear wheel arch must account for the jolting of the suspension as well as the simultaneous presence of snow chains. For this purpose, Figure 2.25 shows the possible cases and the resulting maximum lowering values that are possible.

Figure 2.25



173263

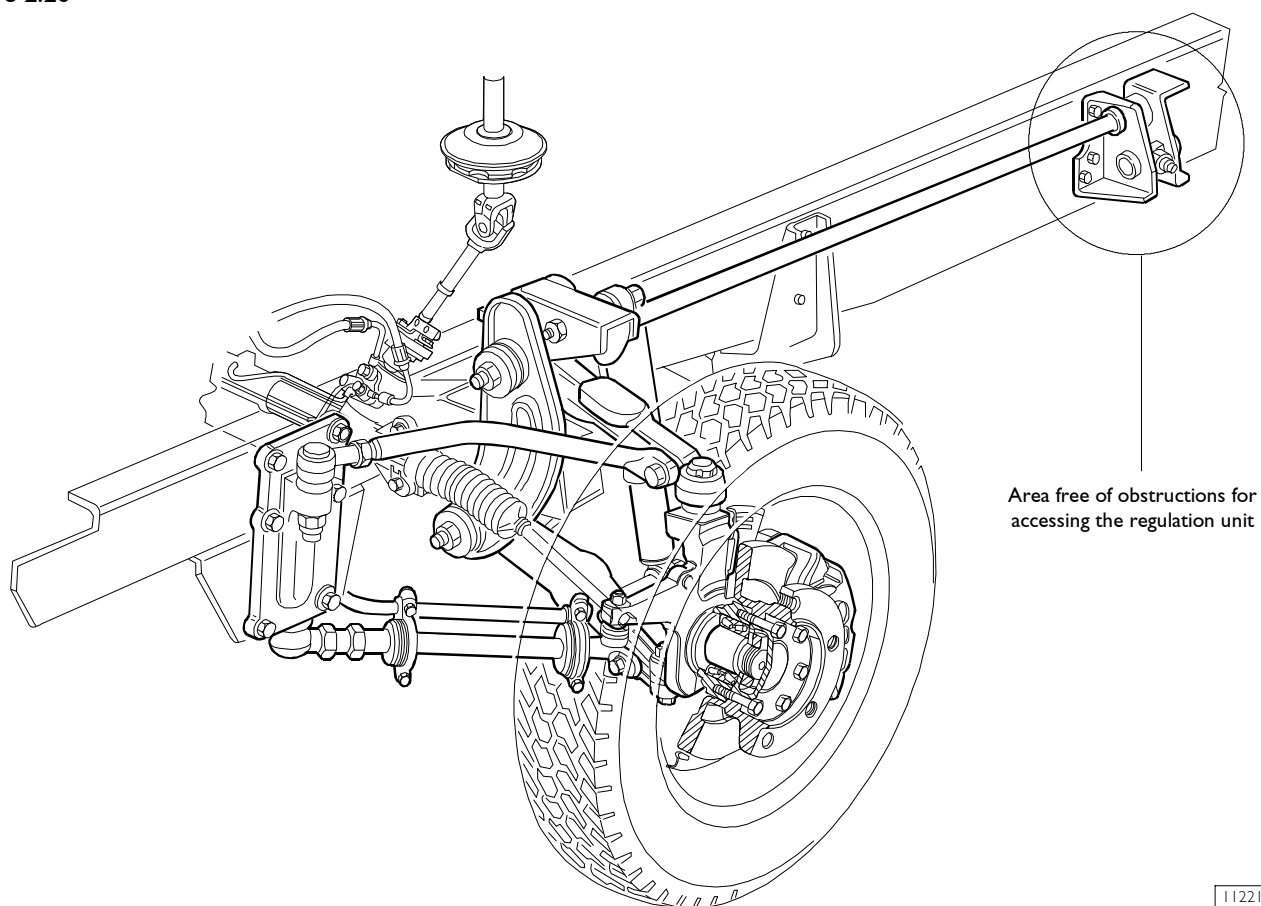
A. Windowed van/Vendor 3.5 t P. 3000/3300 - B. Minibus-Vendor/Windowed van 4.2-4.5-5 t - C. Van 6.5-7 t  
I. Standard van version wheel arch section - a. Maximum possible lowering

Table 2.20

Maximum total permitted weight [ t ]	Tyres	Measurement at [ mm ]
3.5 (side member of the straight chassis)	225 / 65 R16	195
4.2 - 4.5-5 (side member of the straight chassis)	195 / 75 R16	165
6.5-7 (side member of the straight chassis)	225 / 75 R16	165

**NOTE** If working on the bodywork of vehicles equipped with a front suspension with a torsion bar, it is necessary to guarantee accessibility to the position adjustment system.

Figure 2.26



112216

### 2.13.4 Creating deep cabs

When creating deep cabs (e.g. 8+1), for special vehicles, for municipal uses, for the fire department, etc., the suspension must be adjusted according to the greater weight and the extra seats created.

This type of operation requires confirmation by IVECO regarding the suitability of the original suspension devices.

In general, solutions equivalent to those foreseen in normal production for similar versions can be adopted.

When defining a suitable flexible system, the following is necessary:

- comply with the position of the cab foreseen for the standard vehicle;
- prevent the additional weight from weighing on the original part of the cab and its relative suspension;
- guarantee normal oscillations along the vertical, longitudinal and transversal planes.

To help preserve the integrity and rigidity of the cab, it is recommended to maintain the rear structure as intact as possible. The cut may be made laterally, without damaging the door compartment ring.

The fitter must implement the necessary connections to the weight bearing structure, composed of longitudinal sections and pillars, and connect the new floor to them; furthermore, inspection panels must be provided, if necessary.

It is recommended to pay particular attention to the surface preparation of the elements to be welded (using a zinc primer) and to adopt the necessary precautions in order to properly prepare the bottom for subsequent painting (see chapter 2.3).

Changing the cab could involve components such as the air intake and filter. Using original parts already foreseen for similar versions could represent a good solution and permit compliance with legislative requirements.



**A deep cab could have an impact on vehicle behaviour and safety (suspension, controls). Therefore, its implementation must be done with extreme care and using the necessary methods.**

### 2.13.5 Occupant protection

The airbags, the safety belt attachments, the position of the retractors and the pre-tensioners, the anchoring of the seats are an integral part of passive safety.

Any change made to these components could jeopardise the protection of the transported passengers and compliance with legal regulations.

#### Airbag/Window bag

No work may be performed or components installed in areas that could inhibit the proper operation of the airbag devices. The following must therefore be avoided:

- changes to the front structure of the vehicle, to the floor, the firewall, the side panels and the dashboard fastening points;
- changes to the installation area for the airbag control unit (positioned under the floor between the front seats) to the points involved with the sensor system and relative wiring;
- installation of components near the opening on the dashboard;
- changes to the steering column;
- replacement or installation of seats with an "H" point different than the original one.

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**NOTE** In the case of a passenger side airbag, comply with the regulations for the installation and use of child seats.

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**The supplementary circuits must be separate from the main vehicle circuit and protected with a suitable fuse.**

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#### Safety belt anchoring

Operations carried out in areas of the body involved with the safety belt attachments could change the functionality of these devices.

Therefore, the fitter is responsible for complying with the regulations concerning:

- tightening and assembly torques;
- selection of belts different than the original ones;
- operational homogeneity between the original belts and conformation seats different than the original.

#### Seats

Moving existing seats or fitting additional seats (for example, in an NI cat. van) is only permitted on vehicles manufactured with supplementary attachments and already granted alternative type approval.

Any other solution remains the full responsibility of the fitter, both for the implementation as well as for the execution of the destructive tests.

## 2.14 Changing tyre size

**NOTE** The replacement of the tyres with others of a different size or load capacity in comparison to what was foreseen during vehicle approval requires IVECO authorisation and verification of the need to reprogram braking system management.

The vehicle must be presented to the competent department for checking the replacement and for updating the registration documents.

Using larger tyres:

- requires checking the dimensions with respect to the mechanical components, wheel arches, etc. in the various dynamic, steering and jolting conditions;
- in some cases, this may require checking the length of the fastening screws;
- may involve replacing the rim and as a result verification of the need to adjust the spare wheel support;
- may influence the distance off the ground of the rear under-run protection and in this case, it is necessary to check compliance with the legal requirements, replacing the support brackets if necessary with appropriate and type-approved types (see Chapter 2.20);
- requires verification of compliance of the transversal limit contour with the regulations.

### Prescriptions

**NOTE** Replacing the tyres with others with a different external diameter may have an impact on vehicle performance (e.g. speed, max negotiable gradient, driving force, braking capacity, etc.); therefore the body-computer (speedometer, tachograph and speed limiter) must be recalibrated at an authorised IVECO workshop.



**It is prohibited to mount tyres with a different size and structure type on the same axle.**

The load capacity of the tyres and the relative reference speed must be suitable for vehicle performance. If using tyres with a lower loading capacity or reference speed, the permitted loads must be suitably reduced. On the other hand, the use of tyres with a higher capacity does not automatically involve an increase in the permitted weights on the axles.

The dimensions and loading capacities of the tyres are defined internationally and nationally (ETRTO, DIN, CUNA standards, etc.) and are specified in the manuals of the respective manufacturers.

Particular performance values can be foreseen by national regulations for special uses, fire-fighting, winter services, airport cisterns, buses, etc.



**If it is necessary to remove the wheels to equip the vehicle, when remounting them the contact surfaces between the rim and connection flange must be clean and free of corrosion. Furthermore, the tightening torques according to IVECO standard must be guaranteed (see Table 2.21).**

Table 2.21 - Wheel tightening torques according to IVECO std. 17-4000

CONNECTING ELEMENTS		Thread	TIGHTENING			
N.	Name		CLASS	Torque [Nm]		CHARACTERISTICS "S"*
				Min.	Max.	
1	Front and rear wheel fastening (29L-35S)	M14 stud	II	144	176	"S"
2	Front and rear wheel fastening (35C-50C)	M18x1.5 nut	II	290	350	"S"
3	Front and rear wheel fastening (60C-65C-70C)	M18x1.5 nut	II	290	350	"S"

\* Characteristic "S": safety tightness (see IVECO std. 19-0405).



**If using brackets for fastening aesthetic bosses between the rim/nut or screw, or if using rims that are thicker than the original, the geometric functionality of the fastening must be guaranteed using suitable lengths of engaging thread.**



## 2.15 Work on the brake system

### General information



**The brake system and its components represent an element of fundamental importance for the safety of vehicle driving and operation.**

**It is not permitted to make changes to the brake cylinders and callipers, adjustment units and valves, parking brake, brake control and aid systems.**

**Any change to the braking system requires IVECO authorisation.**

If foreseen by national standards, the vehicle must be inspected by competent authorities.

### 2.15.1 Piping



**The welding of pipes is never permitted.**

If changes are made to the vehicle wheelbase, the involved brake piping must be replaced with new piping implemented in a single piece; if this is not possible, it is necessary to use the same type of unions that were originally used. When making the replacements, respect the minimum internal dimensions of the existing pipes.

The specifications and material of the new pipes must correspond with those of the originally used pipes. The assembly must be carried out in a manner that ensures that the system is suitably protected.

For the supply of materials and their assembly, it is recommended to contact the IVECO Support Service or specialised workshops.

#### Metal pipes

The additions and replacements must include:

- for materials, dimensions, unions : Standard ISO 4038
- curvature radiuses (referred to the centre line of the pipe  $\varnothing = 4.76$  mm) : min. 25 mm
- tightening torque:
 

rigid pipes, unions M10x1 and M12x1	: 12 ÷ 16 Nm
flexible pipes, male unions M10x1	: 17 ÷ 20 Nm

## Plastic pipes

They are used on vehicles with air spring suspension for connecting the air springs to the integrated control unit and for controlling the braking corrector.

In the case of replacement, keep in mind that plastic material is not permitted:

- in areas where the temperature could exceed 80 °C, (e.g. within 100 mm of the engine exhaust system);
- between the chassis and moving parts, where the use of specific flexible pipes is necessary.

The operations must include:

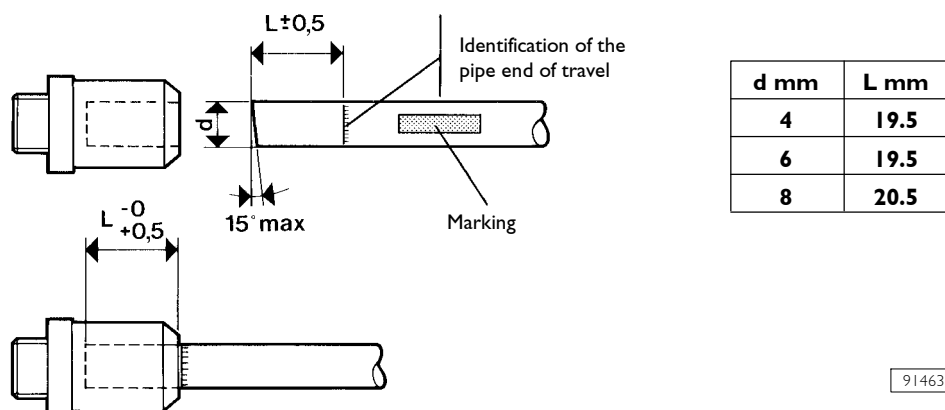
- materials and dimensions Standards DIN 73378 and 74324  
(Maximum operating pressure 11 bar)
- curvature radiuses: min.  $6 \cdot \varnothing \text{ ext}$   
(referred to the centre line of the pipe)

## Preparation and assembly

Cut the pipe at a right angle (maximum error 15°) using a specific tool, in order to prevent imperfections that compromise the seal.

In an indelible manner (using tape or ink), mark the length section L (see Figure 2.27) that must be inserted in the union to guarantee a secure seal. Mark the pipe to prevent assembly errors when performing future work.

Figure 2.27



In general, use quick coupling type unions (it is recommended to use the same brands used to originally equip the vehicle). When required due to dimensions (e.g. near curves) unions with a metal insert can be used. Before inserting the pipe into the union, tighten the union itself into the threaded seat of the component (e.g. pneumatic valve), using the following values for tightening:

Table 2.22

Thread	Tightening torque (Nm $\pm$ 10%)
M 8 x 1 mm	5
M 12 x 1.5 mm	24
M 14 x 1.5 mm	28

Insert the pipe into the union for the section of length L that was previously marked, using a force between 30 and 120 N, based on pipe dimensions.

The components can be replaced (valves, etc.) as the coupling and the union permit internal rotation during unscrewing and screwing operations.



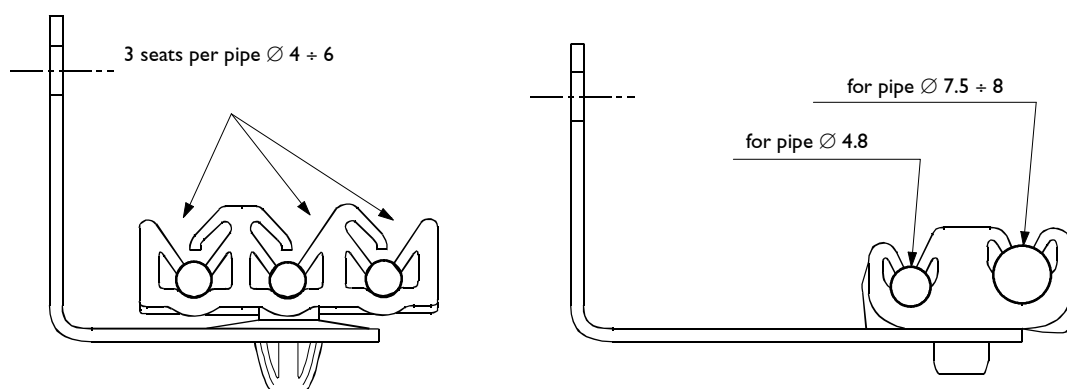
**New unions must be used when replacing a pipe . A union may not be reused after it has been opened.**

### Pipe installation

The new piping must be carefully cleaned inside before being used.

The fastening elements must completely wrap the pipe; must be in metal with rubber/plastic protection or be made out of plastic. Figure 2.28 shows two examples of brackets with retaining springs for fixing the brake pipes along the chassis.

Figure 2.28



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Provide a suitable distance, in general 500 mm max, between fixing elements.

For plastic pipes, in order to prevent deformations and tensions when closing the unions, foresee precautions in the arrangement and positioning of the chassis fixing elements. The correct positioning of the fasteners must prevent the pipes from rubbing up against the fixed parts of the chassis.

Comply with the necessary safety distances from moving components and heat sources.



**After each operation, both on the system as well as on the equipment, carefully bleed the air.**

**The liquid ejected from the hydraulic circuit during the bleeding operation must not be reused.**

**For topping up, only use the specified type of liquid contained in original sealed containers that must only be opened at the moment of use.**

**Then check the correct operation of the brake system.**

### **Bleed the air with "MODUS" or "E.A.SY." on vehicles with an ABS/ABD/EBD system**

On vehicles equipped with an ABS/ABD/EBD system, the traditional manual bleeding operation may not be sufficient.

It is necessary to carry out the operation controlled by the program included in "MODUS" or in "E.A.SY.".

This program makes it possible to perform a complete bleeding operation (primary circuit and secondary circuit of the modulator) under System filling/emptying.

Follow the instructions that appear on the video, being careful not to exceed the pump and solenoid valve activation time to prevent the components from overheating.

In that case, the system will deactivate and the predetermined amount of time must pass before restarting the operation.



**If replacing the modulator (supplied by IVECO Parts already filled with brake fluid in all parts) it is sufficient to perform the manual bleeding procedure, making sure not to empty it and to not cycle the pump or the solenoid valve before filling is complete.**

The ABS, ABD, EBD modulator devices, positioned on the chassis in the engine compartment, must not be moved.

### **Warning**

When performing the work, particular attention must be paid to ensure that the pipes are connected correctly for each wheel. After each operation, perform the necessary checks and controls to ensure correct operation at Authorised Workshops equipped with the specific equipment.

### 2.15.2 Braking corrector

For vehicles that are still requested without ABS, there are two types of braking correctors:

- version for the dual braking circuit combined with the single rear wheels (models 29L and 35S);
- version for the single circuit combined with twinned rear wheels (models 35C).

#### Adjusting the corrector

The adjustment is performed originally in the production plant and makes the vehicle suitable for transporting loads or for the application of normal superstructures in compliance with deceleration and traction values required by the relative EC Directives. The adjustment and control data is specified on a specific plate, located on the vehicle as specified in the specific documentation. Having to adjust the corrector differently, proceed as indicated below (see Figure 2.29).

**NOTE** In the case of new springs, it is necessary to correctly settle the rear suspension before carrying out the adjustment.

**For this purpose, it is recommended to partially load the vehicle (approx. 2/3 of the permitted maximum), drive on an uneven road and then perform a series of braking operations in forward and reverse gears.**

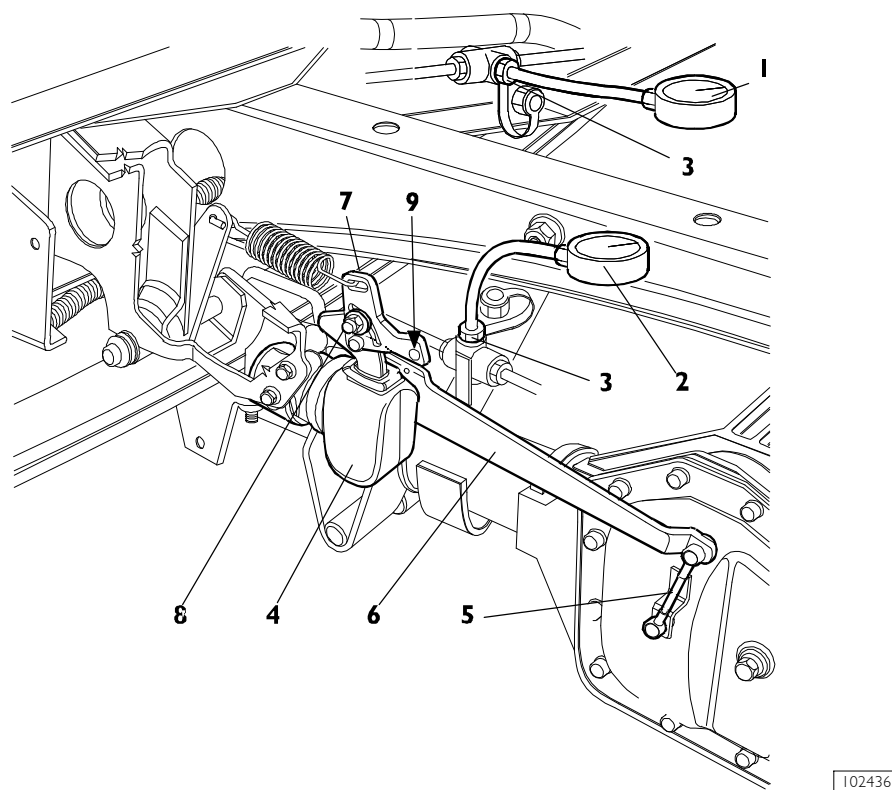
- Connect pressure gauges 1 and 2 to the pressure test points upstream and downstream of the corrector using the test unions 3.
- Loosen the screw 8 joining the adjustment lever 7 to the corrector.
- Apply the specific adjustment load for each model and for each spring to hole 9 after loading the engine axle according to the reference value (see Table 2.23).

Table 2.23

Models	Rear leaf spring Type (part. no°)	Load on the adjustment lever (kg)	Reference load on the ground on the rear axle (kg)
29L - 35S	single-leaf (504054606 -...)	1.5	1500
35C	semi-elliptic (504048792 -...)	3.5	1500

- Tighten the connecting screw 8 to the required torque of  $16 \div 19$  Nm.
- Activate the brake pedal until a control pressure of 100 bar is reached in the circuit upstream of the corrector.
- Check that the output pressure reaches the value indicated on the plate, corresponding to the resulting ground weight.

Figure 2.29



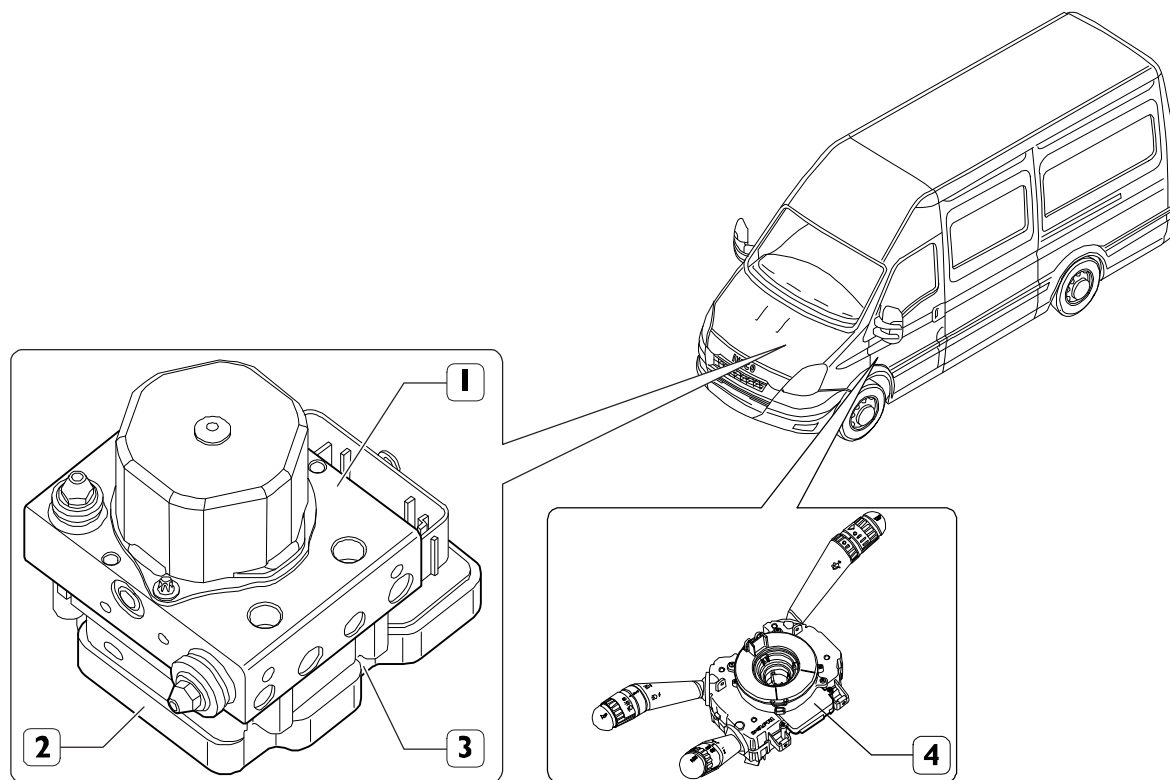
Single-circuit corrector for model 35C

1. Pressure gauge upstream of the corrector - 2. Pressure gauge downstream of the corrector - 3. Test unions - 4. Breaking corrector - 5. Rod - 6. Main lever - 7. Adjustment lever - 8. Coupling screw - 9. Hole for the application of the calibration load

### 2.15.3 ESP (Electronic Stability Program)

ESP is an electronic function that contributes towards the active safety of the vehicle. This function controls the transversal dynamics and stability using the components indicated in the Figure 2.30. In particular, in the case of potential vehicle instability and through the electro-hydraulic modulator, the control unit activates the modulated braking of one or more wheels at the same time.

Figure 2.30



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1. Electro-hydraulic modulator - 2. Braking system control unit - 3. Yaw and acceleration sensor - 4. Steering angle sensor

The following parameters are relevant for the correct programming of the ESP control unit:

- vehicle configuration (van, truck, camper,...);
- wheelbase;
- G.V.W.;
- type of suspensions;
- type of gearbox;
- wheel circumference;
- possible presence of a retarder.

Each change to one or more of these parameters requires reprogramming the control unit or the functional downgrading of the system. The following paragraph describes the main situations that can be determined.

**NOTE** The reprogramming of the control unit or the downgrading of the ESP system can be performed exclusively by the IVECO Support Service.

## 2.15.4 ESP system downgrading



The downgrading of the ESP system involves the complete deactivation of the vehicle's stability control.

When the downgrading is performed, the following functions still remain active:

- ABS (Antilock Braking System) to prevent the wheels from locking
- EBD (Electronic Brake Force Distribution) to distribute the braking force between the front and rear axles
- ASR (Anti Slip Regulator) to limit the slipping of the driving wheels at pickup
- MSR (Motor Schleppmomenten Regelung) to control the braking effect of the engine when released
- HBA (Hydraulic Brake Assist) to increase system pressure in the case of sudden braking
- HHC (Hill Holder Control) to make pickup on an upward incline easier from a stopped position

### Transformation from truck to tractor

The transformation from a truck to tractor must be authorised by IVECO and is not compatible if an ESP system is installed. Therefore, if authorisation is granted, the downgrading of this system is mandatory.

### Transformation from van to truck

The transformation from van to truck must be authorised by IVECO and is not compatible if an ESP system is installed. Therefore, if authorisation is granted, the downgrading of this system is mandatory.

### Variation of the G.V.W.

The variation of the G.V.W. must be authorised by IVECO and is possible only in some particular cases if an ESP system is installed. In cases of compatibility, the system management software must be reprogrammed, in all other cases downgrading is mandatory. Reprogramming or downgrading may only be performed by the IVECO Support Service.

### Modification of the wheelbase:

#### a) Towards values included in the product grid

If the transformation leads to a wheelbase value that exists among those in production for the specific vehicle model, it is necessary to reprogram the ESP system software.

#### b) Towards values that are not included in the product grid

If the transformation leads to a wheelbase value that does NOT correspond with those in production for the specific vehicle model, downgrading of the ESP system is mandatory.



### Suspension modification or replacement

If an ESP system is installed:

- no change to any part of the suspension is permitted;
- it is permitted to replace the entire suspension with another type that is already approved for the specific vehicle model;
- it is possible to replace pneumatic suspensions with mechanical suspensions, or vice versa, as long as units are used that have already been approved for the specific vehicle model.

These operations may only be carried out if authorised by IVECO and require the reprogramming of the ESP system software.

### Stabilizer bar modification or replacement

The modification or replacement of the stabilizer bars must be authorised by IVECO and may not be done if there is an ESP system.

Therefore, if authorisation is granted, the downgrading of this system is mandatory.

### Pneumatic gearbox

See Chapter 2.14



**It is prohibited to vary the tyre specifications beyond the limits of IVECO approval.**

### Retarders

With regard to the possibility of using a retarder when an ESP system is installed, please note that:

- a) electro-mechanical type retarders are NOT permitted as they do not interface with the vehicle via the CAN network and therefore cannot be managed;
- b) the retrofitting of an electronically-operated electro-magnet retarder is compatible, but requires IVECO authorisation also due to the resulting changes to the mechanical components (see Chapter 2.19).

In the case of a favourable result, the authorisation is released and instructions are provided for connection to the CAN network by means of a bridle.

If not provided as an original option, this bridle can be requested from IVECO spare parts with the references:

- drawing 5801619664 for left-hand drive vehicles
- drawing 5801619666 for right-hand drive vehicles

Please note that after the work is performed, it is mandatory to have some control units (Body Computer, instrument panel, automated transmissions (if applicable)) reprogrammed by the IVECO Support Service.

The possible removal of the retarder involves the restoration of normal functionality of vehicle electronics; also in this case it is necessary to contact the IVECO Support Service.

### Non-permitted transformations

Change of the ESP control unit configuration parameters.

Change of engine characteristic data.

Change to the installation of the steering angle sensor and the electro-hydraulic modulator.

Change and/or application of superstructures that could involve load distributions that do not comply with what is required in Chapter 1.15.

Change to the kinematic steering ratio.

## 2.16 Electrical system: work and current draws

**NOTE** For information regarding work on the electrical system, refer to what is described in section 5 - Chapter 5.4.

## 2.17 Moving components and fastening supplementary units and equipment

If it is necessary to move units (various components, fuel tank, spare wheel, etc.) for the installation of particular equipment, the operation is permitted on the condition that:

- the functionality of the units themselves is not jeopardised;
- the same type of original connection is restored;
- the new situation and distribution of mass is compatible with the original vehicle situation.

The protruding fastening of heavy components is not permitted (batteries, for example); the supports, in addition to being placed on the side member, must be secured to other components, such as support surfaces or one of the sides.

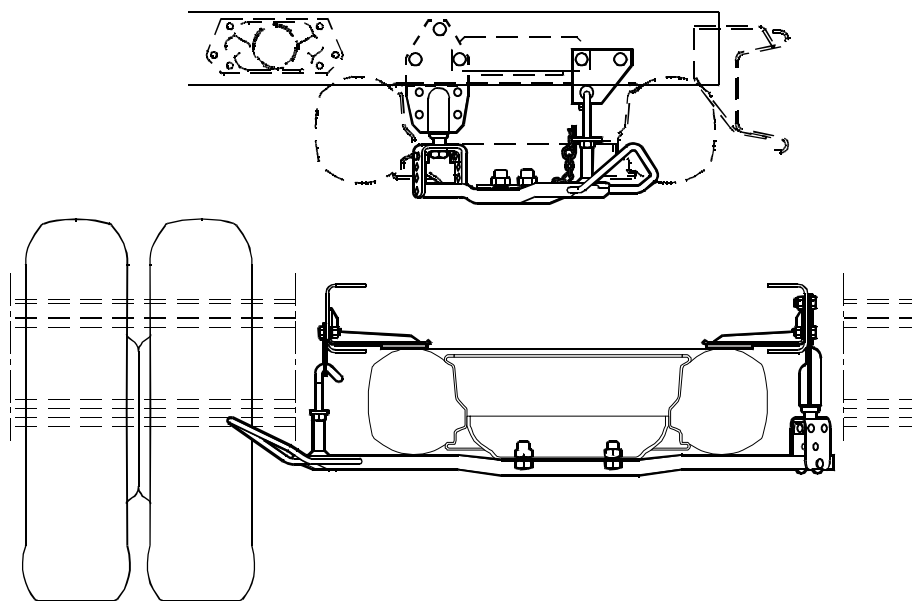
### Wheel holder

For cabs not supplied with a spare wheel holder, or if it is necessary to move the location of the spare wheel, a suitable support must be implemented that permits quick removal and that respects a minimum entry angle of 7°.

Two possible solutions are shown in figures 2.31 and 2.32.

For the fastening of the spare wheel on the side of the vehicle with a support placed on the rib of the side member, it is recommended to place a local reinforcement plate inside or outside of the side member that is sized in function of the wheel weight and if there are other reinforcements on the side member or not.

Figure 2.31



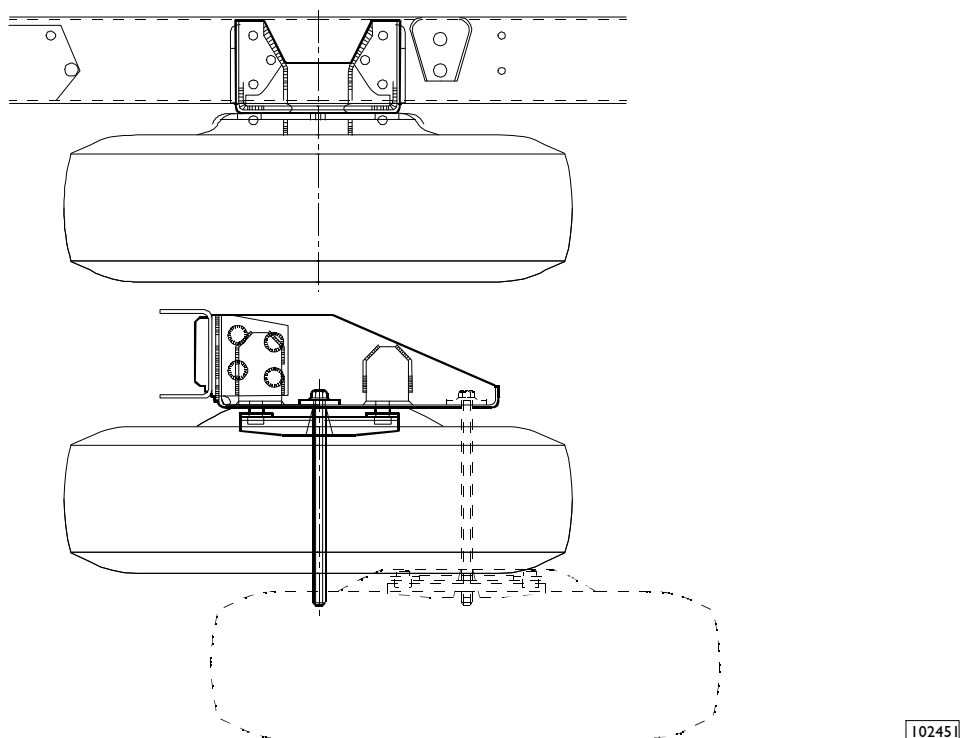
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In order to limit the torsional stress on the vehicle chassis it is recommended to install it in correspondence of a cross member, especially in the case of heavy units.

It is necessary to proceed in the same manner when installing tanks, compressors etc.; their location must be taken into account when distributing weights (see Chapter 1.15). In all of these situations, a sufficient margin in their height from the ground must always be guaranteed based on vehicle use.

The holes to be made for the new positions must be made on the rib of the side member, according to the requirements specified in Chapter 2.2 and, being careful to use already existing holes as much as possible.

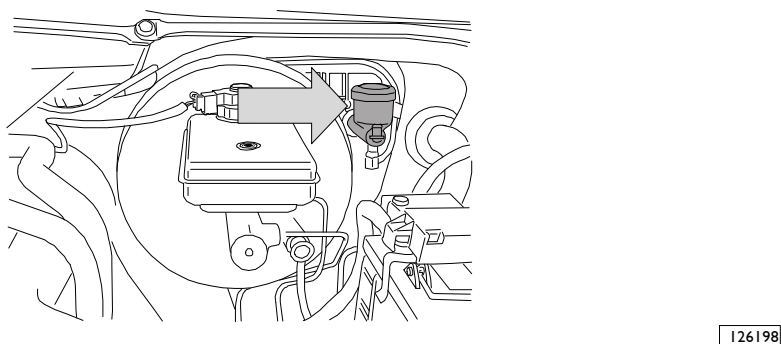
Figure 2.32



### Clutch control tank

This is located in the front part of the chassis, the tank cover must not be removed and the unit does not require maintenance.

Figure 2.33

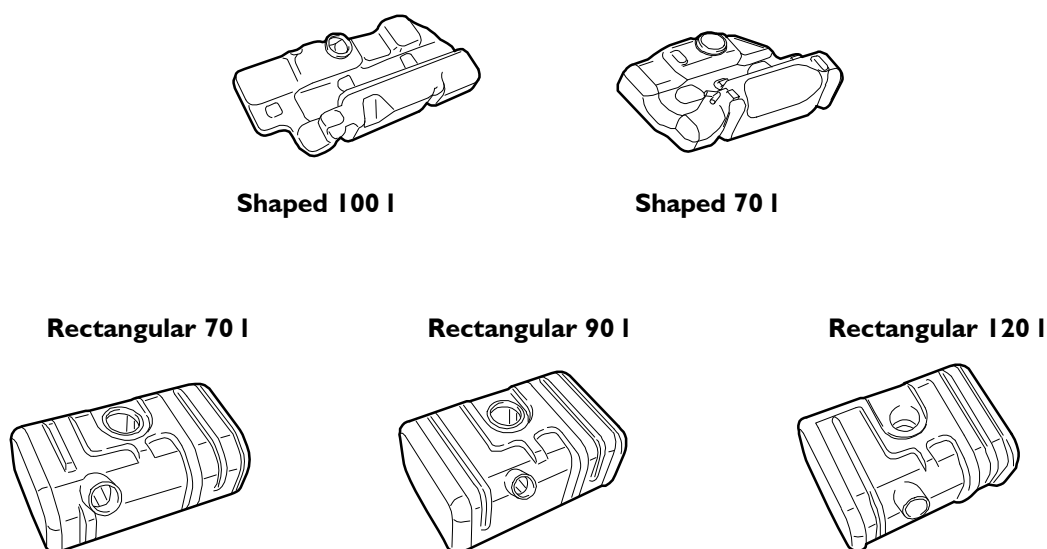


## Fuel tank

If the fuel tank capacity is not sufficient or the tank is not suitable for the fitter's requirements, a tank of a larger size or with a different shape can be installed. Before replacing it, check that the new tank is compatible with the vehicle's original configuration.

Figure 2.34 specifies the types of IVECO tanks available as an alternative to the original one.

Figure 2.34



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Please note that if the tank is replaced with a different type, the body computer must be updated. In fact, the body computer processes the signals of the level indicator, associating them with the emptying rules of the specific tank, and as a result, using a different tank requires the resetting of the consumption and range indications, etc.

---

**NOTE** Fuel tanks are subject to ministerial type approval.

---

## 2.18 Road transport of hazardous goods (ADR)

Based on the specific ECE document (European Agreement) and its national implementations, hazardous goods are classified as explosives, flammable liquids, gas, hydrogen.

Hazardous goods must be transported by specifically equipped vehicles and the type of equipment is different based on the said categories.

IVECO does not provide ADR versions, although the vehicles are already compliant on the level of some electrical parts, mechanical components and materials inside the cab.

The fitter who makes a request is issued a declaration containing the detail of the paragraphs of the ECE document with which the vehicle is already compliant.

Anything that is missing for the full adaptation of the vehicle is the responsibility of the fitter. The fitter is also fully responsible for the implementation.

The transformation must be authorised by the Authorities that perform these inspections.

## 2.19 Application of a retarder

Fitting a supplementary retarder (only the electronically-operated electro-magnet type) requires work on the propeller shaft and therefore must be authorised by IVECO.

Models 29L and 35S cannot adopt the device, whereas suitability must be checked for the others based on the product grid (wheelbases, versions).

The retarder must be selected based on the following formula:

$$\frac{i_p \cdot C_f}{R' \cdot PTT} \cong I$$

$i_p$	=	axle ratio
$C_f$	=	maximum braking torque (Nm)
$R'$	=	loaded radius of the used tyre (m)
$PTT$	=	total ground weight (kg)

### Calculation example of the maximum braking torque

Considering a 50C15V/P vehicle with axle ratio of 3.15 and 195/75R16 tyres.

From the data

1.  $i_p = 3.15$
2.  $R' = 0.317 \text{ m}$
3.  $PTT = 5200 \text{ kg}$

the following is obtained:

$$C_f = (5200 \cdot 0.317) / 3.15 = 520 \text{ Nm}$$

A retarder brake with a maximum braking torque of 500 Nm may be applied.

The application must be taken care of directly by the supplier in strict compliance with Chapters 2.2, 2.8 and 5.4 of these Directives. The delegated workshop is responsible for every phase (fastening the unit to the vehicle structure, cutting the propeller shaft, connections, checking correct operation).

For the connection of the management control unit, a bridle must be used on the instrument panel, which can be obtained from the IVECO spare parts service with reference no. 5801619664 (right-hand drive) and 5801619666 (left-hand drive).

**NOTE** For vehicles with an ESP system, see Paragraph 2.15.4.

## 2.20 Changes to the under-run protection bar

The vehicles are equipped with an under-run protection device in compliance with current EC Directives.

The maximum distance permitted between the device and the most set back part of the superstructure is 400 mm, less the deformation found during the approval phase (10 mm on average).

When the changes on the chassis require an adjustment of the rear overhang, the under-run protection device must be repositioned (in compliance with current regulations) making the same connection to the chassis foreseen in the original version.

When transforming vehicles or applying special equipment (e.g. rear tail lifts) it may be necessary to perform work on the under-run protection structure. This must not jeopardise the original characteristics of resistance and rigidity (compliance with any national standards). Upon request, the fitter must present the necessary documentation for compliance with the required characteristics.

If another under-run protection device must be fit, compliance with current regulations must be checked. The inspection certificates or documentation must be presented, if requested, to the competent Authorities.

Rear under-run protection and wheelhouses

## 2.21 Rear under-run protection and wheelhouses

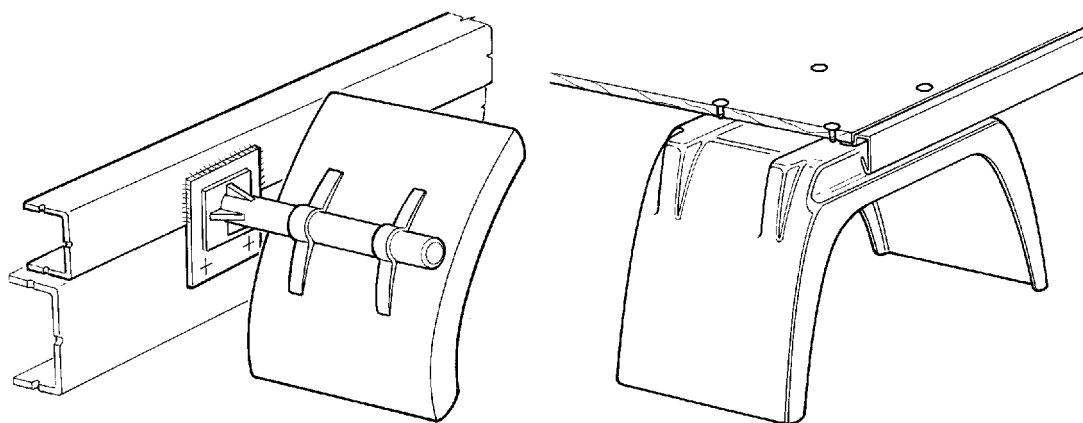
In cab vehicles supplied without mudflaps, these can be positioned by implementing solutions equivalent to what is foreseen by IVECO.

For the implementation of the mudflaps, the wheelhouses as well as for the conformation of the superstructure, keep in mind that:

- the free movement of the wheels must be guaranteed also if chains are used, in compliance with the limits specified in Paragraph 2.13.3;
- the maximum width of the tyres must comply with the legal limits foreseen for the vehicle;
- the support structure must be suitably robust, avoiding sudden variations in sections and the presence of vibration;
- the connection can be made to the vertical rib of the vehicle side members or to the longitudinal sections of the sub-frame. In the first case, the connection must be done using only screws, or directly under the superstructure (see Figure 2.35).

The first and the second point must also be kept in mind when implementing the wheelhouses.

Figure 2.35



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## 2.22 Mudflaps

If required by regulations and if not originally fitted, it is necessary to ensure that the complete vehicle is provided with suitable mudflaps. For the assembly, the distances specified by current regulations must be respected.

## 2.23 Side protections

In some countries, regulations (national or EC) require the application of side protections. Compliance with the required characteristics must be guaranteed by the fitter who completes the vehicle, if this has not already been originally installed (optional equipment).

In permanently installed superstructures (e.g. fixed bodies, van bodies) the side protection may be applied on their base structure (e.g. frame of the floor, cross member), whereas for mobile superstructures (e.g. tilting bodies, interchangeable, roll-off equipment) the connection may be made by means of suitable supports on the sub-frame or directly on the vehicle chassis. In the latter case, use if possible the existing holes in the vertical rib of the side member, in accordance with Chapter 2.2.

When implementing the external protection, according to what is specified by the regulations (e.g. EC Directive), it is permitted to use a single section on an extended surface in a vertical direction or multiple longitudinal sections, with predefined dimensions and distances from each other.

The side protection must be connected to its support structure in order to permit quick removal or tilting in the case of maintenance or repairs on the units positioned nearby.

Functionality and accessibility to the following components must be guaranteed:

- braking system equipment;
- fuel supply;
- suspensions;
- spare wheel;
- engine exhaust.

It is recommended to use suitable materials (e.g. FeE420).

Particular attention must be placed on the implementation to ensure the distances from the various vehicle components required by regulations are respected.

## 2.24 Chocks

Normally, installation takes place directly in production. If this is not the case, or if it is necessary to change the original position, the Fitter must identify a new position in compliance with local regulations. The new position must be reliable and safe and be easy to access.



## SECTION 3

**Fitting supersstructures**

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

### 3.1 Construction of the subframe

The purpose of the sub-frame is to ensure uniform distribution of loads on the vehicle chassis, sharing their resistance and rigidity effects according to the specific vehicle use.

#### 3.1.1 Material

In general, if stress on the sub-frame is not excessive, the sub-frame can be built with materials of poorer characteristics than those used for the chassis, provided that it needs to be easily weldable and that it must not have values lower than those (I) shown in Table 3.1.

Materials with better mechanical characteristics may be used when stress limits require them (e.g. in cranes), or if excessive section heights are to be avoided. However, take into account that reducing the inertial moment of the reinforcing profile causes greater flexion and stress on the main chassis.

The following are the characteristics of some materials taken into account for some of the applications described below.

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

Steel name		Breaking load (N/mm <sup>2</sup> )	Yield point (N/mm <sup>2</sup> )	Elongation
IVECO	FE360D	360 (I)	235 (I)	25% (I)
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 - Section bar dimensions

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

While the resistance modulus is a determining value for material stress the inertial moment is significant mainly for flexion rigidity as well as for the ratio of flexing moment to be sustained, according to the connection used.

### 3.1.3 Aluminium subframe

When materials having different characteristics than steel are used (e.g. aluminium) the size and structure of the sub-frame must be adapted appropriately.

- a) When the task of the sub-frame is mainly to provide a uniform distribution of the load while the chassis maintains the fundamental task of providing resistance, longitudinal aluminium profiles can be used, having a size identical to that used for steel. Some typical examples are fixed trays, vans, tanks, provided that supports are continuous and close to each other, or located in proximity of the suspension supports. Cases when excessive stress on the chassis requires relatively big sizes of steel reinforcing profiles or shear resistant connections are exceptions.
- b) When the sub-frame must also provide support in resistance and rigidity (for example structures with high concentrated loads, tilting bodies, cranes, central axle trailers, etc.), using aluminium is not recommended and it must be authorized from time to time by IVECO.

Furthermore, when calculating the minimum size of reinforcing profiles, the allowed stress limit of aluminium must be taken into account as well as the different elasticity modulus compared to steel (approx. 7,000 kg/mm<sup>2</sup> compared to 21,000 kg/mm<sup>2</sup> of steel), which requires greater sizes for the profiles.

Similarly: when the connection between chassis and sub-frame is such as to ensure the transmission of shearing forces (connection with plates), the new neutral axis must be defined when verifying the stress at the two extremities of the single section, according to the different elasticity modulus of the two materials.

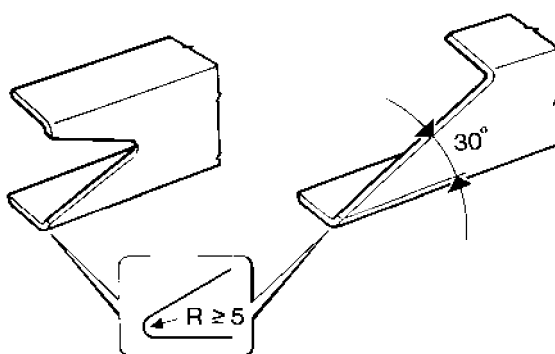
This application for aluminium therefore requires large sizes, scarcely convenient.

## 3.2 Elements making up the subframe

### 3.2.1 Longitudinal runner profiles

The side members of the additional structure must be continuous, extended as much as possible toward the front part of the vehicle and toward the area of the rear support of the front spring; furthermore, they must lean on the chassis and not on shelves. In order to create a gradual decrease of the resisting section, the front ends of the profile must be tapered in height to an angle no greater than  $30^\circ$  or with another tapering having an equivalent function (see Figure 3.1); the front end in contact with the chassis must be coupled appropriately, with a min. radius of 5 mm.

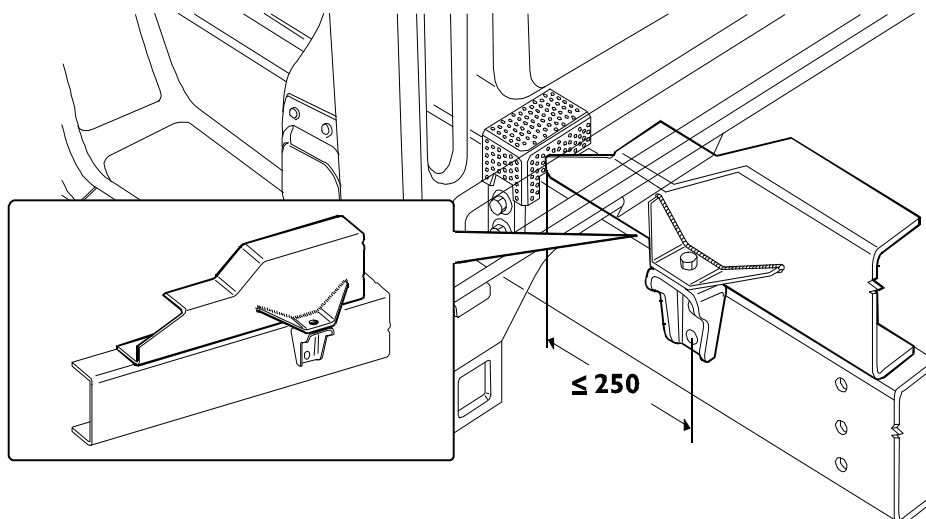
Figure 3.1



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When the components of the cab rear suspension (e.g. with deep cabs) do not allow the profile to pass through in its entire section, the section can be created as shown in Figure 3.2. This might require checking the minimum resisting section with high front flexing moments (e.g. with a crane behind the cab operating toward the front of the vehicle), requiring a mounting not beyond 250 mm from the front end of the sub-frame.

Figure 3.2



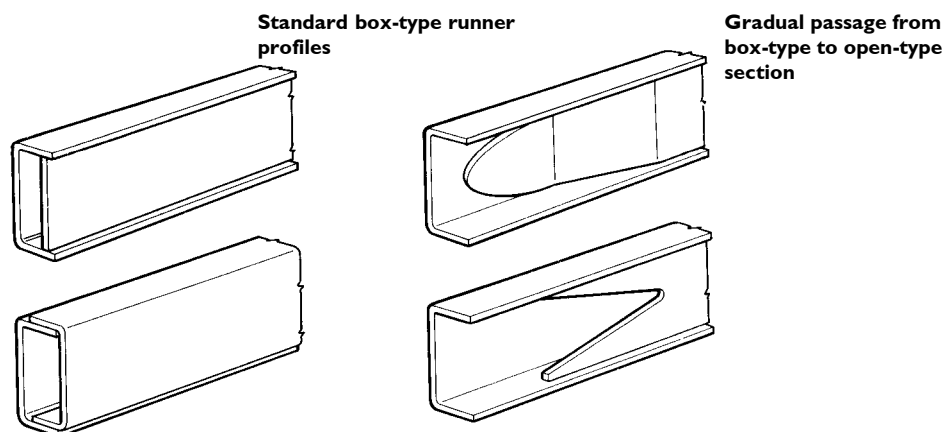
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The shape of the profile section is determined according to the function of the sub-frame and the type of structure above it. Open C profiles are recommended when the sub-frame must adapt elastically to the vehicle chassis, or boxed sections when a greater rigidity of the assembly is required.

Take care to create a gradual passage from the boxed section to the open section, as in the examples of Figure 3.3.

Figure 3.3



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The profiles of the sub-frame must be continuously leaning on the profiles of the chassis; if it is not so, continuity can be re-established by means of sheet metal or light alloy straps.

If a rubber antiskid element is positioned here, we recommend specifications and thickness identical to those used for normal 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).

The sizes described for side members for various types of frames are the minimum recommended values, normally valid for standard vehicle wheelbases and rear overhangs. In every case similar profiles can be used provided that their inertial moment and resistance are no lower than these values: these values can be found in the technical documentation of the profile manufacturers.

### 3.2.2 Cross members

A sufficient number of cross members, to be positioned near the fastenings of the chassis, must brace the two profiles of the sub-frame.

Cross members can have an open section (e.g. C-section) or a closed section if greater rigidity is required.

Use suitable plates when connecting them, so as to provide appropriate resistance (see Figure 3.4). When greater connection rigidity is desired, construction can be performed as per Figure 3.5.

Figure 3.4

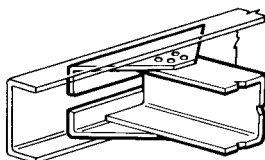
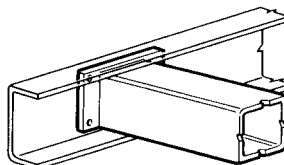


Figure 3.5



### Stiffening the subframe

The sub-frame must be made more rigid in the rear part for some structures (e.g. tilting bodies, cement mixers, cranes on the rear overhang, structures with high centre of gravity).

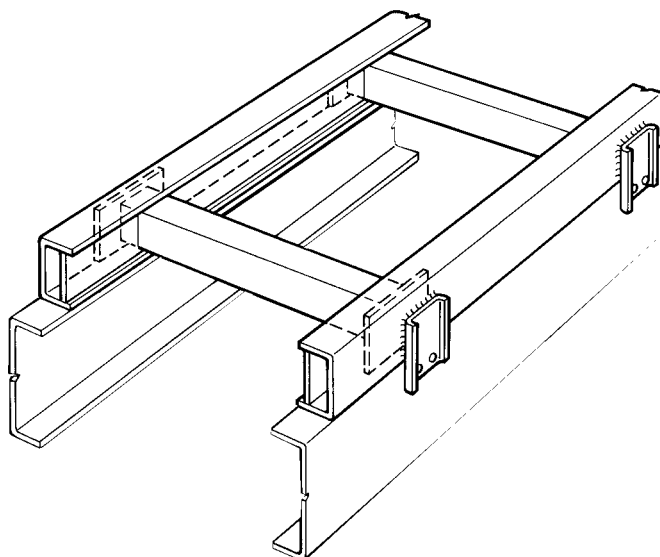
This can be performed with a greater amount of rigidity to achieve:

- 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).

These solutions can be combined.

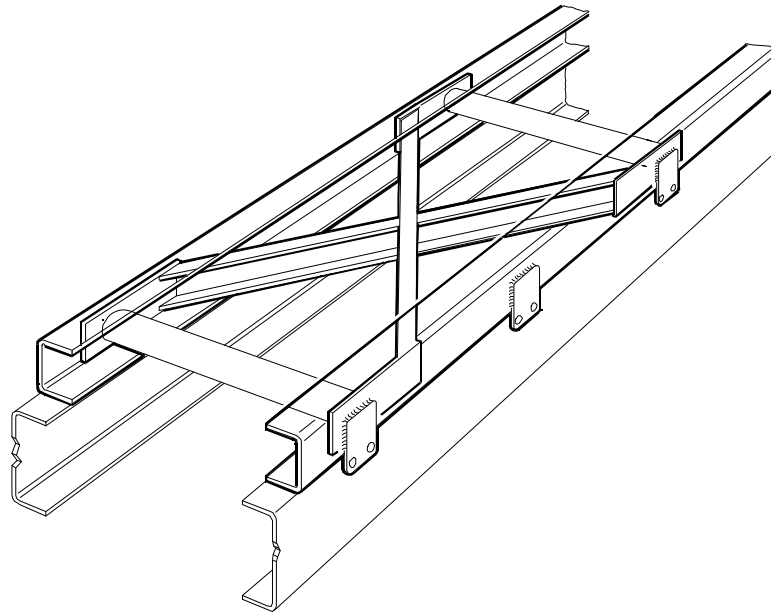
Generally speaking, using longitudinal boxed profiles must be avoided in the front part of the sub-frame.

Figure 3.6



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Figure 3.7



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**Self-supporting bodies as subframes**

When installing self-supporting structures (e.g. vans, tanks) or when the basic structure of the equipment to be installed is already shaped as a sub-frame, the use of a sub-frame (longitudinal profiles and cross members) can be avoided.

### 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 IVECO - is very important in terms of the subframe providing strength and stiffness, for the appropriate body type.

It can be elastic (shelves or flanges) or rigid, resisting to shearing strains (longitudinal and transversal plates); choice must be based on the function of the structure to be applied (see points 3.4 to 3.9), taking into account the stress transmitted from the additional equipment to the vehicle chassis, both in static and dynamic conditions. Quantity, size and construction of the fastenings, properly distributed along the length of the sub-frame, must be such as to ensure good connection between chassis and sub-frame.

The screws and flanges must have a resistance class no lower than 8.8, nuts must be provided with loosening prevention systems. The first fastening must be fixed, if possible, approximately 250 to 350 mm from the front end of the sub-frame.

It is preferable to use the fastening elements already present on the vehicle chassis.

The aforementioned distance for the first fastening must be respected particularly when structures are fitted with loads concentrated behind the cab (e.g. cranes, front tilting body cylinder, etc.), so that the stress on the chassis and the stability are improved. If necessary, perform additional fastenings.

If a structure with characteristics differing from those for which the chassis body is approved needs to be installed (e.g. a tilting body on a chassis approved for a fixed tray), suitable connections must be prepared (e.g. shelves must be replaced with shear-resistant plates in the rear area of the chassis).



**When anchoring the structure to the chassis, no weldings must be performed on the vehicle chassis and its wings must not be pierced.**

In order to improve the longitudinal or transverse securing of the connection, it is permissible to have holes on the flanges of the side members, but only at the rear end of the members, over a length of not more than 150 mm, provided that the anchorage of any cross members that may be present is not weakened (see Figure 3.12). The mountings shown in Figure 3.11 may be used, applying the screws which connect the rear cross member or underrun brackets to the chassis.

**Note:** in all other cases, it is strictly prohibited to pierce the wings.

#### 3.3.2 Body mounting characteristics

**Elastic** connections (see Figure 3.8, 3.9 and 3.10) allow limited movement between chassis and sub-frame; these connections can be considered as cooperating in parallel with the two resisting sections, each taking care of a share of flexing moment proportionally to its inertial moment.

With **rigid** connections (see Figure 3.11), the two profiles can be considered having a single resisting section, provided that the quantity and distribution of connections are such as to support the consequent shearing forces.

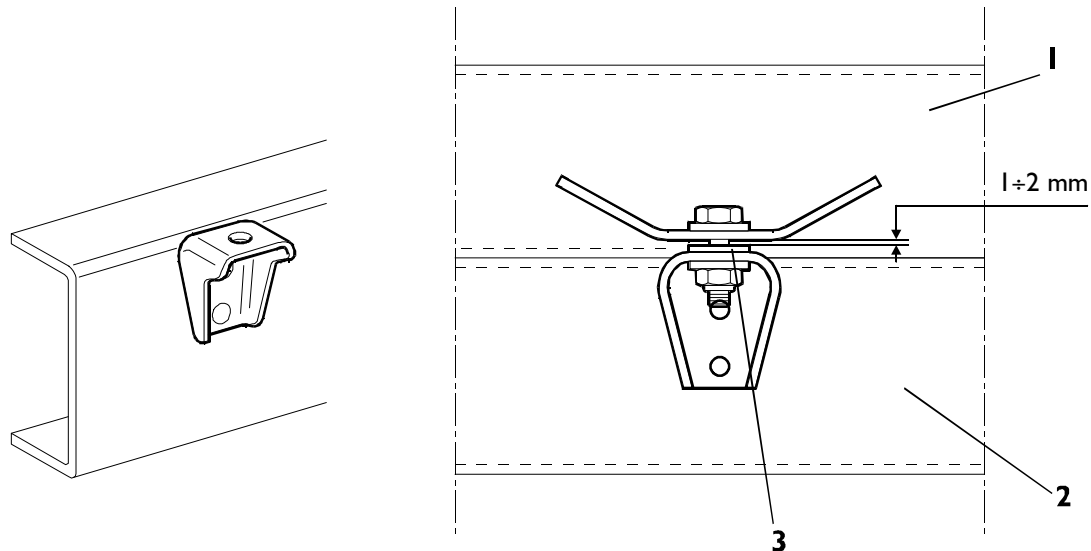
The possibility of creating a single resisting section between chassis and sub-frame allows reaching greater resisting capacity compared to connections with shelves or flanges, with the following benefits:

- lower height of the subframe profile under the same bending moment acting on the section;
- higher bending moment under the same subframe profile dimensions;
- further increase of resisting capacity if materials with high mechanical characteristics are used for the sub-frame.

### 3.3.3 Connection with brackets (flexible joint)

Some examples of this type of connection are shown in Figure 3.8 and 3.9.

Figure 3.8



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1. Subframe - 2. Frame - 3. Shims

To ensure elasticity of the connection, before tightening the screws the distance between chassis and sub-frame shelves must be 1 to 2 mm; greater distances must be decreased by using suitable shims. When tightening the screws, the shelves must come into contact.

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.

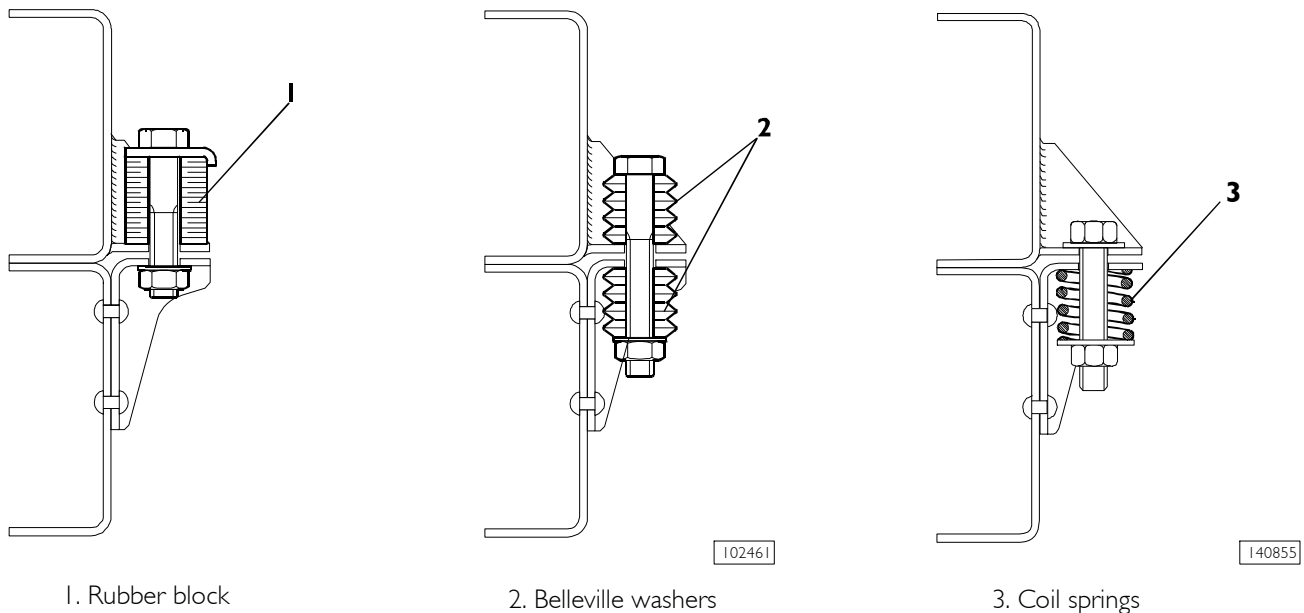
In order to better sustain transversal loads, usually the shelves are applied so that they protrude slightly in the vertical direction with respect to the upper edge of the chassis. If the shelves must be exactly flush, the side guide of the structure must be anchored in other ways (e.g. using guide plates connecting only to the sub-frame or to the vehicle chassis, see Figure 3.10). When the front connection is elastic (see Figure 3.9), the side containment must be ensured also when the chassis is at maximum torsion conditions (e.g. driving off-road).

If the vehicle chassis is already fitted with shelves to connect a tray of a type approved by IVECO, these shelves must be used to that purpose. Shelves applied to the sub-frame or structure must have resistance characteristics no lower than those originally fitted on the vehicle (see Table 2.7 and Table 3.1).

### 3.3.4 Elastic connections

When greater elasticity is required for the connection (e.g. vehicles with highly rigid structure, such as vans, tanks, etc. used on winding roads or poor conditions or off-road, etc.), the fastenings shown in Figure 3.9 must be used in the area behind the cab. In other words brackets fitted with silentblocks (1), Belleville washers (2) in line or in parallel or coil springs (3) must be used.

Figure 3.9



The characteristics of the elastic element must be suitable for the structure rigidity, the wheelbase and the type of use of the vehicle (road conditions).

Furthermore:

- rigidity must progressively increase for the fastenings that are closer to the rear part of the chassis;
- the total capacity of the connection must include also shear-resistant fastenings, which must be positioned near the rear suspension.

Therefore, the first fastening behind the cab must always be performed with one of the solutions shown in Figure 3.9 and this solution must be repeated also for the following fastening, changing only its rigidity, especially when the vehicle has a long wheelbase.

For example, when using brackets with silentblocks, elements having the same hardness ( $sh = 83$ ) must be used and assembled double in the first bracket and single in the following, with M10 screws and tightening torques of 15-18 Nm.

For all types of fastenings, observe the following:

- use materials that ensure good long-term flexible properties;
- provide appropriate instructions for periodic checking;
- retighten the tightening torque if necessary.

Also note:

- when fitting structures generating high flexing and torquing moments (e.g. crane behind cab), the sub-frame must have a size suitable to support them;
- in versions where the vehicle must be lifted by means of hydraulic stabilizers (e.g. cranes, lifted platforms), the yield of the elastic element must be limited in order to ensure sufficient support of the sub-frame and to avoid excessive flexing moments on the original chassis.

### 3.3.5 Connection with U bolts (clamps)

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

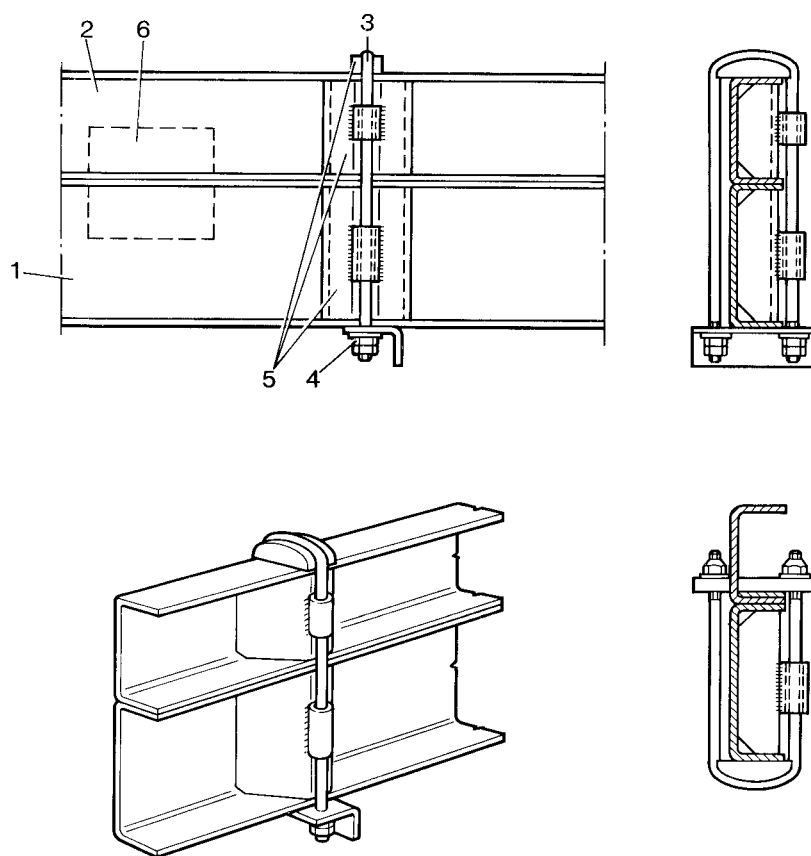
In this case the Bodybuilder must position a spacer (preferably made of metal) between the wings of the two side members and at the fastening U bolts, so that the wings will not be flexing due to the pull of the U bolts.

In order to guide and contain as best as possible the structure added to the chassis in the transversal direction, this type of fastening can be completed by adding plates welded to the sub-frame as shown in Figure 3.10.

The characteristics of this connection are not suitable for a general integral use on the vehicle; in any case, the fastening must be accompanied by longitudinal and transversal plates toward the rear part in order to provide the structure with a suitable longitudinal containment as well as an appropriate rigidity.

To this purpose, the screwed connection at the rear end of the chassis can also be used as shown in Figure 3.11.

Figure 3.10

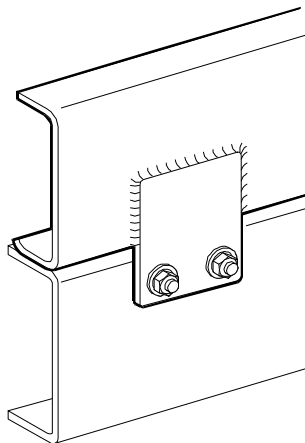


1. Frame - 2. Subframe - 3. U-bolts - 4. Locking with lock nut -  
5. Spacers - 6. Cleat plate (where necessary)

### 3.3.6 Connection with plates for longitudinal and transverse fixing (rigid joint)

The type of fastening shown in Figure 3.11, with plates welded or bolted to the sub-frame and fastened with screws or nails to the vehicle chassis, ensures good reaction to longitudinal and transversal forces and greater support to the overall rigidity.

Figure 3.11



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In order to use these plates correctly, take the following into account:

- the fastening of the vertical rib of the side members of the chassis must be performed only after checking that the sub-frame adheres exactly to the chassis;
- distribution must be limited to the central and rear area of the chassis;
- the quantity and thickness of the plates and the quantity of fastening screws must be suitable to transfer the flexing and shearing moments of the section.

Rigid joints are useful when the structure generates high flexing and torqueing moments on the chassis and the capacity of the chassis to resist shearing must be improved, or when the height of the sub-frame needs to be limited as much as possible (e.g. towing central axle trailers, crane on the rear overhang, tail lifts, etc.). If this occurs, the indications of the following table must be observed:

Table 3.3

Chassis / subframe section height ratio	Max. distance between the centre line of the shear-resistant plate (mm) <sup>1)</sup>	Models <sup>3)</sup>	Min. plate characteristics	
			Thickness (mm)	Screw size (min. 3 screws per plate) <sup>2)</sup>
>1.0	700	35C, 40C	4	M12 (min. 2 screws per plate)
≤ 1.0	500	45C, 50C	4	M12 (3 screws per plate)
≤ 1.0	500	60C, 65C, 70C	5	M12 (3 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) For 29L and 35S models, installation of shear resistant plates will need to be assessed for each case.



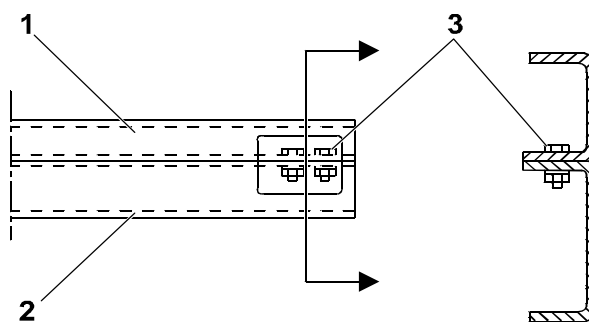
### 3.3.7 Mixed connections

According to the indications for the creation of the sub-frame (point 3.1) and the considerations in paragraph 3.3, the connection between vehicle chassis and reinforcing sub-frame can be mixed, i.e. created by using elastic (shelves, U bolts) and rigid (longitudinal and transversal plates) connections rationally.

As a general rule, elastic connections are preferable in the front part of the sub-frame (one or two for each side), while plate connections are recommendable for the rear part of the vehicle, when the additional structure needs to contribute to a greater overall rigidity (e.g. tilting bodies, cranes on the overhang, etc.).

To this purpose, the screwed connection at the rear end of the chassis can also be used as shown in Figure 3.12.

Figure 3.12



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1. Subframe - 2. Chassis - 3. Longitudinal and transverse securing bolts

### 3.4 Fitting box bodies

#### Dimensions and centres of gravity

Check that the weights are distributed correctly and, observe in particular the indications relative to the height of the centre of gravity in chapter I, taking suitable constructing measures to ensure that the transported load has the utmost stability during driving.

#### 3.4.1 Fixed boxes

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)	Modulus of resistance $W_x$ (cm <sup>3</sup> )
29L, 35S	All (1)	9
35C, 40C, 45C, 50C	All	16
60C, 65C, 70C	Up to 3750	21
	Above 3750	26

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.

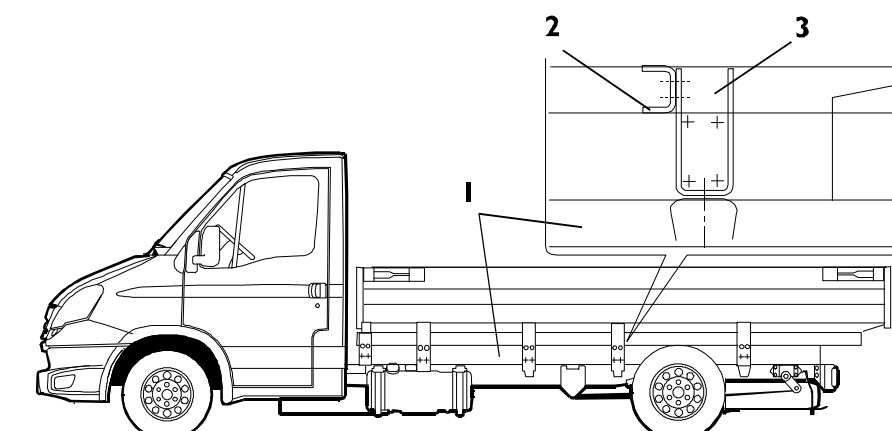
Fastening must be performed by means of suitable shelves fitted to the vertical rib of the side members; if these fastenings are not already fitted by IVECO, they must be created following the indications in point 3.3.3. In order to perform an adequate longitudinal containment, when connecting with shelves or flanges, it is advisable to fit a rigid connection (on each side) on the end of the rear overhang, performed by means of plates or screws on the upper wing of the side member (see Figure 3.11 and 3.12).

In no other case new holes must be drilled on the wings of the main side members.

When the tray uses high supports above the sub-frame (e.g. cross members), strengthen these supports appropriately in order to contain longitudinal forces as shown in Figure 3.13.

The front side of the body must be resistant and robust enough to support the forces generated by the transported load in the event of sudden high deceleration.

Figure 3.13



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1. Subframe - 2. Brackets - 3. Stiffening crosspieces

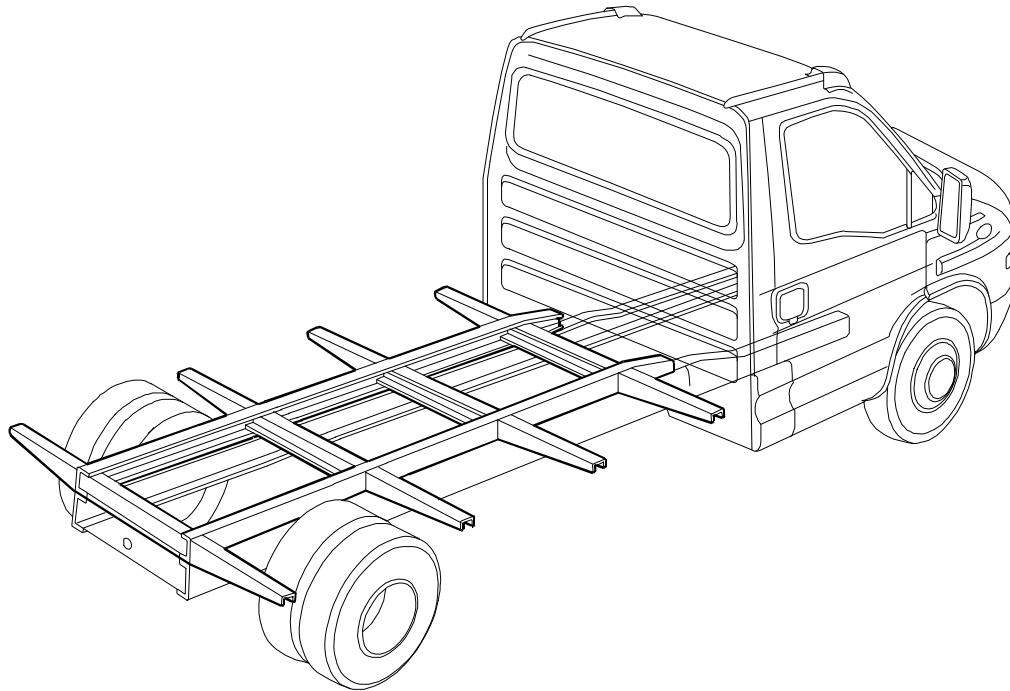
### Building vans

A structure made of longitudinal profiles and cross members can be created to connect to the vehicle chassis. For longitudinal profiles, see Table 3.4.

Figure 3.14 shows an example, where the longitudinal profiles are completed by cross members and shelves for the entire length in order to limit the height of the structure.

In this case the rear wheel arches can be inserted into the base of the structure.

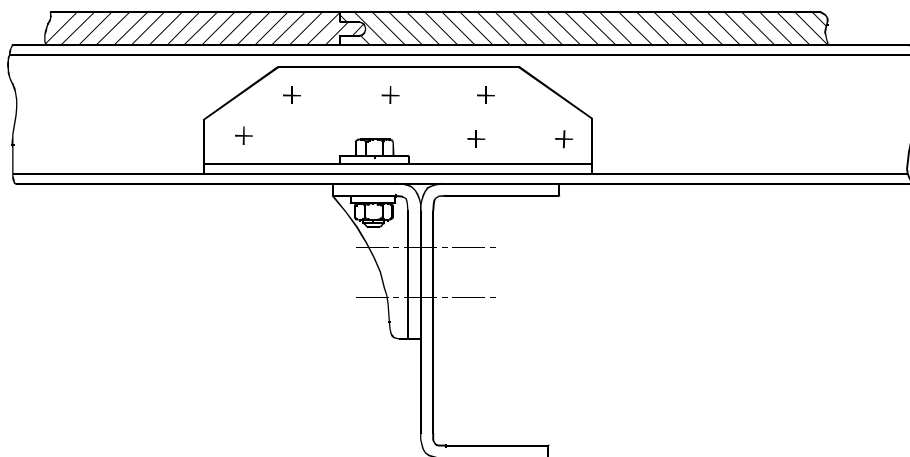
Figure 3.14



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When cross members are used for the floor with a distance no longer than 700 mm between them, connected so as to form a sufficiently rigid structure (self standing), the use of longitudinal profiles may not be necessary (see Figure 3.15). To ensure the required stability of the cross members and to avoid excessive rigidity of the chassis in the front part, we recommend taking into account the observations of paragraph 3.4.1.

Figure 3.15



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Applying trays or other structures with high torsion rigidity requires elastic connections toward the front of the structure in order to avoid excessive reduction in deformability of the main chassis.

### Front bulk-head

It must be resistant and robust enough to sustain the forces generated by the transported load in the event of sudden high deceleration.

### Bodies integrated with the cab

In these cases the connection must be performed so as to limit the stress transferred to the vehicle cab. Take the following into consideration when applying connections and reinforcements:

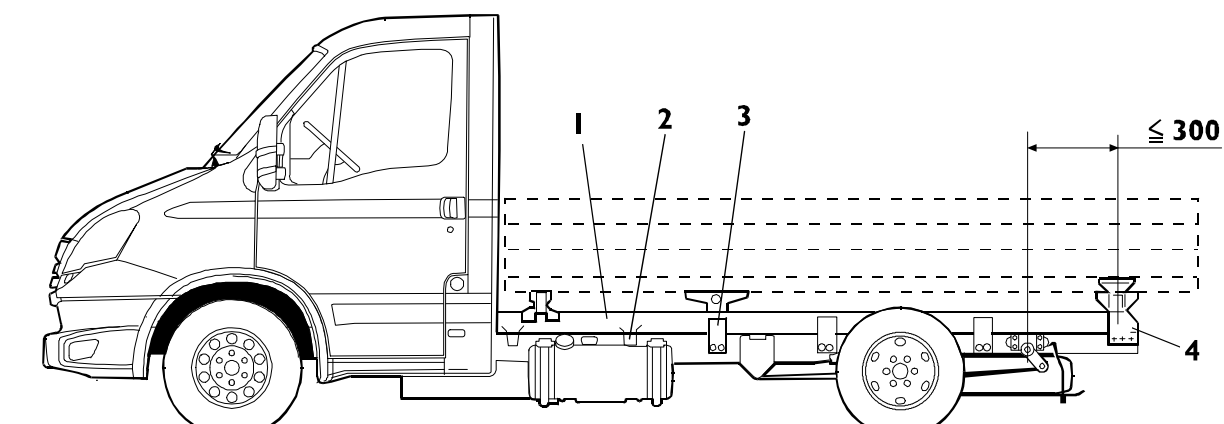
- cab sheets must not be welded and only mechanical fastenings must be used;
- the structure on the van, self standing, must not require support from the cab;
- all modified cab parts must be protected against oxidation and corrosion (see point 2.2).

### 3.4.2 Tipper boxes

The use of tilting platforms at the rear and on all three sides generally subjects to the frame to considerable stress. Therefore take into account the following indications.

- a) The use of a stabiliser bar is recommended for models for which IVECO considers it an optional.
- b) The sub-frame must be:
  - suitable for the vehicle type and for the specific operating conditions.
  - It must have adequately dimensioned side and cross members (see Table 3.5)
  - strengthened toward the rear by means of boxing profiles and cross-diagonals (see Figure 3.6 and Figure 3.7). The connections for chassis fastenings must be elastic (shelves or brackets) in the front, while they must be rigid (plates) in the rear (see Figure 3.11) so that the additional structure can provide further rigidity.  
Omega shelves can be used on vehicles originally fitted with them.
- c) The hinging for the rear overturning must be arranged on the counterframe and its position must be as near as possible to the rear suspension support (see Figure 3.16). The distances between the hinge and rear suspension support must be fully observed so as not to compromise vehicle stability during overturning of the body and so as not to put the frame under excessive strain. If this is not possible, use sub-frame profiles of greater size compared to usual, and strengthen the rear part further. In particular cases, when long trays are required for greater volumes, we recommend using longer wheelbases rather than creating long overhangs.
- d) Particular care must be taken in positioning the lifting device, both with regards to the necessary strength of the supports and to realize a precise and convenient positioning of the fittings. In any case, in order to reduce the quantity of localized load, we recommend a position in front of the centre of gravity of the tray - payload assembly.
- e) In rear tilting bodies, we recommend applying a stabiliser to guide the travel of the tray, particularly if the lifting cylinder is located behind the cab.
- f) Hinging of the lifting device must be performed on the added sub-frame. The payload of the tray must be appropriate, while respecting the maximum limits allowed for the axles, to the volume weight of the material to be transported (consider a volume weight of approx. 1600 kg/m<sup>3</sup> for excavation materials).  
When transporting goods with low volume weight, the payload can be increased within set values for the maximum height of the load centre of gravity (including the equipment).
- g) The Bodybuilder must take care to safeguard the functions and safety of all parts of the vehicle (e.g. light position, towing hook, etc.) and must ascertain that after adding the structure the vehicle remains stable when tilting.

Figure 3.16



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1. Subframe - 2. Body mounting brackets - 3. Shear-resistant plates - 4. Hinge constraint

Table 3.5

Models	Minimum reinforcing longitudinal	
	Modulus of resistance $W_x$ (cm <sup>3</sup> )	Dimensions (mm)
35C, 40C	19	80x50x5
45C, 50C, 60C, 65C, 70C	36	100x60x6

### 3.5 Tractor for half-trailers

The range does not envisage special vehicles for towing semitrailers.

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

This authorisation provides the instructions that the Bodybuilder must follow, the allowed masses and the prescriptions for use.

Below are some general instructions.

#### Fifth wheel mounting

The application of a suitable structure of the sub-frame type (see Figure 3.17) has the purpose of distributing the load on the fifth wheel and ensuring the vehicle chassis a suitable torsion and flexion support. Table 3.6 gives the minimum dimensions to use for the longitudinal runner sections.

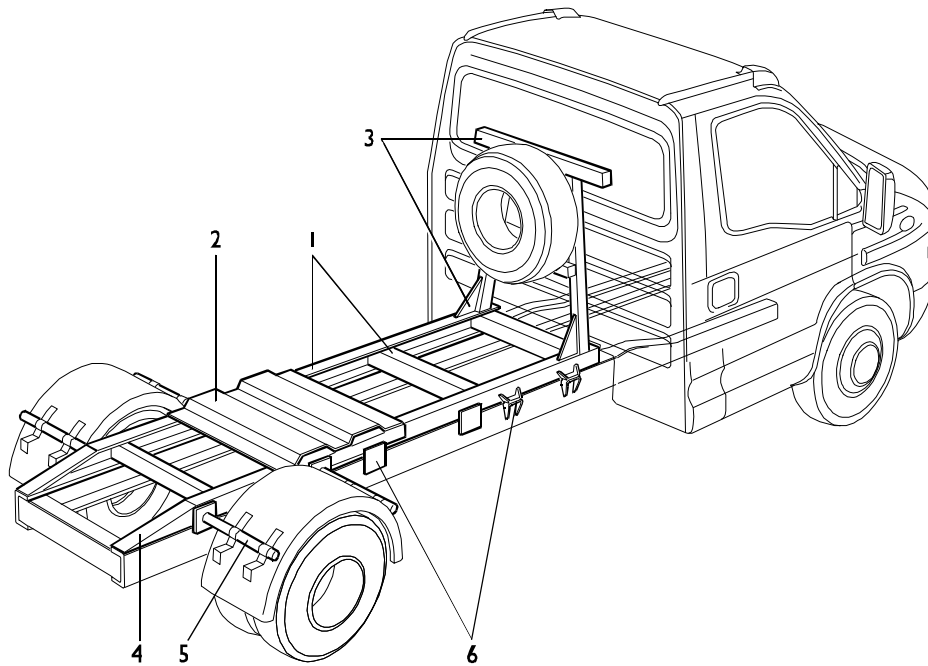
Furthermore, take the following into consideration for its construction:

- the structure must be sized appropriately for vertical and horizontal loads transmitted by the fifth wheel;
- the characteristics of the structure material must refer to point 3.1.
- the upper and lower surfaces of the structure must be flat to ensure good support on the chassis;
- the components of the structures, when constituted by several elements, must be connected by means of weldings and/or nails so as to constitute a single assembly;
- fastening the structure to the tractor must be performed by means of shear resistant plates in the central and rear part of the chassis and by means of shelves in the front part. For the connection use at least 8.8 class screws (in quantity and diameter such as to perform a fastening resistant to longitudinal and transversal forces) and use loosening prevention systems.

Table 3.6

Models	Wheelbase (mm)	Minimum reinforcing section	
		Modulus of resistance $W_x$ (cm <sup>3</sup> )	Dimensions (mm)
35C, 50C	3450	24	100x50x4

Figure 3.17



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1. Longitudinal runners and crossmembers - 2. Fifth wheel supporting plate or base unit - 3. Cab rear structure, support for electrical and brake connections (can also be used for spare wheel support) - 4. Tapered rear portion - 5. Rear wing support - 6. Connection to the chassis

### Fifth wheel

All fifth wheels can be used on IVECO vehicles provided that their load, size and performance capacities are declared by the Manufacturer to be suitable to the specific use.

The fifth wheels must comply with national and/or international regulations and be type approved. Follow the Manufacturer's instructions to know how to fasten the supporting structure, the quantity of screws, the size and position of the longitudinal and transversal stoppers.



**Since it is an important element for vehicle safety, the fifth wheel must not be modified.**

### Braking system

The Bodybuilder must provide a specific braking system for the semitrailer.



**The braking system must be extremely well designed and constructed due to its great significance for the active safety of the vehicle.**

**Use components, pipes and unions of the same type used on the original vehicle.**

According to the total weight, the braking system (service, emergency and parking brake) performance must meet national or EC directives or regulations with regards to deceleration, behaviour when warm, responsiveness, etc.

Furthermore, documentation about the adherence curves and compatibility must also be available (if not otherwise provided).

Upon request IVECO provides the technical documentation with the system specifications and braking capacity of the original vehicle.



### Electric system

Perform any modification observing the general precautions under point 5.4.

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**NOTE** For vehicles with ESP system, see point 2.15.3.

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### Combining the tractor with the semi-trailer

Semitrailers must not have construction characteristics (e.g. excessive chassis flexibility, insufficient braking capacity, etc.) such as to cause negative effects on the driving behaviour of the semitrailer. When coupling the tractor and semitrailer, all relative movements must be checked under the various use conditions; of course the required safety tolerances must be ensured, observing any legal norm or regulation.

### **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.

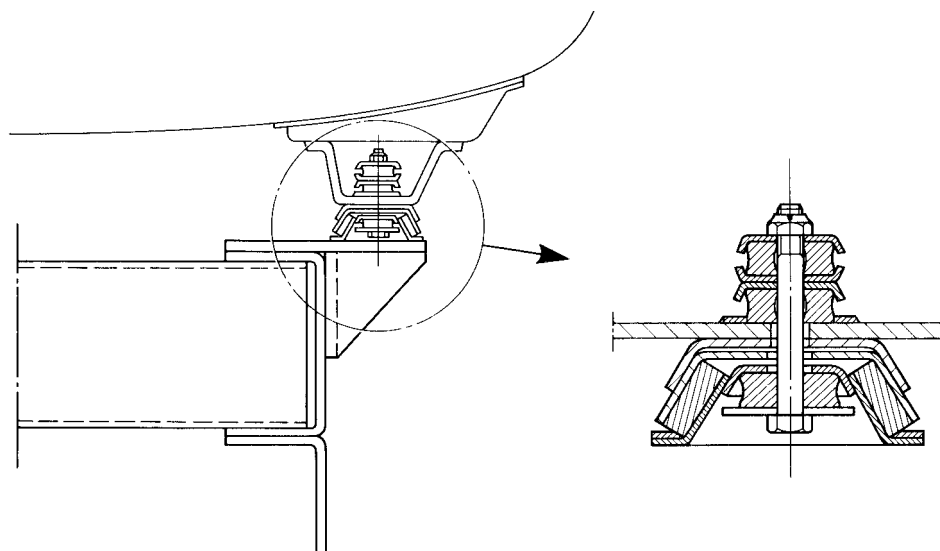
For transport systems where particular force configurations arise following concentrated vertical loads and dynamic thrust during braking, a preventive check on the vehicle's suitability must be carried out directly with IVECO.

The structure to support the load on the tractor must be of the sub-frame type, while other limits can be defined from time to time.

### 3.7 Installation of tanks and containers for bulk materials

Installation of tanks and containers on vehicle chassis is usually performed by applying a suitable sub-frame. Table 3.7 contains the guidelines for the dimensions of the longitudinal runners to be used for the auxiliary frame.

Figure 3.18



- a) As was mentioned in the case of other applications, the positioning of the mountings through which the forces are discharged is similar here. The rigid mounts go in a position corresponding to the rear suspension supports and the flexible mounts as near as possible to the rear support of the front suspension. When this is not the case, reinforcement longitudinal profiles may be required, having a greater size compared to that shown in Table 3.7.

Table 3.7 - Installing a tank

Models	Wheelbase (mm)	Minimum reinforcing longitudinals	
		Modulus of resistance $W_x$ (cm <sup>3</sup> )	Dimensions (mm)
35C, 40C, 45C, 50C	All	16	80x50x4
60C, 65C, 70C	Up to 3750	21	80x60x5
	Above 3750	26	100x50x5

The fitting of tanks, or generally of very rigid torsion structures, must be performed so as to leave a gradual and sufficient torsion flexibility to the chassis, avoiding areas of excessive stress.

- b) In order to determine elastic connections, take into account the rigidity of the vehicle chassis, of the areas where the connections are to be applied and the type of use.  
For on road vehicles, generally the first front elastic connection should allow for a separation of a few mm between sub-frame and chassis during the torsion of the vehicle chassis.
- c) Installation of tanks directly on the chassis can be performed under the following conditions:
- the distance of the various supports must be determined according to the load to be transmitted (generally with distances no greater than 800 mm);
  - the supports must be created for the uniform distribution of the load, on a sufficiently wide surface area and with appropriate bracing to contain longitudinal and transversal forces;
  - anchors must be sufficiently long (approx. 400 mm) and must be placed in close proximity with the fittings of the suspensions.  
In particular, choose elastic characteristics for the front anchoring which are suitable to allow the necessary torsional movements of the vehicle chassis;
  - other anchoring solutions must be authorized by IVECO.

Self standing tanks can be placed directly on the vehicle chassis if suitable supports are used, located immediately behind the cab and in the rear axle area. Quantity and distribution of the supports depend on the wheelbase and at least two for each side must be fitted, e.g. for short wheelbase vehicles.

To ensure that the max allowed limits for the axles are respected, the max values of volume, container filling level and volume weight of transported goods must be determined. In tanks and single container with separated compartments, not only the max limits on axles but also the minimum ratio between front axle and overall weight of the vehicle at full load must be respected under any filling condition (see point 1.15).

Depending on the type of version, take particular care in limiting the height of the centre of gravity as much as possible in order to ensure good stability when the vehicle is driving (see point 1.15); we recommend using vehicles fitted with stabiliser bars.

Suitable transversal and longitudinal bulkheads must be fitted in cistern and tanks for fluids. Indeed, if these containers are not completely filled, the dynamic forces generated by the fluid during driving could have a negative impact on the driving and resistance conditions of the vehicle.

When installing containers for flammable fluids, also strictly comply with current safety regulations.

### 3.8 Installation of cranes

The choice of crane type must be based on its characteristics and on the vehicle performance.

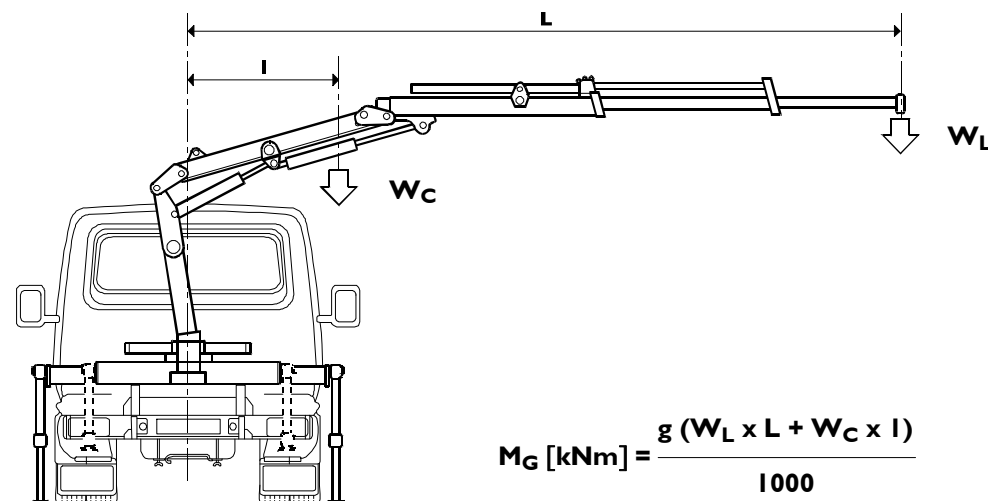
Placement of the crane and payload must respect the load limits allowed for the vehicle. When applying the crane, respect specific regulations, national norms (e.g. CUNA, DIN) and international norms (e.g. ISO, CEN) and check what is required for the vehicle. As a general rule, to install the crane a sub-frame must be fitted, built according to the general instructions (see point 3.1) and with profiles having sizes as per Tables 3.8, 3.9 and 3.10.

The longitudinal runners can also be determined by calculation, the dimensions refer to the total maximum static moment of the crane ( $M_G$ ) and is the moment of the crane + the moment of the load which is calculated on the basis of the equation given below in Figure 3.19.

If the vehicle version (e.g. tilting body) requires a profile with greater resistance modulus than that required for the crane, that profile can be considered valid for the crane as well.

Particular cases when the values of the  $M_G$  moment correspond to value "E" in Table 3.8 (or greater values) must be checked from time to time and must be expressly authorized by IVECO.

Figure 3.19



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$g$  = gravity acceleration, equal to  $9.81 \text{ m/s}^2$ .

$W_L$  = weight applied to the end of the crane [kg];

$L$  = horizontal distance between the point where load  $W_L$  is applied and the vehicle centre line [m];

$W_c$  = crane's own weight applied to its centre of gravity [kg];

$l$  = horizontal distance between the centre of gravity of the crane and the vehicle centre line [m].



**The Bodybuilder must verify each time the vehicle's stability and take all the necessary precautions to ensure correct operation. The crane Manufacturer and the Bodybuilder share the responsibility in defining the type and quantity of stabilizers, as well as constructing a sub-frame according to the maximum static moment and the position of the crane.**

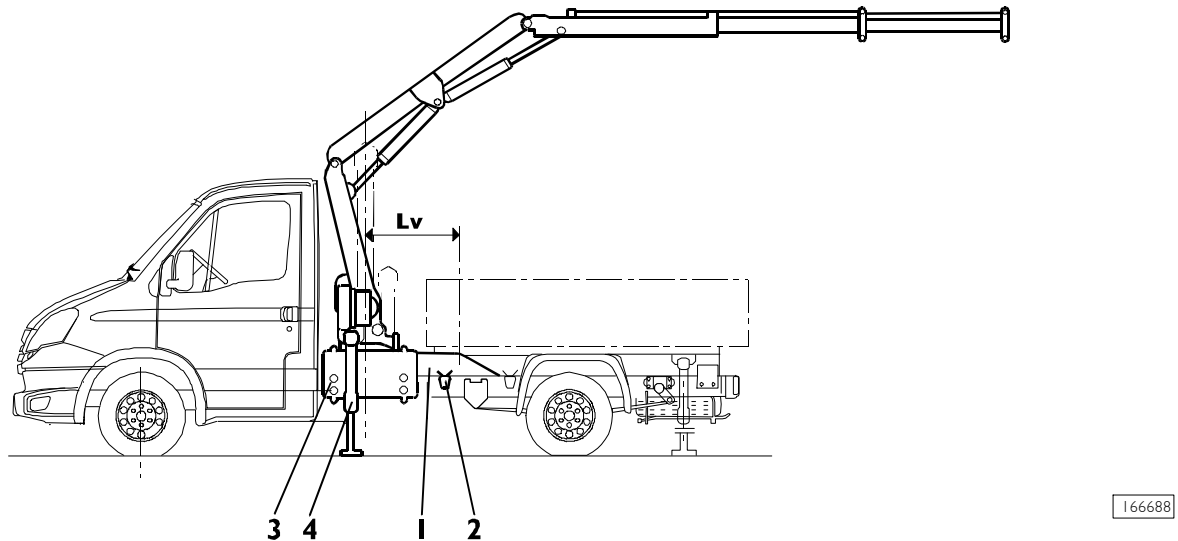
### 3.8.1 Crane behind the driver's cab

- a) Fastening of the reinforcing profiles to the chassis must be performed by means of standard shelves (see Figure 3.20), completing them, if necessary, with elastic fastenings (shelves or flanges) in order to maintain unchanged the flexion and torsion characteristics of the chassis as much as possible.  
The size of the reinforcing profiles to be used for this type of connection are shown in Table 3.6.
- b) For vehicles used almost exclusively on the road, where the sub-frame profile height must be decreased, the sub-frame can be fastened with shear resistant connections. The minimum size of the reinforcing profile for these applications are shown in Table 3.9.

We recommend using profiles with a constant section along the entire length of the vehicle; the profile section can decrease (gradually) in the areas where the flexing moment generated by the crane takes the values shown in Tables 3.8 and 3.9.

The crane sub-frame (Figure 3.20) can be integrated in its rear part with that of another structure; the "Lv" length must not be less than 35% of the wheelbase if the profile of the structure has a lower section.

Figure 3.20



1. Subframe - 2. Connections - 3. Crane joints - 4. Stabilisers

When installing the crane on vehicles with deep cab (e.g. 6+1), extend the sub-frame all the way up to the cab (see Figure 3.2), otherwise the rotation field of the crane must be limited according to the crane capacity in order not to exceed the flexing moment allowed by the chassis.

When installing the crane on vehicles to be used on poor roads, elastic connections between chassis and sub-frame must be fitted (See Figure 3.8) in the front and central part in order not to limit excessively the torsion movement of the chassis. Since the crane is connected only to the sub-frame, the size of longitudinal profiles must be suitable to support the generated moments.

The function of vehicle elements located behind the cab (e.g. fuel tank) must not be hindered; they can be moved as long as the same type of original connection is restored.

Placing the crane behind the cab usually requires moving back the tray or equipment. In the case of tilting equipment, take particular care in placing the supports of the device and the rear tilting hinges, which must be moved back as little as possible.

**Table 3.8 - Cranes fitted behind the driver's cab (Subframe fixed by means of brackets)**

Models	Chassis section at the centre line (mm)	Crane capacity $M_G$ max (kNm)						
		0-20	20-30	30-40	40-50	50-60	60-70	70-80
		Min. value of subframe section modulus $W_x$ (cm <sup>3</sup> ) <sup>1</sup>						
35C, 40C	174x70x4	21	36	57	89	E		
45C, 50C	174x70x4	21	36	57	89	105	E	
60C, 65C, 70C	174x69x5	19	21	46	57	89	105	E

**Table 3.9 - Cranes fitted behind the driver's cab (Subframe fixed by means of shear-resistant plates)**

Models	Chassis section at the centre line (mm)	Crane capacity $M_G$ max (kNm)						
		0-20	20-30	30-40	40-50	50-60	60-70	70-80
		Min. value of subframe section modulus $W_x$ (cm <sup>3</sup> ) <sup>1</sup>						
35C, 40C	174x70x4	19	21	31	57	E		
45C, 50C	174x70x4	19	21	31	57	89	E	
60C, 65C, 70C	174x69x5	19	19	21	46	57	89	E

Close the reinforcing runner in the crane mounting area.

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

1) **When the subframe requires a high moment of resistance the latter shall be established also for the crane.**

**NOTE** Tables 3.8 and 3.9 show that the subframe material yield limit is 360 N/mm<sup>2</sup>.

### 3.8.2 Cranes on the rear overhang

It is advisable for this type of application to extend the subframe over the entire length of the vehicle that is available for the body up to the area behind the cab. The dimensions of the longitudinal runners to be used are given in Table 3.10.

Considering the particular distribution of weights on the vehicle (load concentrated on the overhang) and in order to ensure the torsion rigidity necessary for a good behaviour on road and during operation of the crane, the sub-frame must be strengthened in accordance to the crane capacity. Therefore boxed profiles and bracing must be adopted (see point 3.1) near the rear suspension and on the entire rear overhang (measure  $L_v$ ) - see Figure 3.21.

The passage between boxed and open profiles must be well coupled, according to the examples shown in Figure 3.3.

In the area of the boxed profile, fastening to the vehicle chassis must be performed with shear resistant connections (sufficient quantity plates, spaced max 400 mm), while still using the elastic fastenings in the front part. Check that under any loading condition the weight on the front and rear axles respects the limit defined for each vehicle (see point 1.15).

Since the rigidity required by the sub-frame depends on various factors (e.g. crane capacity, sizing of the support base, tare of the vehicle, overhang of the chassis) we cannot provide instructions for all situations; therefore the Bodybuilder must operate, if necessary, also by means of behaviour tests on the vehicle stability. If after these measurements the rigidity is insufficient, the Bodybuilder must take the appropriate measures to achieve correct construction.

The rear crane overhang (measure  $L_k$  see Figure 3.21) must be as limited as possible (not over 40% of the wheelbase) in order to maintain good vehicle driving characteristics and acceptable stress levels for the chassis.

Table 3.10 - Cranes fitted on the rear overhang (subframe mounting with cleat plates)

Models	Chassis section at the centre line (mm)	Total torque $M_G$ max (kNm)						
		0-20	20-30	30-40	40-50	50-60	60-70	70-80
		Min. value for the subframe section modulus $W_x$ (cm <sup>3</sup> ) <sup>1)</sup>						
35C, 40C	114x70x4	32	57	71	E			
45C, 50C	114x70x4	32	57	71	110	E		
60C, 65C, 70C	174x69x5	23	23	32	42	71	E	

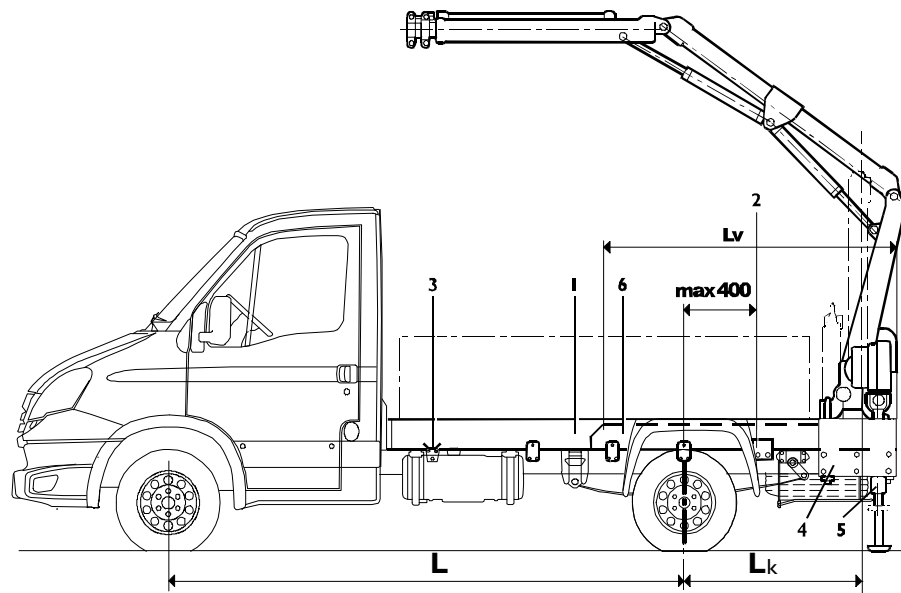
Note = To be checked on a single case basis (forward the technical documents including the stress and stability calculations).

1) **When the subframe requires a high moment of resistance the latter shall be established also for the crane.**

**NOTE** Table 3.10 shows that the subframe material yield limit is 360 N/mm<sup>2</sup>.



Figure 3.21



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1. Subframe - 2. Shear-resistant plates - 3. Mounting brackets - 4. Crane mounting plates -  
5. Stabilizers - 6. Subframe reinforcing area

### 3.8.3 Removable cranes

Installation of removable cranes on the rear overhang can be performed according to the previous paragraph, provided that the type of fastening used between the crane and the sub-frame does not generate additional stress on the vehicle chassis.

Taking into account the possibility of using the vehicle with or without crane (when allowed), we recommend marking the position of the payload for both cases on the structure.

When the vehicle must be able to tow a trailer, all conditions set by the regulations for correct coupling must be observed.

### 3.9 Installation of tail lifts

**NOTE** When applying tail lifts, observe the maximum allowed load limits on the rear axle of the vehicle and the minimum load for the front axle (see paragraph 1.15). If this is not possible, shorten the rear overhang.

Fastening of the tail lift must be performed with a structure allowing the strains to be distributed, in particular for specific versions without a suitable sub-frame (e.g. vans, trays with cross members).

The size of the reinforcing profiles to be used can be determined:

- by means of Table 3.11 for standard rear overhangs,
- by means of instructions in Figure 3.22 for other overhangs and/or with specific tail lifts (e.g. aluminium tail lifts).

In the first case, the flexing moments caused on the chassis in accordance to the capacity of the tail lifts have already determined average values; in the second case these moments must be calculated each time.

Table 3.11 - Installation of tail lifts

Models	Overhang (mm)	Tail lift capacity, kN (kg)					
		3 (300)	5 (500)	7.5 (750)	10 (1000)	12.5 (1250)	15 (1500)
		Minimum value of the resistance modulus of the sub-frame section $W_x$ (cm <sup>3</sup> )					
29L, 35S	-	E	E	E			
35C, 40C 45C, 50C	1240 - 1355	16	21	26 + S	31 + S	E	
35C, 40C 45C, 50C	1655 - 1715	21	21 + S	26 + S	31 + S	E	
45C, 50C	1885 - 2350	26	26 + S	31 + S	36 + S	E	
60C, 65C, 70C	1355 - 1655	21	21	26 + S	26 + S	31 + S	E
	1885 - 2350	26	21 + S	26 + S	26 + S	36 + S	E

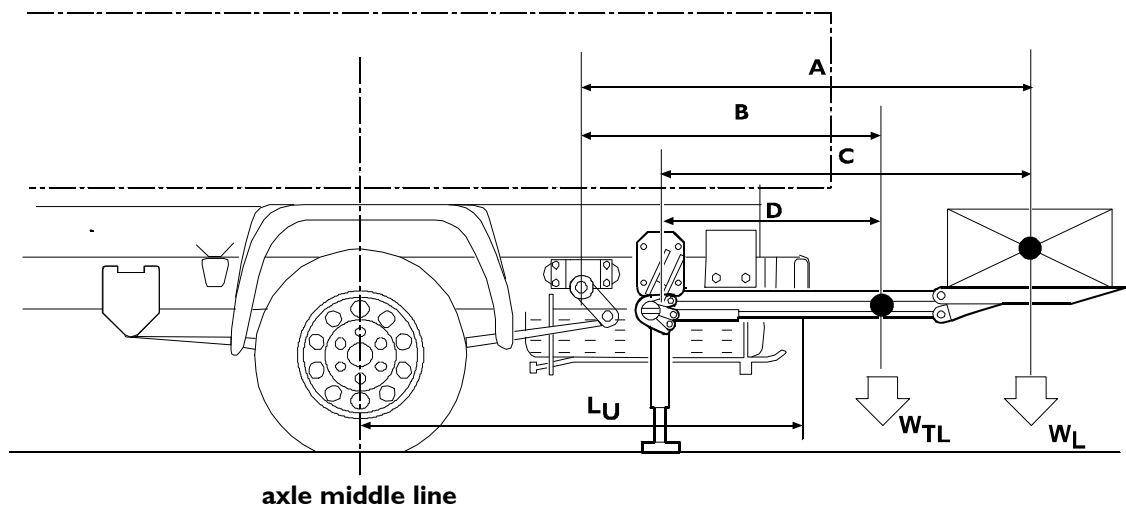
E = To be checked on a single case basis (submit the technical documents including the stress and stability calculations).

S = Stabilizers must be fitted.

**NOTE** Table 3.11 shows that the subframe material yield limit is 360 N/mm<sup>2</sup>.

Connection between chassis and sub-frame must be created with shear resistant plates, particularly for overhangs longer than 1200 mm; these plates, at a maximum distance of 400 mm, must be placed in the area of the overhang and up to the front support of the rear suspension.

Figure 3.22



W<sub>TL</sub> = Tail lifts weight  
 W<sub>L</sub> = Tail lift capacity

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

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

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

As mentioned, in order to decrease the elastic sagging of the chassis, which cannot be avoided when using a tail lift, use reinforcing profiles with Wx resistance modulus of a higher value than the minimum values shown in Table 3.11. This is even more valid for high and non standard overhangs, where the need of using stabilizers must in any case be checked (see Figure 3.22).



**According to the capacity of the tail lift, take into account the stability and trim of the vehicle deriving from the sagging of the suspensions and chassis during the operation of the tail lift. Therefore, always assess if it is necessary to use stabilizers, even when it would not be required taking into account only the stress generated on the chassis.**

Stabilizers must be fixed to the support structure of the tail lift and must be preferably hydraulically operated.



**Stabilizers must be operated under all loading conditions of the tail lift.**

When installing electro-hydraulic tail lifts, check that the batteries have a sufficient capacity and the alternator power (see paragraph 5.4).

IVECO requires fittings a switch isolating the electric circuit of the tail lift from the vehicle circuit when the tail lift is not operating. Furthermore, the Bodybuilder must take care of any modification of the underrun bar or the placing of a new type of cross member (see paragraph 2.19) as well as respecting the visibility of rear lights, overhang angles and positioning of the towing hook, as established by the relative national regulations.

In van versions, lifters with a capacity up to 3 kN (300 kg) can be applied after installing local reinforcements on the chassis; greater capacities must be assessed from time to time.

### 3.10 Recovery vehicles

Installation of equipment for road help and rescue must adopt a specific sub-frame ensuring uniform distribution of loads and correct fastening of components and assemblies used to move the rescued vehicle.

This equipment must comply with towing weights, vertical loads on the hook and the minimum ratio between front and rear axle weights as defined in the specific authorizations issued by IVECO.

The Bodybuilder must also provide plates/labels indicating the specific conditions under which transport is authorized (towing weight, load on hook, maximum operating speed, etc.).

### 3.1.1 Municipal, fire-fighting and special services

Fitting of vehicles for community work (compactors, compressors, road sprayers) requires the following in many cases:

- construction of a very robust sub-frame toward the rear and elastic connections to the chassis toward the front of the vehicle;
- shortening of the rear chassis overhang.  
When very short overhangs are required, the chassis may be shortened immediately behind the rear spring hanger (or after the anti-roll bar connection in the case of pneumatic suspension), keeping the cross member connection to the chassis intact;
- vertical positioning of the exhaust, behind the cab;
- use of more rigid rear suspensions or suspensions with asymmetrical springs;
- new position of rear lights.



**Do not use the reversing light switch fitted on the gearbox to activate functions requiring high reliability and safety (e.g. engine stop when reversing, on vehicles for waste collection by personnel located on the rear footboards).**

### **3.12 Installation of front snowploughs**

Installation of snow blades in the front of the vehicle must be performed by means of suitable support structures, taking into account the instructions of point 2.3 with regards to connection to the chassis.

Furthermore, all national norms and regulations governing the application of this equipment must be respected, as well as maintaining the function and possibility of using original elements placed in the front of the vehicle (e.g. towing hook). Otherwise the Bodybuilder must install equivalent systems, complying with safety norms and regulations.

Due to the limited maximum speed for most IVECO vehicles used as snow-ploughs, an increase of the maximum load allowed on the front axle can be granted upon request.

Respecting the requested load must be documented and ensured by the company performing installation.

### 3.13 Winch installation

A winch can be applied to the vehicle in 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.

Installation must be performed so as not to alter the correct operation of vehicle assemblies and components, respecting the maximum allowed loads on axles and following the instructions of the winch Manufacturer. The assembly and gears must be fastened according to point 2.3, taking care to reinforce the anchoring area not only locally (see point 2.1.7), according to the pull of the winch rope and in particular of its transversal component when traction is on a diagonal.

Installation of a winch in the area behind the cab requires an additional sub-frame with size and structure (cross and diagonal members for rigidity) suitable to the winch capacity.

In the event of winches:

- with hydraulic drive: hydraulic pumps already installed for other functions (tilting bodies, cranes, etc.) can be used;
- with mechanical drive: for control transmission follow the instructions under points 4.1 and 4.2;
- with worm screw drive: the size of the elements of the drive must take into account the low yield of this type of drives;
- with electric drive: must be used for low power and low duration, due to the limited capacity of the battery and alternator of the vehicle.



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

### 3.14 Special body conversions

The Bodybuilder must ensure that any modification meets the regulations, particularly for versions for passenger transport.

#### 3.14.1 Chassis-cowls

They are built specifically to install bodyworks or special versions (store vans, caravans, etc.).

Indications and precautions of the technical documentation (chassis diagram) provided by IVECO must be carefully observed.

#### 3.14.2 Motor homes

The limits to weights for single axles and overall weight must be strictly complied with, taking into account the number of people on the vehicle and a sufficient margin to load the following:

- luggage, curtains, sports equipment;
- water tank, toilets;
- gas bottles, etc.

Ensure that the load to be transported is placed in specific compartments, allowing for suitable safety margins and providing suitable indications.

Take particular care in creating compartments for gas cylinders, which must be built in compliance with specific current regulations and adopting the necessary safety measures.

For any modification of the rear overhang, see the instructions in point 2.5.



### 3.14.3 Installation of overhead platforms

The application of an overhead platform or basket must comply with national (e.g. CUNA, DIN) and international (e.g. ISO, CEN) regulations, in addition to any specific limitations.

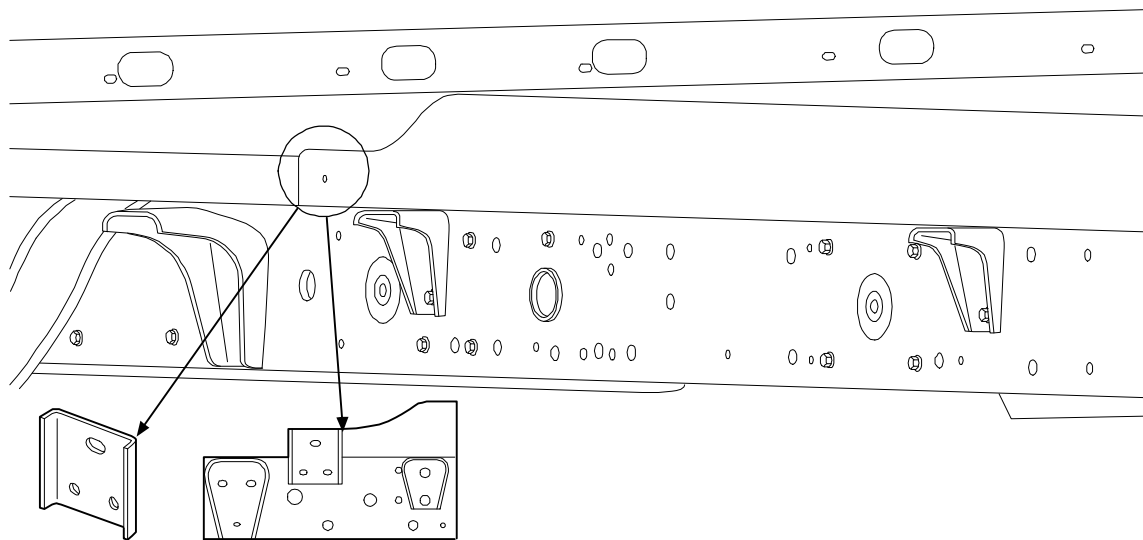
The choice of platform must be carried out by checking compatibility with the characteristics of the vehicle frame that is present. Positioning on the vehicle must comply with the admissible load and distribution limits.

Exceptional cases must be assessed from time to time and specific authorisation must be obtained from IVECO.

The installation of an overhead platform/basket requires the introduction of a suitable counterframe. In addition to following the general instructions, (see Chapter 3.3 and Table 3.2 and Table 3.3), the Fitter must also:

- assess the maximum static momentum and the envisaged position for the superstructure;
- avoid sudden section changes;
- realize a fastening solution as shown in Figure 3.2 on page 3.6 or, in the event of extreme mechanical stress, as shown in Figure 3.23.

Figure 3.23



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INITIAL FASTENING OF THE COUNTERFRAME



**The Fitter must carry out all the necessary precautions to ensure correct use and the operational stability of the vehicle. In this context the type and number of stabilizers must be decided with the Manufacturer of the superstructure.**

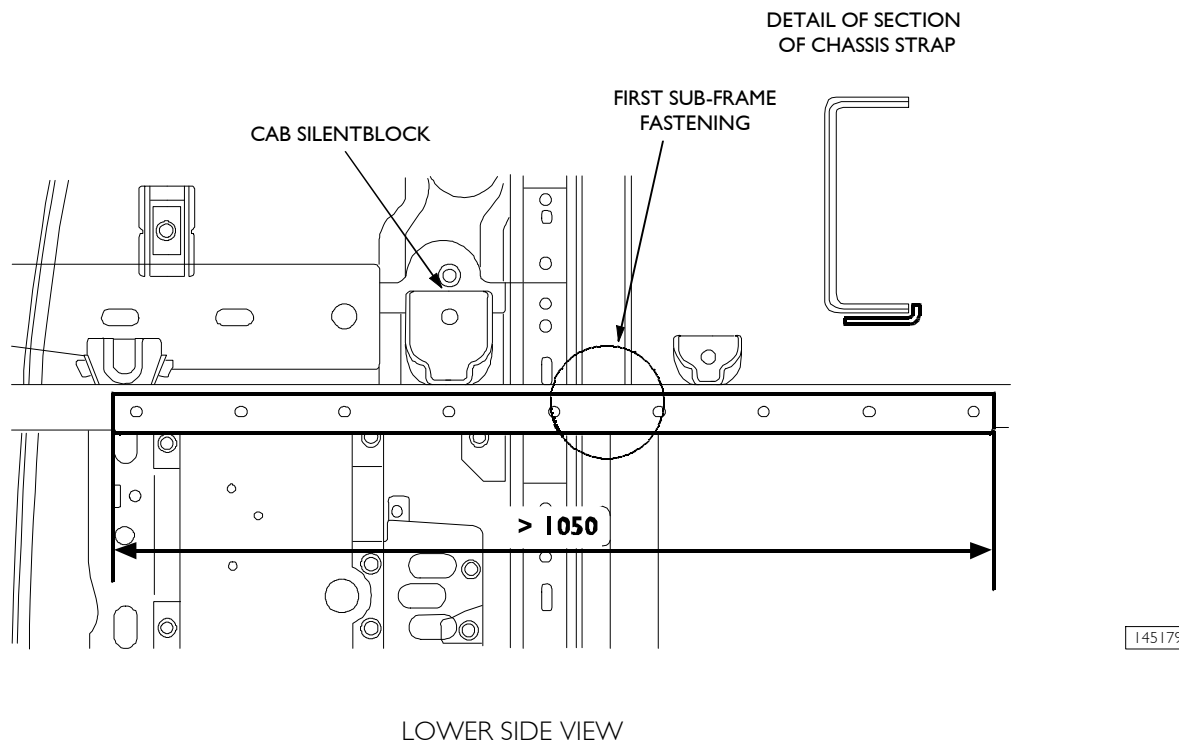
Hence the Fitter must also:

- adjust the raising/lowering speed of the vehicle on the stabilizers by means of the appropriate flow control valves in the hydraulic system;
- indicate the requirement to limit, as much as possible (3-5 cm), raising the vehicle's front axle off the ground, compatibly with the condition of maintaining horizontal alignment.

### Aerial platforms on vehicles 29L-35S

The installation of this version on vehicles 29L-35S (single wheels) is possible after fitting specific reinforcing straps on the chassis, which can be ordered originally with specific option no. 74131 or at IVECO Parts with spare parts no. 504267869.

Figure 3.24



The straps must have a minimum thickness of 4 mm and a length sufficient to cover the side member of the chassis in front of the cab silentblock areas and behind the first sub-frame fastening (see Figure 3.24); the total length must not be less than 1050 mm. The additional straps must be fixed to the wing of the chassis by means of nails with a maximum distance of 110 mm and must be made of high resistance steel.

## SECTION 4

### Power Take Offs

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## 4.1 General specifications

Different types of Power Take Offs (PTO) for motion withdrawal can be mounted to control of the ancillary control units. According to the type of use and the performances required, the application can be performed as follows:

- the gearbox;
- transmission;
- the front of the engine.

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

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

Choose the Power Take Off transmission ratio to ensure that power uptake occurs within the flexible engine operating range; avoid low speeds (lower than 1000 rpm) to rule out unevenness and jerkiness in vehicle operation.

The power taken in relation to the number of revolutions of the Power Take Off at the required torque.

$$P(\text{PS}) = \frac{M \cdot n \cdot i}{7023} \quad P(\text{kW}) = \frac{M \cdot n \cdot i}{9550}$$

**P** = Useable power

**M** = Torque permitted for the Power Take Off (Nm)

**n** = Power Take Off rpm.

**i** = Transmission ratio = PTO output rpm/ engine rpm

### Type of use

Applications may be sporadic or continuous.

In sporadic applications, the duration of Power Take Off operations does not exceed 30 minutes.

In continuous use this is significantly longer; however whenever the use is comparable to that of a stationary engine, it is necessary to evaluate the opportunity to reduce take off of torque also on the basis of the surrounding conditions (engine cooling, gearbox etc.).

Take off of torque is possible without problems if the type of use does not result in significant variations of torque in terms of frequency and amplitude.

Should this not be the case (e.g. hydraulic pumps, compressors), clutches or safety valves may be necessary to avoid overloading.

### PTO transmissions

In respect of the transmission manufacturer's requirements, particular care must be given to the kinematics (angles, rpm, moment) from the PTO to the attached device during the design phase and dynamic behaviour during the production phase.

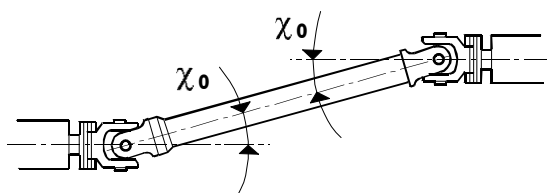
This means that:

- the forces which will be present during maximum power and torque output conditions must be considered when calculating scaling
- equal shaft-end angles must be realised for good homokinetics (see Figure 4.1); these must be no more than 7°
- solution Z is preferable to W, as the loads on the bearings of the PTO and the driven equipment are lower. In particular, when it is necessary to realise a transmission line with shafts inclined in the space according to an angle  $\varphi$  (as illustrated in Figure 4.2), it must be remembered that the overall homokinetics can only be ensured if the intermediate shaft is fitted with forks offset by the same angle  $\varphi$  and if the end angles  $\chi_1$  and  $\chi_2$  are equal.

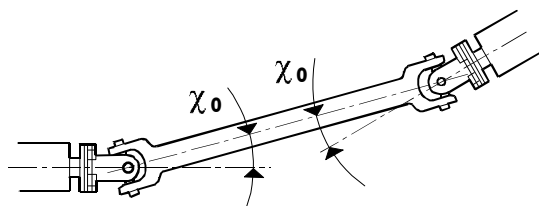
For transmissions employing multiple sections, the instructions given at point 2.8.2 should be followed.

Figure 4.1

Solution Z

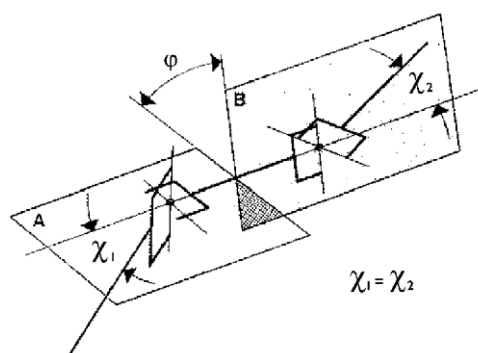


Solution W



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Figure 4.2



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## 4.2 Power Take Off from gearbox

Take off from the transmission lay shaft is possible via flanges or couplings positioned in the left part of the casing (see fig. 4.3). Table 4.I lists the maximum torques and the output rpm to engine rpm ratios for the various transmission/IVECO optional PTO combinations.

Any higher take-off torques, for occasional uses, must be individually authorised by IVECO on the basis of the type of use.

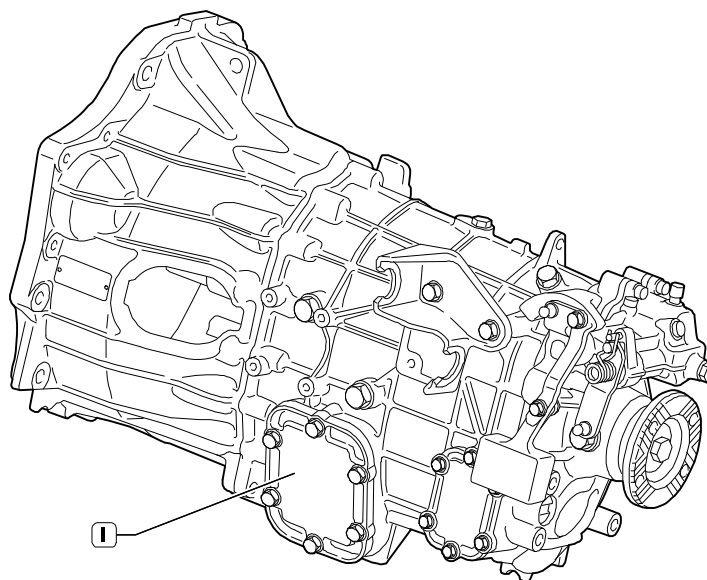
The PTO must normally be used with the vehicle parked and must be engaged and disengaged with the clutch disengaged to avoid excessive stress on the synchronisers.

When, under exceptional circumstances, it is used with the vehicle in movement, no gear changes must be performed.

The same PTOs for manual gearboxes can be used with gearboxes fitted with torque converters.

It must, however, be remembered that for engine rpm of below 60% of the maximum, the converter works hydraulically and in this stage the PTO rpm is subject to fluctuations depending on power draw, even if the engine rpm is constant.

Figure 4.3



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I. Cover for arranging Power Take Off

**NOTE** After the assembly of the Power Take Off perform the filling up and check the oil level from the speed gearbox.

### Transmission PTO data

Post-production installation of a PTO requires reprogramming of the gearbox control unit (if automatic) as well as some work on the electrical system. As such, it is recommended you read section 4.6 "PTO management" before proceeding.

The control unit must be reprogrammed by following the instructions found in the relevant IVECO manuals, using the diagnostics tool available from Dealers and Authorised Workshops and supplying information on the PTO used.

Table 4.1

Gearbox	Position (1)	Output (1)	Direction of rotation (2)	Max. torque C <sub>max</sub> (Nm) (2)	PTO ratio
2830.5 2835.6	Left-hand side	Rear	Clockwise	120	1.00
2840.6 2850.6 6AS400	Left-hand side	Rear	Clockwise	180	1.04

(1) With respect to forward direction of travel.

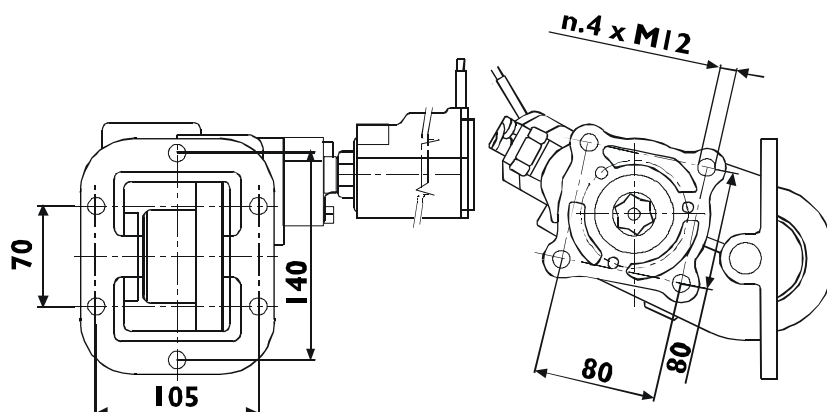
(2) When viewing the PTO output from the front.

(3) The maximum torque that can be taken refers to an engine speed of 1,500 r.p.m. output from the PTO. For higher speeds, the value for the torque that can be taken must be reduced proportionally.



**IVECO reserves the right not to honour any guarantees on the transmission where the malfunction can be traced back to the PTO and, in this case, the PTO installed by the Bodybuilder has specifications and performance different from those indicated in Table 4.1.**

Figure 4.4



166656



### Direct application of pumps

In the case that pumps or other equipment are directly connected to the PTO, that is without intermediate shafts, you should first check that there is a safety margin between the chassis and power unit, and then that the static and dynamic torques exerted by the mass of the pump and the PTO are compatible with the resistance of the gearbox casing walls.

Moreover, the inertial effects of any added masses must be verified so as not to induce resonance conditions in the power unit inside the operational range of engine speeds.



**For torque drawing, keep values defined in Table 4.1.**

**Transmission oil temperature must not exceed 110 °C during prolonged use. Coolant temperature must not exceed 100 °C.**

**Not all types of Power Take Off available on the market are suitable for continuous use. When in use the specifications (working periods, pauses etc.) specific to the Power Take Off in question should be respected.**

PTOs supplied by IVECO have a flange for direct attachment of pumps with UNI 4-hole connectors. The output consists of a 21 ISO 14 splined shaft (Figure 4.4).

### 4.3 Power Take Off from transfer box

**NOTE** Not present on Daily 4x2.

### 4.4 Power Take Off from drive line

Authorisation of the installation of a PTO on the transmission after the gearbox will be given after examination of the complete documentation which must be presented to IVECO.

The power and torque values are defined each time on the basis of the usage conditions.

As a general rule, bear in mind that:

- the PTO may only operate with the vehicle stationary;
- the Power Take Off r.p.m. is dependent on the gear selected;
- the installation must be performed immediately after the gearbox; for vehicles with transmissions of two or more shaft sections the PTO may also be installed in correspondence with the oscillating mount between the first and second section (follow indications in point 2.9.2);
- the original transmission angles in the horizontal and vertical planes must be maintained as closely as possible;
- anything added to the transmission must not cause abnormal vibrations or instability or otherwise damaging effects on the drive transmission components (from the engine to axle) either during driving or use of the PTO;
- the PTO must be attached to the chassis with its own suspension system.



**The transmission is a component that is important to vehicle driving safety. Any operations on the transmission must be carried out only by highly specialised companies that have been approved by the supplier.**



**Any operation carried out on the propeller shaft without obtaining previous authorisation from IVECO will cause the vehicle warranty to immediately become null and void.**

#### 4.5 Power Take Off from engine

The use of these PTOs is intended for equipment requiring continuous power and with low torque values (e.g. driving AC systems).

Power is taken from the front part of the engine via belt drive.

The data listed in Table 4.2 refer to take off with a specific pulley designed according to Figure 4.5.

### Table 4.2 - Power Take Off from the front of the engine

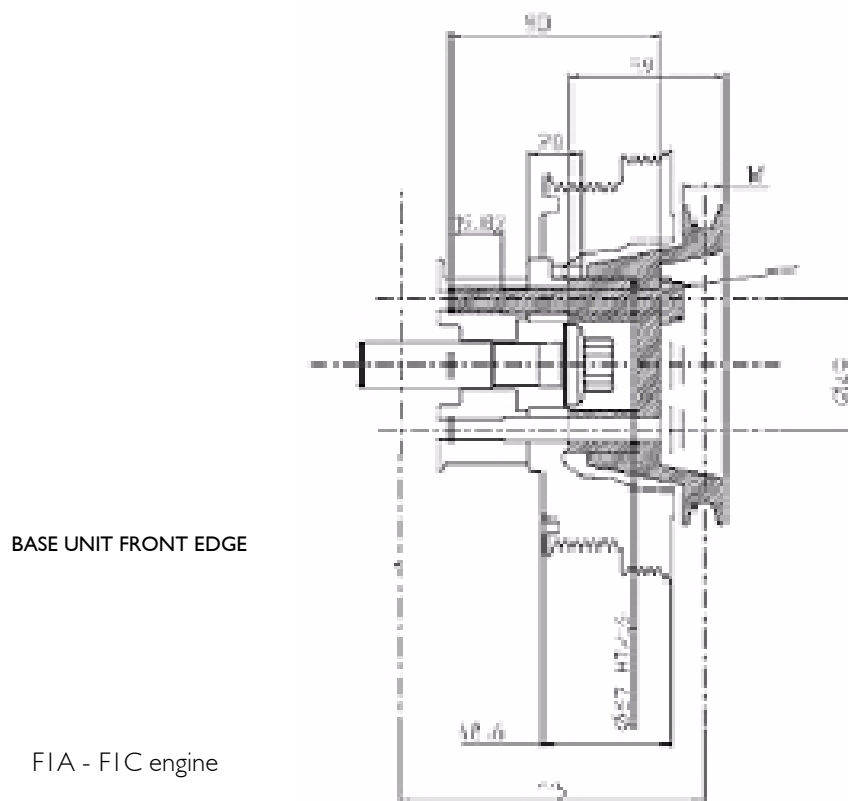
Engine	Engine code (1)	n <sub>max</sub> (rpm) (2)	Max. take-off values			
			Max. no-load speed (r.p.m.)	Max. torque that can be taken (Nm)	Max. inertia moment (kgm <sup>2</sup> )	Max. bending moment (Nm) (3)
<b>FIA Euro 5 Series</b>						
.11	FIAE348IA*A	3900	4600	35	0,005	42
.13	FIAE348IB*A	3600	4600	35	0,005	42
.15	FIAE348IC*A	3600	4600	35	0,005	42
<b>FIC Euro 5 Series</b>						
.15	FICE348IJ*B	3500	4200	35	0,005	42
.17	FICE348IK*B	3500	4200	35	0,005	42
.21	FICE348ID*B	3500	4200	35	0,005	42
<b>FIC EEV Series</b>						
.15	FICE348I8*C	3500	4200	35	0,005	42
.17	FICE348IC*C	3500	4200	35	0,005	42
.14	FICE044IA*B (CNG)	3500	4200	35	0,005	42

(I) Verify engine code on engine plate

(2) Maximum revs corresponding to the maximum rating

(3) With respect to the base front edge

Figure 4.5



BASE UNIT FRONT EDGE

FIA - FIC engine

102475

## 4.6 PTO management

### 4.6.1 General specifications

The vehicle may be equipped with the following alternative original equipment options:

- a) only PTO (opt. 75076/75077/75078);
- b) PTO (opt. 75076/75077/75078) and Expansion Module (opt. 8657);
- c) only Expansion Module (opt. 8657);

where the Expansion Module is an electronic interface designed to manage certain types of conversion (additional lights, alarms, after-market PTOs, etc).

See the specifications in IVECO Guideline no. 603.95.231 of 12/2010 for description of the characteristics and methods of use.

In case (a) where only the PTO is present, a control panel is installed on the instrument cluster (Figure 4.6, page 4-11), which consists of:

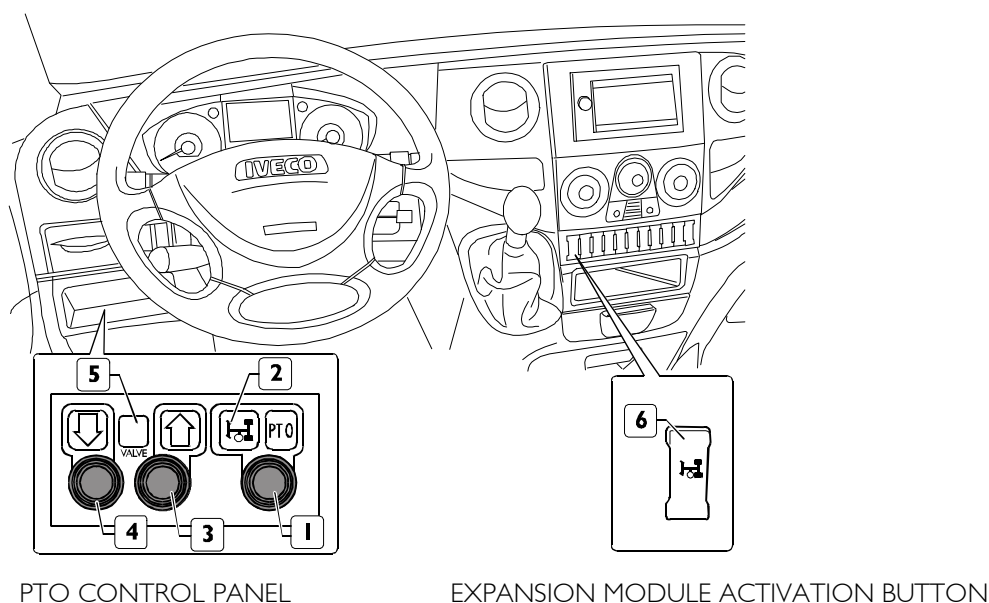
- **PTO section**, which provides management of the engagement and disengagement of the Power Take Off using a pushbutton (1) with a warning light (2) signalling the situation in progress;
- **VALVE section**, for managing the operation of a dump body (if present) and interaction with the hydraulic distributor fitted on the lifting system. For vehicles without a tipping body, the VALVE section is not operational.

For operation of the tipping body, see instructions on page 4-11.

In case (b), in addition to the panel for the PTO, a special button (6, Figure 4.6, page 4-11) for operation of the Expansion Module is located in the centre of the dashboard.

In case (c) the Bodybuilder is left free to decide where to position the PTO controls.

Figure 4.6



147477

### Operating tipper box (if present)

Button (3) controls tipping body lifting: this action will be simultaneous and will be cancelled when the button is released. A continuous LED light (5) indicates that lifting of the tipper truck is in progress.

Button (4) controls tipping body lowering: this action will be simultaneous and will be cancelled when the button is released. See any additional functions and safety features in the manufacturer's handbooks.

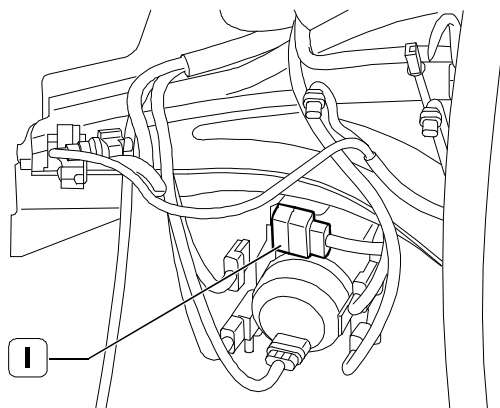
### After-market PTO installation

After-market installation of the PTO is possible on vehicles with or without Expansion Modules.

Installation of the PTO is possible only where this is provided for on the vehicle.

- c) For vehicles without an Expansion Module it is necessary to order the components for installation of the PTO, the cable for connection to the engine compartment cable connector (1) (connector on anti-theft bracket), the enabler relay to install on SCMI/B in the engine compartment (tab 5.14 pag. 5-46, relay T55) and the PTO control panel (fig 4.6) to connect to the dashboard cable.

Figure 4.7

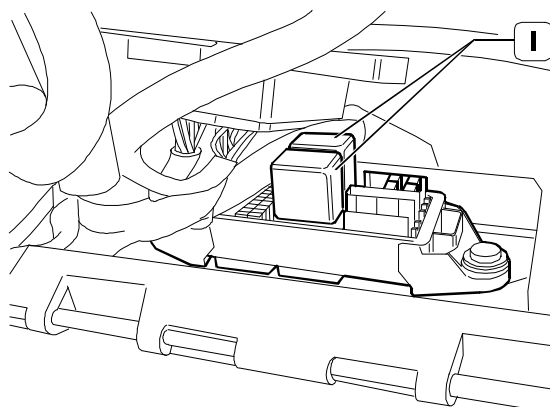


166053

PTO connector on engine compartment cable

- d) For vehicles with an Expansion Module it is necessary to order the components for installation of the PTO, the cable for connection of this to the engine compartment cable connector (I -fig. 4.7), the two relays (I -fig. 4.8) to install in the Expansion Module (fig 4.8) and the PTO activation/deactivation request button (6 -fig 4.6).

Figure 4.8



Relay and fuse module for PTO with Expansion Module

I66054

Table 4.3

SCMI/C	Power	Protection	Presence		Capacity	Type	EURO5 4x2	EUROV 4x2	BIFUEL
			S	OPT					
F79	30	Expansion Module relay T61 (30-87) for PTO		X	15	A0	X	X	X
F80	30	Expansion Module relay T62 (30-87) for PTO		X	15	A0	X	X	X
F86		AVAILABLE				A0			
F88		AVAILABLE				A0			
F89		AVAILABLE				A0			
F90		AVAILABLE				A0			

SCMI/C	Power	Protection	Presence		Capacity	Type	EURO5 4x2	EUROV 4x2	BIFUEL
			S	OPT					
T61		Expansion Module		X	20		X	X	X
T62		Expansion Module		X	20		X	X	X

- NOTE**
- With the PTO installed, the Engine Control Unit can be configured by IVECO service in order to set the engine operating conditions with PTO engaged.
  - If you wish to install a PTO after market, you must check whether the vehicle is fitted with Cruise Control.
  - The Expansion Module does not manage the tipper body. If a PTO is to be installed after market for this use, the kit with PTO control panel must be purchased (kit for vehicles without Expansion Module).

## 4.6.2 PTO mode

### 4.6.2.1 Mechanical gearbox

#### PTO engagement

The purpose of this operation is to prepare the equipment installed on the vehicle for work. When carrying out the operating sequence, the driver is assisted in order to avoid errors.

- a) If the equipment is of the type working with vehicle stopped (stationary PTO):
- stop the vehicle and apply the hand brake;
  - press the clutch pedal;
  - put the gearbox into neutral;
  - keeping the clutch pedal depressed, press and release button (1) on the PTO control panel (Figure 4.6, page 4-11).  
The PTO engagement indicator (2) blinks slowly at first and stays on fixed when the operation is successfully concluded;
  - slowly release the clutch pedal.
- b) If the equipment is the type that works also when the vehicle is running (non-stationary PTO) the same procedure basically applies except for the need to engage the right gear for the work (first, reverse or possibly neutral) before slowly releasing the clutch pedal.

To adjust the engine speed, see paragraph 4.6.2.3.

#### PTO disengagement

Irrespective of the type of PTO installed:

- stop the equipment;
- press the clutch pedal;
- press the pushbutton (1); the indicator (2) goes off when the PTO is disengaged;
- release the clutch pedal.



**For safety reasons, when the non-stationary PTO is engaged:**

- gear changes (involving automatic disengagement) are not possible
- the vehicle should not be driven over 20 km/h.



**The PTO must be disengaged when torque drawing is not in progress.**

**NOTE** If an after market PTO is to be installed, check to ensure that the vehicle is equipped with the Cruise Control option.

**NOTE** After fitting an after-market PTO, refer to the IVECO Assistance Service for updating the engine ECU software via remote service.

### 4.6.2.2 Automatic transmission

The Power Take Off of versions with automated gearbox (6AS400) is specific because the control system must recognise the status of the Power Take Off for safety reasons.

#### PTO engagement

The purpose of this operation is to prepare the equipment installed on the vehicle for work. When carrying out the operating sequence, the driver is assisted in order to avoid errors.

- a) If the equipment is of the type working with vehicle stopped (**stationary PTO**):
- stop the vehicle and apply the hand brake;
  - put the transmission into neutral;
  - press and release button (1) on the PTO control panel (Figure 4.6, page 4-11).
- The PTO engagement indicator (2) blinks slowly at first and stays on fixed when the operation is successfully concluded.
- b) If the equipment is the type that works also when the vehicle is running (**non-stationary PTO**) it will moreover be necessary to engage the right gear for the work (first, reverse or possibly neutral).

In both situations, with the gearbox in neutral and PTO correctly engaged, the ECU closes the clutch when 1100 rpm is reached. Also, pickup is possible in first or reverse gear: in this case the gearbox control unit is arranged for closing the clutch at approx. 900 rpm.

To adjust the engine speed, see paragraph 4.6.2.3.

#### PTO disengagement

Irrespective of the type of PTO installed:

- stop the equipment;
- press the pushbutton (1): the indicator (2) goes off when the PTO is disengaged.



**For safety reasons, when the non-stationary PTO is engaged:**

- gear changes (involving automatic disengagement)
- the vehicle should not be driven over 15 km/h.



**The PTO must be disengaged when torque drawing is not in progress.**

**NOTE** If an after market PTO is to be installed, check to ensure that the vehicle is equipped with the Cruise Control option.

**NOTE** After fitting an after-market PTO refer to the IVECO Assistance Service for updating the engine ECU software via remote service.

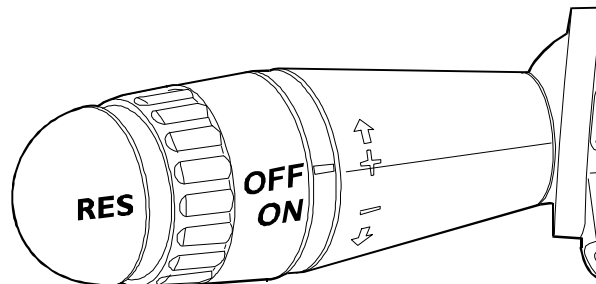


### 4.6.2.3 Engine speed control for Power Take Off

The engine electronic control unit has provision for a function that performs isochronous adjustment of the engine and PTO speed.

As a result of this type of connection it is possible to adjust the speed of both directly with the Cruise Control lever (Figure 4.9).

Figure 4.9



139390

In addition, the control unit is able to check the set speed and keep or restore the balance according to the applied load.

---

**NOTE** Regulation of engine speed via Cruise Control takes place only up to 10 km/h.

---

After setting the selector in Figure 4.9 to ON, it is possible to adjust the Cruise Control lever in + or - direction in order to increase or decrease the rpm in two ways:

- a) in steps of 50 rpm if the lever is operated for between 0.5 and 2 seconds;
- b) with a ramp of 400 rpm for each second of continuous lever operation, over 2 seconds.

It is possible to store (with PTO activated) a new rpm setting by holding down the RESume button for at least 5 seconds.

Refer to the specific manual for management of engine speed, required torque and other parameters which can be programmed on the Expansion Module.

---

**NOTE** With Cruise Control ON it is possible to return to the condition of engine idling speed (setting deleted) by turning the selector of Figure 4.9 OFF or by pressing the brake or clutch pedal (if applicable).

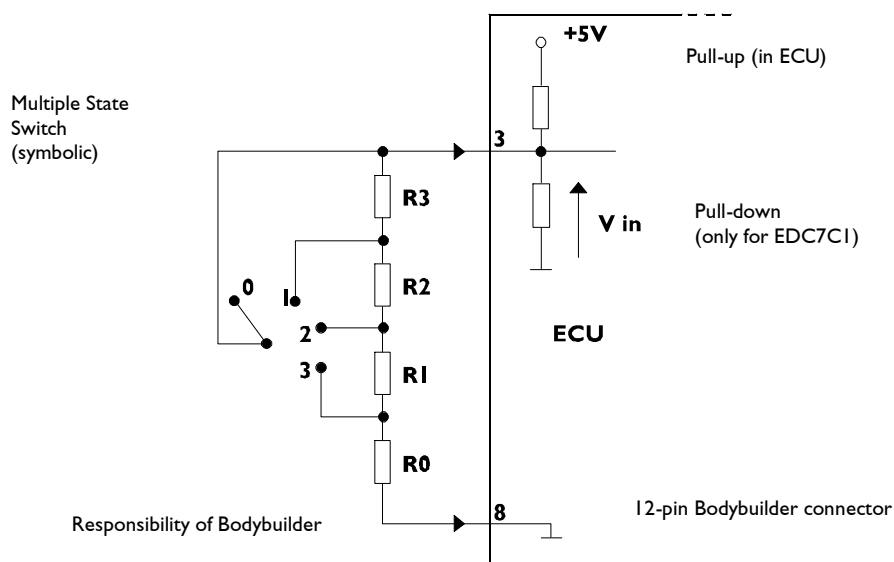
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#### 4.6.2.4 Multiple State Switch

This is an additional function for engine rpm management with PTO engaged available on the 12-way Bodybuilder connector (pin 3 - pin 8).

To obtain this function, the circuit given in the diagram in fig. 4.10 must be created.

Figure 4.10



166055

Table 4.4

Resistance (Ohm)	R0	R1	R2	R3
	120	270	510	2000

Programmable speed (rpm) - default setting		PTO 0	PTO 1	PTO 2	PTO 3
CM		900	1200	900	1200
CA		1200	1200	1200	1200

Resistances ¼ of W and tolerance 1%.

#### Operation:

- 1) Vehicle stationary, with switch in 0 position:
  - Manual operation - press RESume button on the Cruise Control to bring the engine speed to the programmed rpm.
  - Assisted operation - supplying a positive signal to pin 15 of the 20-way Bodybuilder connector, the engine speed will increase to the programmed rpm value.
- 2) Vehicle stationary, with switch in 0 position:
  - without pressing the RESume button, the engine speed will remain at idle. Upon changing the position of the switch, the engine rpm will change to the programmed value for each switch position.

Placing the Cruise Control selector in the OFF position, or else by pressing the brake or clutch pedal, the engine speed control function will disengage independently of the position the switch is in.

Whenever it is necessary to store engine speed values different from the default values set by IVECO, the system allows the desired values to be programmed for each selector position by following the procedure described in section 4.6.2.3.

## SECTION 5

**Special instructions for electronic subsystems**

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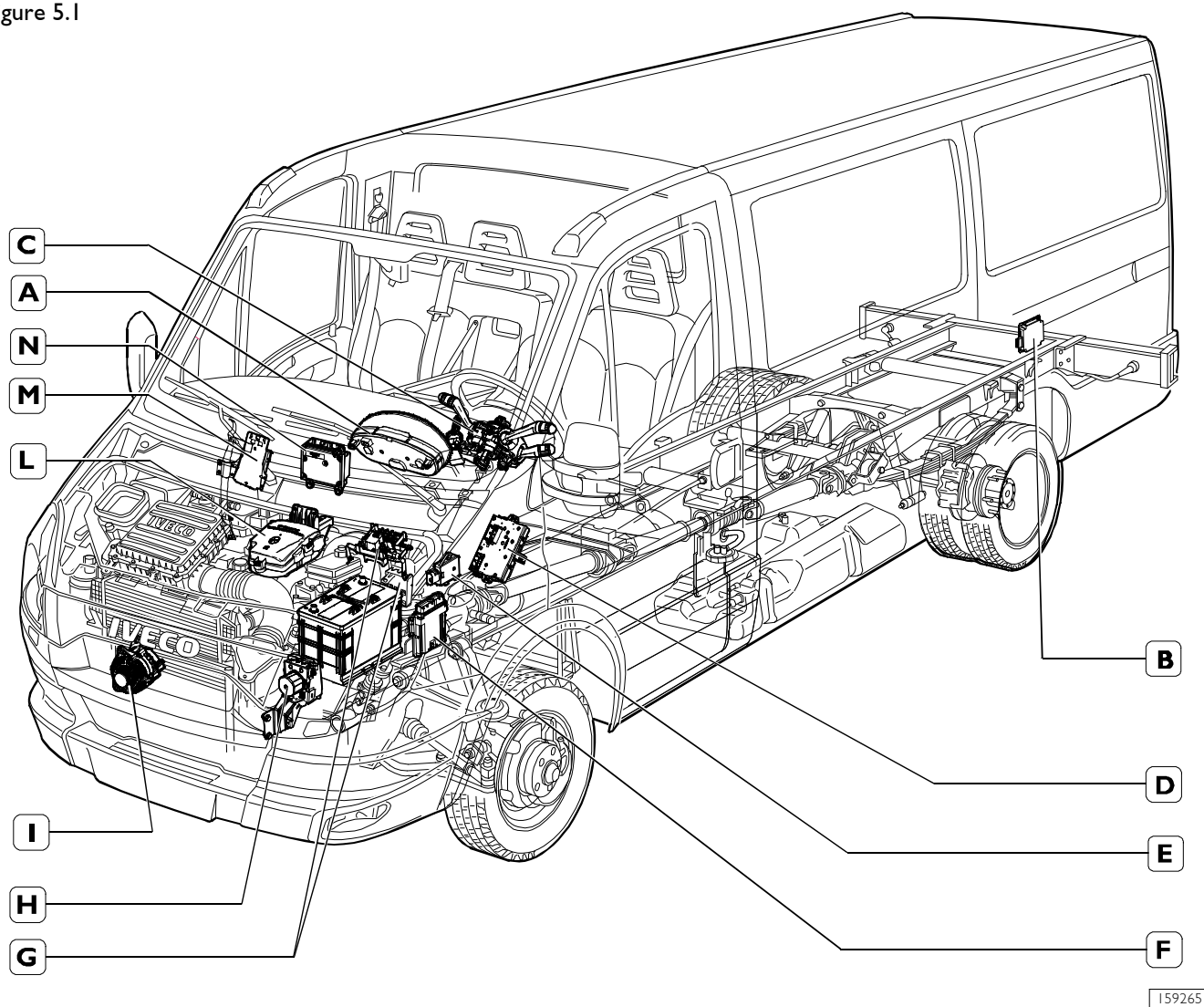
## 5.1 Electronic system

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. Trailer control unit - C. Steering column switch unit and ignition switch - D. "CPL" Connection control unit - E. Body Computer - F. Oil control unit - G. Engine control unit - H. Positive (+30) distribution "CBA" control unit and CFO - I. ABS/ESP control unit - J. Alternator - K. "SCM" Connection control unit (engine) - L. Expansion Module - M. Airbag control unit - N. Airbag control unit

## 5.2 Bodybuilder connectors

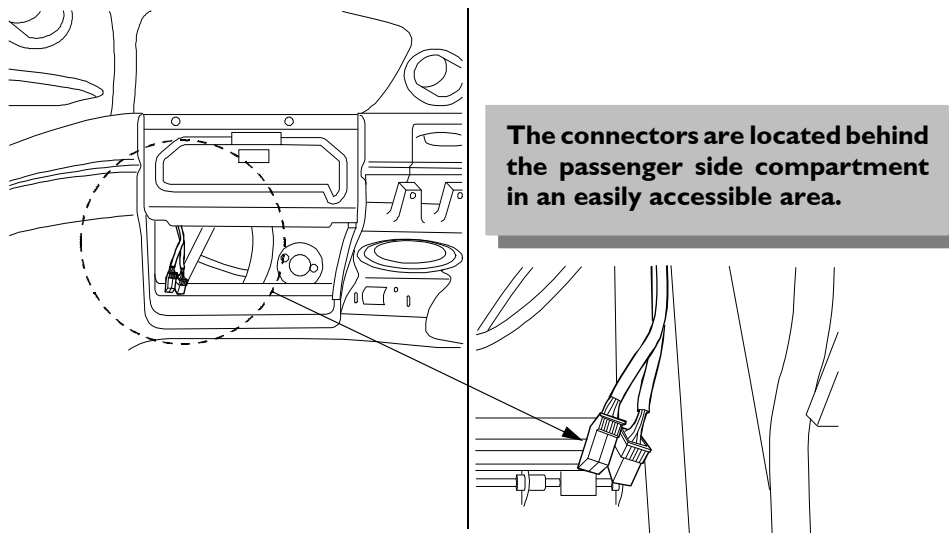
To allow the Bodybuilder to interface correctly and efficiently with the vehicle's electrical system, specific connection points have been provided to be used for supplementary systems.

This provision is necessary to avoid any manipulation of the system, in order to guarantee its functional integrity and therefore the validity of the guarantee.

Two connectors (61071 and 72068) are provided inside the cab. A special kit consisting of connectors and cable terminals must be ordered as a spare part in order to use these connectors.

**NOTE** Any interfacing between the body and the vehicle shall be made by means of diodes and relays (clean contact), unless otherwise specified in the manual.

Figure 5.2



139392

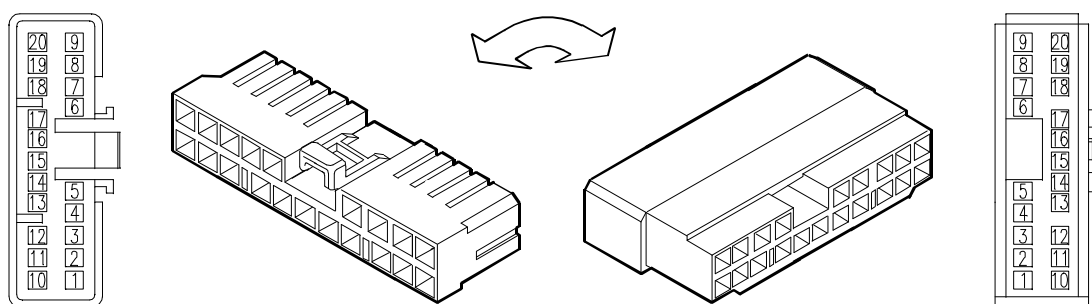


**DIRECT CONNECTION TO THE CONNECTORS IS STRICTLY FORBIDDEN AND WILL IMMEDIATELY INVALIDATE THE GUARANTEE.**

### 5.2.1 20 pin connector (61071)

20-way connector

Figure 5.3



101564

Existing parts on the vehicle

Counterpart to be connected

Table 5.1

Code number	Description
500314817	20-way male holder joint
500314820	Male contact for 0.3 to 0.5 mm <sup>2</sup> cable
500314821	Male contact for 1 to 1.5 mm <sup>2</sup> cable

Table 5.2 - Basic functions of 20 pin connector

Pin	Description	Signal	Remarks
1	Engine start-up	Input max 20 mA	When positive signal is supplied, the starter motor is powered and starts the vehicle engine. Operation takes place only when the key is turned in the barrel. When starting the vehicle, NO SAFETY CHECKS OF ANY TYPE ARE CARRIED OUT e.g. gear engaged etc. For both normal vehicles and for Start & Stop vehicles
			+12 V = engine start-up Open circuit = no action
2	Engine shut-down	Input max 10 mA	When a positive signals is supplied, the vehicle engine is shut down
			+12 V = engine shut-down Open circuit = no action
3	Service braking	Output max 500 mA (interface with uncoupling diode)	When the brake pedal is pressed, a positive signal is generated.
			+12 V = service brake active Open circuit = service brake inactive
4	Vehicle stationary	Output max 500 mA	When the vehicle is stationary, a ground is obtained
			Earth = vehicle parked Open circuit = vehicle in motion
5	Parking brake	Output max 500 mA (interface with uncoupling diode)	When the handbrake is operated, an earth signal is generated.
			Earth = brake engaged Open circuit = brake released
6	Battery positive	Output max 20 A	Positive protected by a fuse present on the Body Computer - F34
7	Exterior light activation	Output max 500 mA	When the sidelights are on, a positive signal is obtained
			+12 V = lights on Open circuit = lights off
8	Alternator operation	Output max 500 mA (interface with uncoupling diode)	When the vehicle alternator is cranked, a positive signal is obtained
			+12 V = Battery charging Open circuit = battery not charging
9	Clutch engagement	Output max 500 mA (interface with uncoupling diode)	When the clutch pedal is pressed, the circuit is open.
			+12 V = clutch engaged Open circuit = clutch released
10	Reverse engagement	Output max 500 mA (interface with uncoupling diode)	When reverse is engaged, a positive signal is obtained
			+12 V = reverse engaged Open circuit = reverse engaged



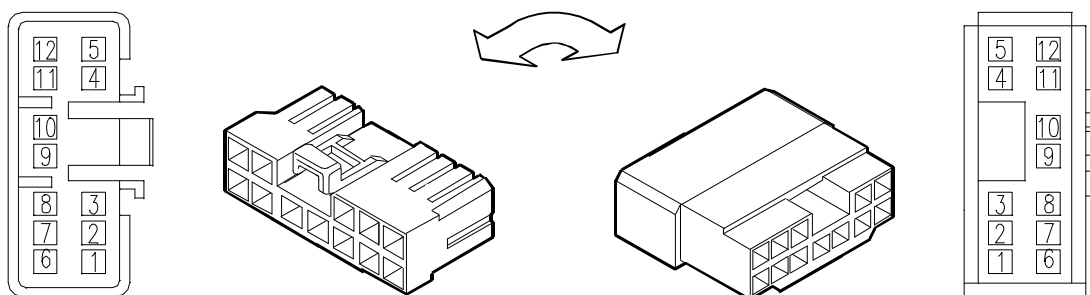
Table 5.2 - (continues) Basic functions of 20 pin connector

Pin	Description	Signal	Remarks
11	Ignition-operated positive	Output max 5 A	Ignition live positive protected by a fuse present on the Body Computer - F49
12	Cruise Control Command	Input max 10 mA	Cruise Control negative analogue signal (in parallel controlled from the steering column switch unit) <b>See specification 3</b>
13	Cruise Control command splitter reference ground	Input max 10 mA	<b>See specification 3</b>
14	Not connected		
15	Not connected		
16	Not connected		
17	Earth	Output max 15 A	
18	Not connected		
19	Not connected		
20	Not connected		

### 5.2.2 12 pin connector (72068)

12-way connector

Figure 5.4



101554

Existing parts on the vehicle

Counterpart to be connected

Table 5.3

Code number	Description
500314814	12-way male holder joint
500314820	Male contact for 0.3 to 0.5 mm <sup>2</sup> cable
500314821	Male contact for 1 to 1.5 mm <sup>2</sup> cable

Table 5.4 - Basic functions of 12 pin connector

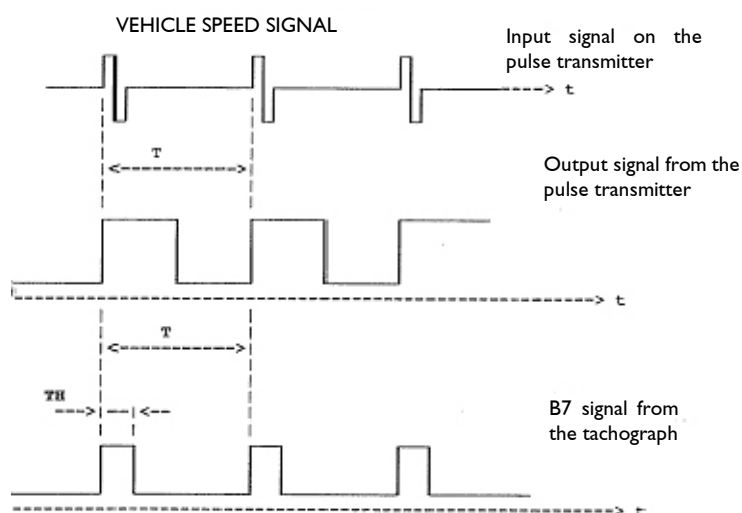
Pin	Description	Signal	Remarks
1	Speed limiter	Input max. 10 mA	When an earth signal is supplied, vehicle speed is limited to 30 km/h Earth = active speed limitation
2	Programmable speed limiter	Input max. 10 mA	When earth is connected, limitation is activated/deactivated at the current speed Earth = speed limitation activated/deactivated
3	Multiple switch	Available for Power Take Offs	
4	Speed signal (B7)	See Specification 1	
5	Key ON-repeat	Input max 500 mA	Positive signal supplied to simulate initial key rotation (key ON position) Only the main loads are powered, the vehicle cannot be started from outside because key recognition absent: +12 V = key active Open circuit = Key inactive
6	Power Take Off activation	Output max 500 mA	When the Power Take Off is engaged, an earth signal is present Earth = Power Take Off engaged Open circuit = Power Take Off disengaged.
7	Horn	Output max 150 mA	Additional horns (to interface with relay) Earth = horn active Open circuit = horn not active
8	Multiple switch	Available for Power Take Offs	
9			
10	Engine revs (r.p.m.)	See Specification 2	
11	Not connected		
12	Not connected		

## Specification I

### Vehicle speed signal

B7 is a square-wave signal having the same frequency as the input signal (from the pulse generator) and a variable duty-cycle, due to the vehicle's tachometric constant.

Figure 5.5

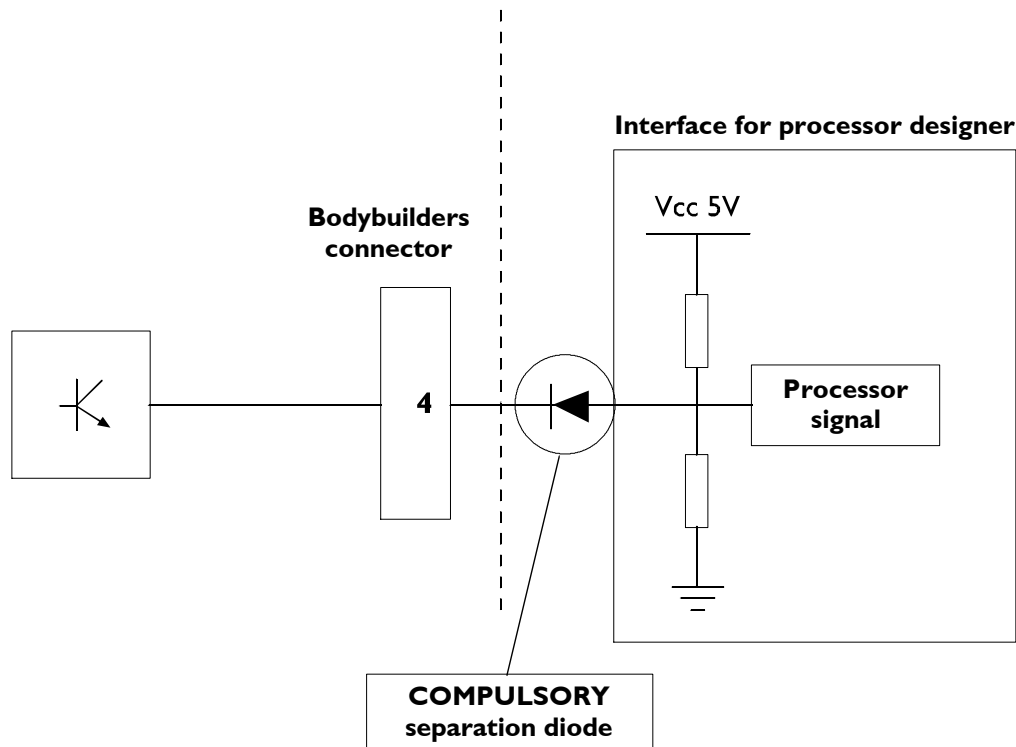


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Below are the electric features of the signal:

- Minimum voltage level	< 1.5 V
- Maximum voltage level	> 5.5 V
- Max. frequency	1.5 kHz
- Pulse duration (TH)	$0.67 \div 6.7$ ms
- Pulse duration tolerance	1%
- Load impedance minimum value	5.5 k $\Omega$
- Load impedance typical value	15 k $\Omega$

Figure 5.6



120377

The Bodybuilder must fit a separation diode so that the  $V_{ON}$  voltage is not lowered.

The signal processing designer must ensure an input interface equal to that shown with a max Vdc of 5 volt and “pull-up/pull-down” in order not to lower the  $V_{ON}$  voltage and increase the response time set by the vehicle interface.

Speed calculation, following signal B7 reading, involves controlling both the frequency and the “duty-cycle” of the signal itself, since the frequency is a function of the vehicle whereas the “duty-cycle” is a function of the tachometric constant.

Below is the formula used to calculate the vehicle speed from signal B7:

$$\text{Vehicle speed} = 225 \frac{TH}{T}$$

where the speed is expressed in km/h and TH, T are in thousandths of a second.

## Specification 2

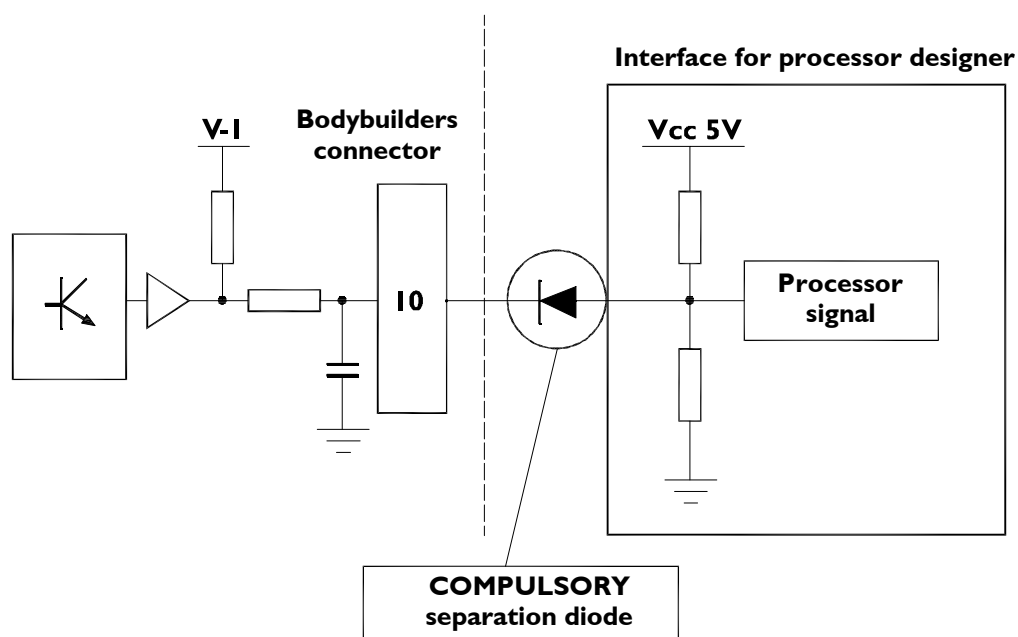
### Engine revs signal

The engine revs signal is represented by a square wave.  
Below are the features of the engine revs signal:

Table 5.5

Features	Condition	Minimum	Typical	Maximum	Unit
C-IO	To container / VBat-	1.2		1.85	nF
R-IO	To VBat+	2.57		2.65	k $\Omega$
I-Out				50	mA
t-Rise	Signal output time from 10% to 90%			10.5	$\mu$ s
R-ON	Output current < 0.05 A			33.8	$\Omega$
V-I		5.4	13.5	15.7	V
Pulses per rev			4		

Figure 5.7



143780

The Bodybuilder must fit a separation diode so that the  $V_{ON}$  voltage is not lowered.

The signal processing designer must ensure an input interface equal to that shown with a max Vdc of 5 V and “pull-up/pull-down” in order not to lower the  $V_{ON}$  voltage and increase the response time set by the vehicle interface.

### Specification 3

#### Cruise Control via Bodybuilder socket

The Bodybuilder must fit the splitter outlined below by connecting it to the 20 way Bodybuilder connector by referring to the pins shown.

Figure 5.8

<b>R1</b>	<b>2490Ω</b>	<b>1%</b>
<b>R2</b>	<b>649Ω</b>	<b>1%</b>
<b>R3</b>	<b>261Ω</b>	<b>1%</b>
<b>R4</b>	<b>133Ω</b>	<b>1%</b>

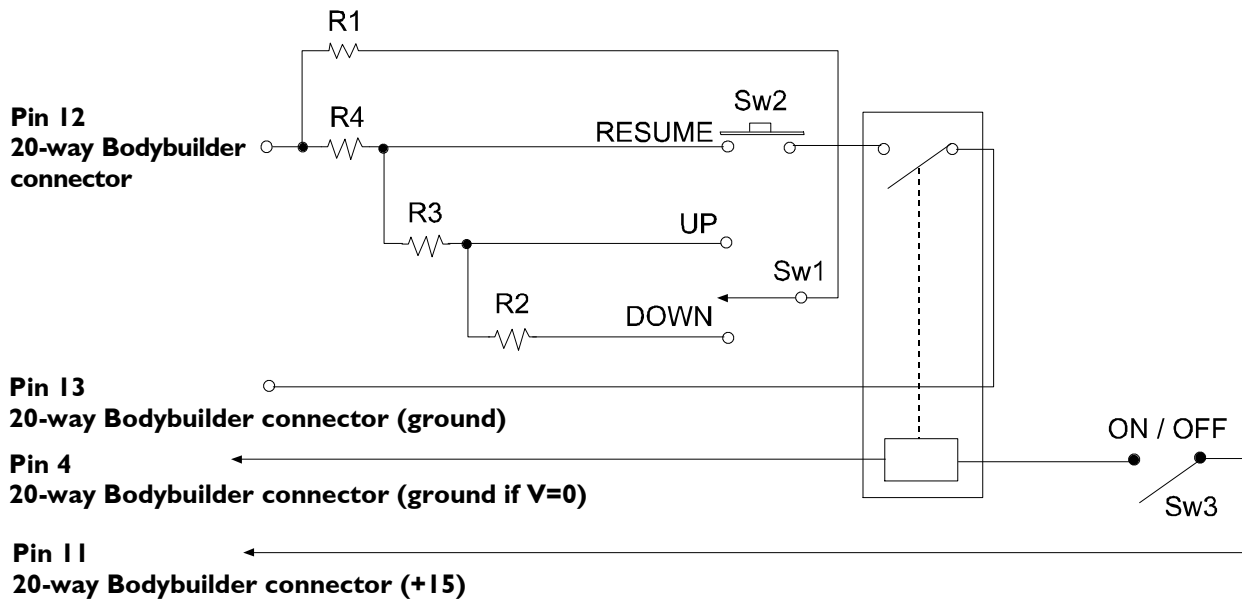


Diagram provided for Bodybuilder panel

162234

### Provision for an additional central rear door locking system (Vans)

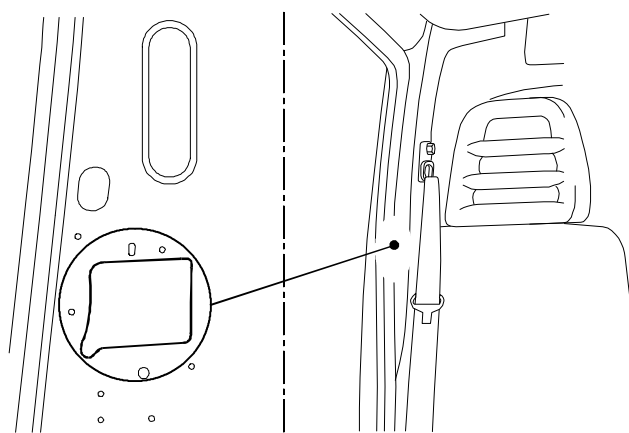
The following exist for "van" versions:

- option 5864 "Central door locking + Provision for an additional central rear door locking system", which provides a socket on the central pillar. The Bodybuilder may fit a remote controlled door on the body in combination with the remote-controlled central door locking system (lock/release).
- option 5865 "Anti-theft system + Provision for an additional central rear door locking system", which offers the anti-theft system in combination with RCL (Remote Control Lock) + Provision for rear door.

These options offer a key with a 3 button remote control (one button is dedicated to the rear door) to control the additional rear door, as well as a button (locks/unlocks all the doors) on the dashboard.

The connector is located beneath the plastic pillar trim behind the passenger seat (see Figure 5.9).

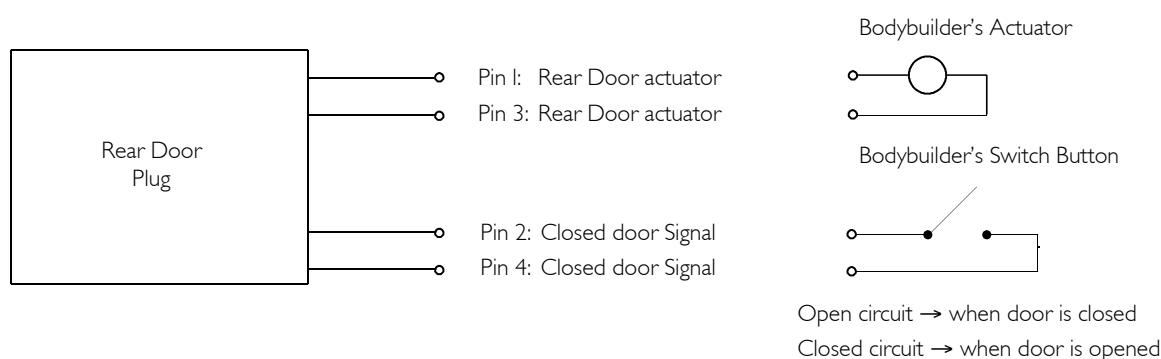
Figure 5.9



139393

The Diagram below shows the connection between to rear door plug and the Bodybuilder's Actuator/close door switch (Figure 5.10).

Figure 5.10



Rear door provision conneting diagram

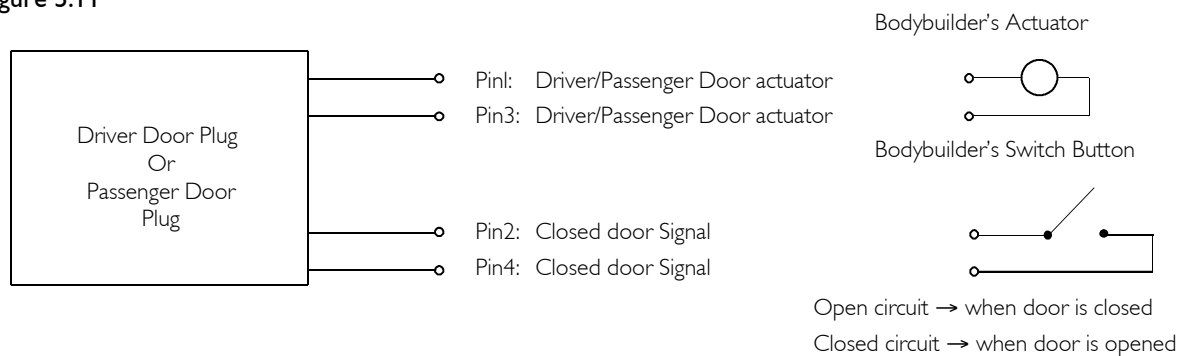
In order to let the system working correctly a "closed door signal" (vehicle with closed door return info) is mandatory.



An identical connection must also be done for the driver and passenger's doors by the Bodybuilder to the side doors plug.

### Driver door and passenger door connecting diagram<sup>(1)</sup>

Figure 5.11



<sup>(1)</sup> Only for Stripped Camper Cowl, Chassis cowl and Stripped Chassis Cowl version.

### 5.2.3 Antitheft system

In combination with central closing, the vehicle can be equipped with a perimeter type anti-theft system controlled from the Body Computer.

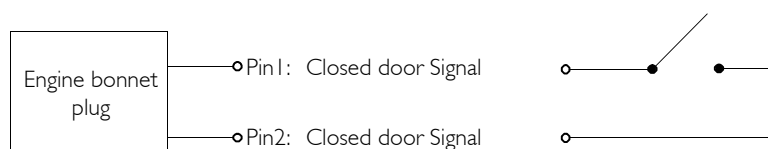
This system consists of:

- a key with remote control, buttons for remote locking/unlocking;
- actuators to close the cab doors, the sliding side doors and the rear doors in the case of a van;
- perimeter door open sensors and bonnet open sensor (Figure 5.12);
- alarm siren (12 V) (Figure 5.13).

Current absorption of the antitheft device is 30-40 mA.

The Bodybuilder must provide a "door closed" signal so that the anti-theft system can also monitor any break-in attempt on the bonnet.

#### Engine bonnet button connecting diagram<sup>(2)</sup>



Open circuit → when door is closed

Closed circuit → when door is opened

<sup>(2)</sup> Only for Stripped Camper, Chassis cowl and Stripped Chassis Cowl version with opt 5865

Figure 5.12

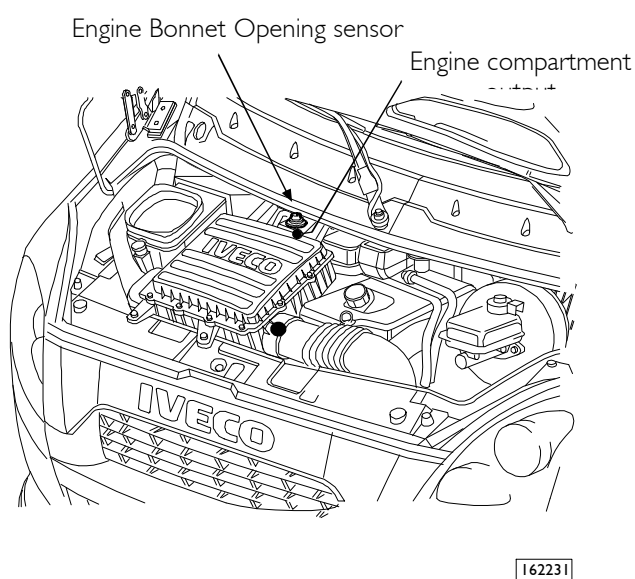
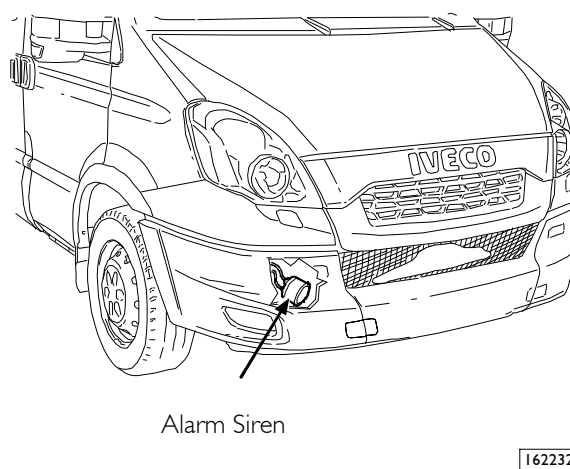


Figure 5.13



For the method of use, refer to the Use and Maintenance handbook.

### 5.3 Electronic control units

#### 5.3.1 Precautions to be taken with the installed electronic control units

In order to avoid any operations that could permanently damage or cause the operation of the vehicle ECUs to deteriorate, it is good practice to:

- remember that connecting to and disconnecting from the battery terminals generates voltage that can cause problems for the vehicle's electronic systems and ECUs;
- do not remove and/or connect the connectors from the control units when the engine is running or the control units are powered;
- disconnect the electronic control units whenever particular operations involve temperatures above 80 °C;
- avoid using a rapid battery charger for emergency starting under all circumstances, because it could damage the electrical systems and in particular the systems that manage ignition and power supply functions;
- do not power the components interlocked with electronic modules with the vehicle's nominal voltage via movable cables;
- connect ECUs supplied with a metal casing to the system ground using a screw or bolt, unless otherwise specified.

In case of actions to be taken on the chassis, which require electric arc welding, the following shall be done:

- disconnect the CBA from the positive battery terminal and do not connect it to the chassis ground;
- remove the connector from the control units;
- disconnect the ECU from the chassis (in the case of welding close to the ECU itself);
- 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.



**Only use fuses with the correct specifications for the specific function.**

**NEVER USE FUSES WITH HIGHER CAPACITY THEN THE PRESCRIBED ONE.**

**Replace only with keys and appliances disconnected.**

Whenever work has been carried out on the electrical system, once the work has been completed the cabling must be restored to its original condition (paths, protection, ties), absolutely avoiding the cables coming into any contact at all with metal surfaces on the structure which could erode their integrity.

## Warnings

Vehicles are equipped with sophisticated electrical/electronic systems that control their operation (e.g. ABS, EDC, etc.). Before installing additional heaters, Power Take Offs, speed limiters, anti-theft devices, mobile phones and cooling system compressors that could interact with the above electronic systems, it is advisable to check the feasibility of application with IVECO. It is also necessary for appropriate diagnostic checks to be carried out in order to confirm that the system has been correctly set up. For more detailed information on the vehicle electrical system, refer to the specific Workshop Manuals.



**Operations on the electrical system (e.g. removal of cables, addition of circuits, replacement of equipment or fuses, etc) carried out in a manner not compliant with IVECO's instructions or carried out by unqualified staff may cause serious damage to the on-board systems, affecting safety and reliability.**



**Operations carried out on the electrical system in a non-compliant manner may cause significant damage (e.g. short-circuits with the possibility of fire and destruction of the vehicle) and authorise IVECO to declare the contractual warranty forfeit.**



**It is absolutely prohibited to make changes to or connections to the CAN lines, which should be considered inviolable. Any diagnosis and maintenance operations must be carried out exclusively by authorised staff using equipment approved by IVECO.**

**NOTE** Written authorisation from IVECO is required for any exemption from the assembly guidelines.  
Failure to comply with the above prescriptions will cause the warranty to become null and void.

### 5.3.2 Disconnecting ECUs



**Work carried out which does not conform with IVECO instructions, or that is carried out by unqualified personnel, can cause serious damage to the on-board systems, compromise driving safety, the good functioning of the vehicle and cause associated damage that is not covered by the contractual guarantee.**

Before disconnecting an ECU, the following instructions must be rigorously followed:

- turn the key in the ignition block to the OFF position and remove it;
- 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;
- isolate the battery by disconnecting the power cables, first the negative pole then the positive; the spots mentioned above are out;
- disconnect the ECU.

### 5.3.3 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.
- ECUs must not be fitted on the subframe;
- the cover must always be refitted;
- avoid subjecting ECUs to knocks from debris and stones from the road when travelling.

## 5.4 Electrical system: modifications and drawing-off power

### General information

The vehicles are designed to operate normally with a 12 V electrical system.

The chassis represents the ground (it acts as a power return conductor between the components located on it and the batteries/alternator energy source) and the negative pole for the batteries and the components is connected to it, therefore an isolated return is not provided.

The installation of auxiliary equipment or additional circuits must take account of the instructions given below and, according to the complexity of the operation, suitable documentation (e.g. electrical diagram) must be provided to accompany that for the vehicle.

The use of cables and connections with colours identical to those used on the original vehicle makes the installation more accurate and facilitates any repair work.

For efficient and correct use of the electrical system, specific connection points have been provided for auxiliary systems. This condition is necessary to rule out any adaptations of the basic design in order to ensure operational integrity and thus maintenance of the vehicle warranty.

**NOTE** For more detailed information on the vehicle electrical system, refer to the special workshop manual, printed 603.95.161 (Daily MY 2012).

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

### Precautions for operations on the system



**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.**

Before removing any electrical and/or electronic components, disconnect the ground cable from the negative terminal of the battery. To avoid damaging the vehicle's electrical system, carefully follow the cable manufacturer's instructions.

The cables must have a section suited to the type of load and the positioning of said load within the vehicle;

- The power cables (+ direct) must:
  - be inserted individually in corrugated sheaths (with suitable diameter) and not together with others with different signals and negative cables;
  - be positioned at a distance of at least 100 mm (reference value = 150 mm) from very hot parts (engine turbine, exhaust manifold, etc.);
  - be positioned at least 50 mm from containers of chemical agents (batteries, etc.);
  - be positioned at least 50 mm from moving parts.
- The route of the cables must be defined as much as possible with dedicated brackets and clamps and moved closer, to avoid hanging parts and provide the possibility (and obligation) to rebuild the same installation in the case of repairs or outfits.

- The cables must have a section suited to the type of load and the positioning of said load within the vehicle.
- The passage of cables in holes and on edges of various panels must be protected by cable glands (besides the corrugation).
- The corrugated pipe must protect the whole cable completely and must be joined (with heat shrink sections or taping) to the rubber caps on the terminals. In addition the corrugated pipe clamps (cut longitudinally) must not be in contact with the sharp edge of the pipe.
- All the terminals (+) for connecting the aforesaid cables and their lugs must be protected by rubber caps, (airtight for zones exposed to the weather or with any stagnation of water).
- The fastening of the lugs on the terminals (also negative) must be assured to avoid loosening, applying a tightening torque where possible and fanning out the lugs in the case of multiple connections (preferably to be avoided).

It is always necessary to isolate the battery before doing any work on the electric system, disconnecting the power cables, first the negative pole then the positive one.

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 ancillaries 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).

### **Precautions for operations on the frame**

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 required by the use of auxiliary equipment, protective diodes must be installed for any inductive current peaks.

The ground signal coming from the analogue sensors must only be wired to the special receiver; further ground connections could falsify the output signal coming from these sensors.

The cable bundle for low intensity signal electronic components must be placed parallel to the reference plane, that is attached to the chassis/cab structure, in order to reduce parasitic capacity to a minimum; distance the path of the additional cable bundle as far as possible from the existing path.

Auxiliary systems must be connected to the system ground with the utmost care (see point 5.4.1); associated cabling must not run alongside the electronic systems already on the vehicle 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



**When failure to start is due to low battery voltage and not to problems in the electric system avoid starting the vehicle by towing.**

**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.**

**Do not start the engine without having first permanently connected the battery.**

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

**ABSOLUTELY avoid using a fast battery charger for emergency starting: due to the high voltages applied, the electronic systems, and in particular the control units that manage the ignition and supply functions, could get damaged.**

Auxiliary method start-up must only be carried out using an external battery carriage, according to the following procedure:

- observe all current accident prevention precautions (including the use of gloves);
- use a battery trolley with specifications similar to those of the vehicle battery;
- using a suitable cable, connect the positive pole of the battery trolley to the positive pole of the CBA control unit fitted on the positive pole of the vehicle battery (see Figure 5.33 paragraph 5.4.5);
- using a suitable cable, connect the negative clamp of the battery trolley to the ground of the vehicle with a 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;
- when starting the engine on vehicles with an automatic gearbox: turn the key ON and press the brake pedal. Wait for all the engine warning lights on the dashboard to go off and for a "Gearbox OK" message to appear on the display. 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 activate the vehicle's electric services, for example low-beam headlights, heater, both in order to allow the accumulation of a sufficient amount of energy and to avoid any current peaks which could damage the electronic 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 be recharged subsequently by disconnecting from 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 5.3 for precautions to be adopted for installed control units.**



### 5.4.1 Earth points

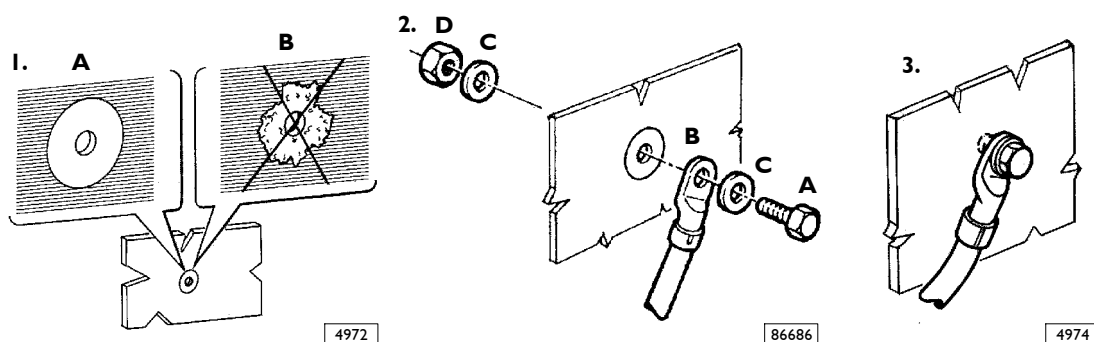
The vehicle's original ground connections should not be modified in principle. In the event that such connections need be displaced or addition ground points need be realized, use the holes found on the chassis as much as possible, taking care to:

- remove the paint on the chassis side and also the terminal side mechanically by sanding and/or by using an appropriate chemical product to create a contact surface without notches or steps;
- apply a suitable paint with high electric conductivity properties between the cable terminal and the metal surface;
- connect the earth within 5 minutes of 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.

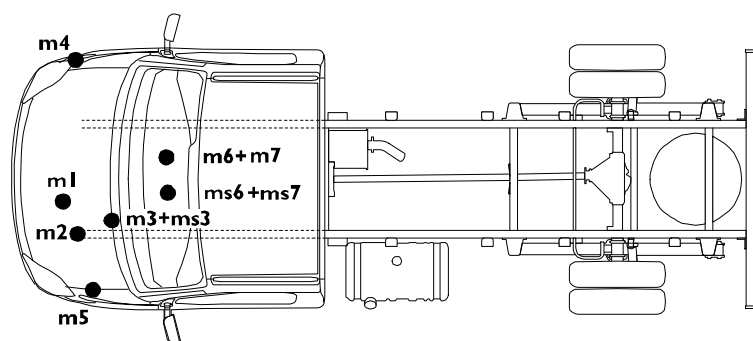
Additional signal grounds must be positioned at different points from the power grounds.

Figure 5.14



1. Ground connections: (A) in the first instance, connection is correct; (B) in the second instance, connection is incorrect -
2. Correct cable fastening to the ground point by using: (A) screw, (B) cable terminal, (C) washer, (D) nut -
3. Cable connected to the ground.

Figure 5.15



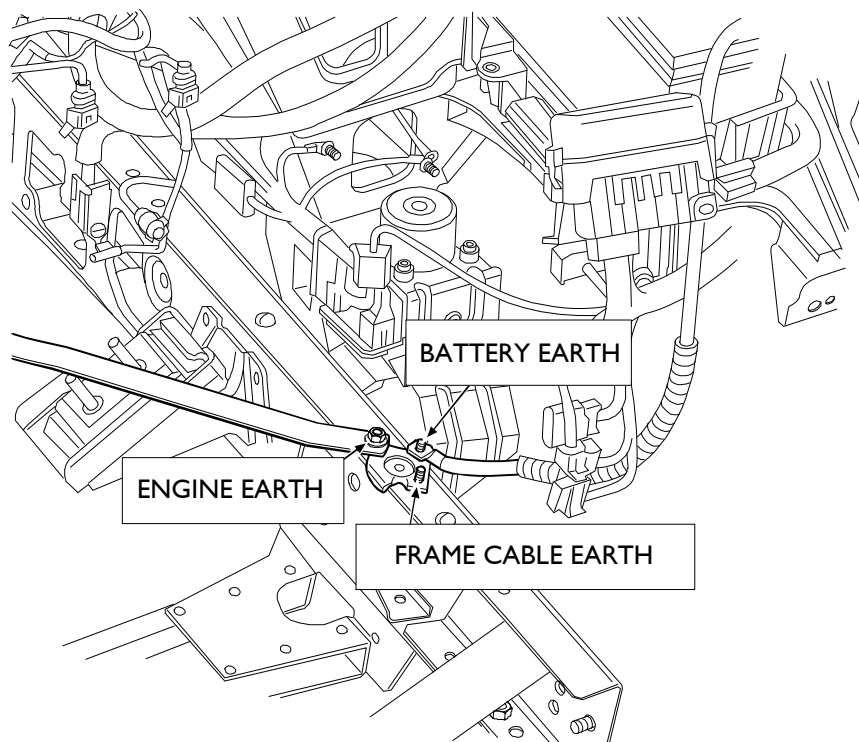
173253

m = power grounds  
ms = signal grounds

#### POSITION OF EARTH POINTS ON VEHICLE

m1. Engine block ground - m2. Engine compartment ground left chassis side member - m3 + ms3. Engine compartment ground under the servo brake - m4. Engine compartment ground near right front light - m5. Engine compartment ground near left front light - m6 + ms6. Ground inside cab central zone - m7. Ground inside cab central zone

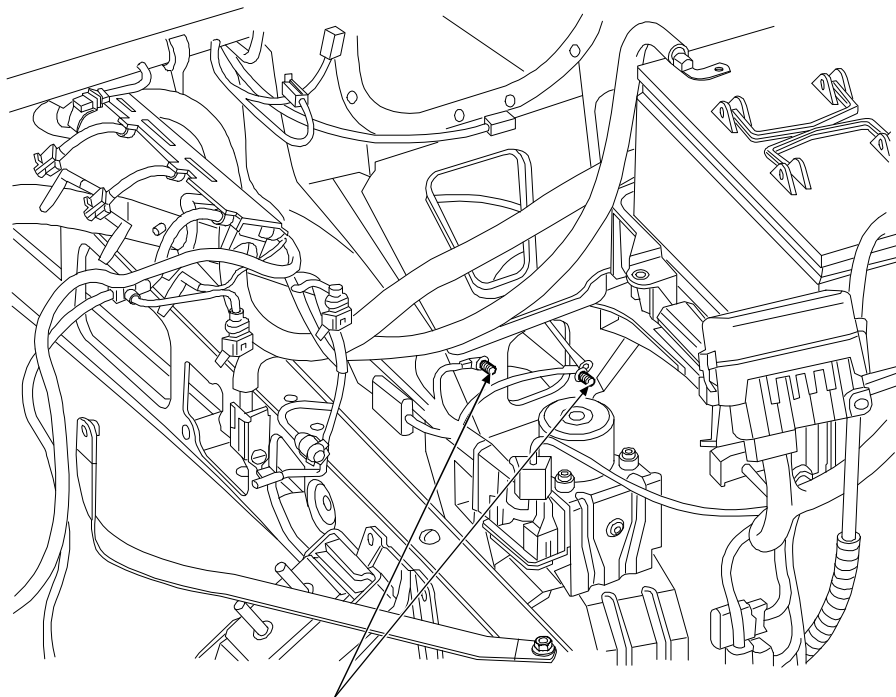
Figure 5.16



128823

m2. Left frame rail engine compartment earth

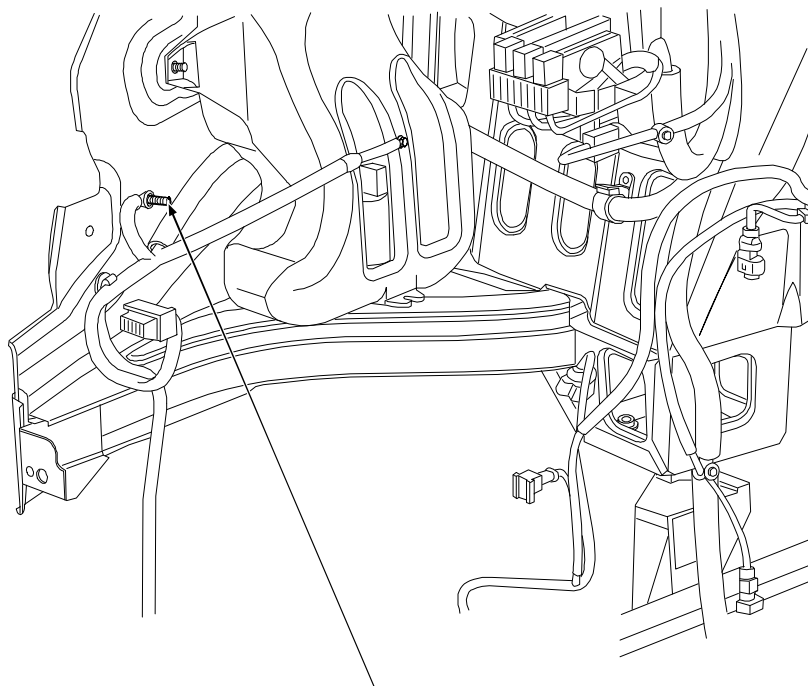
Figure 5.17



128824

m3 + ms3. Engine compartment earth beneath brake servo

Figure 5.18



128825

m4. Engine compartment earth near right front light

Figure 5.19

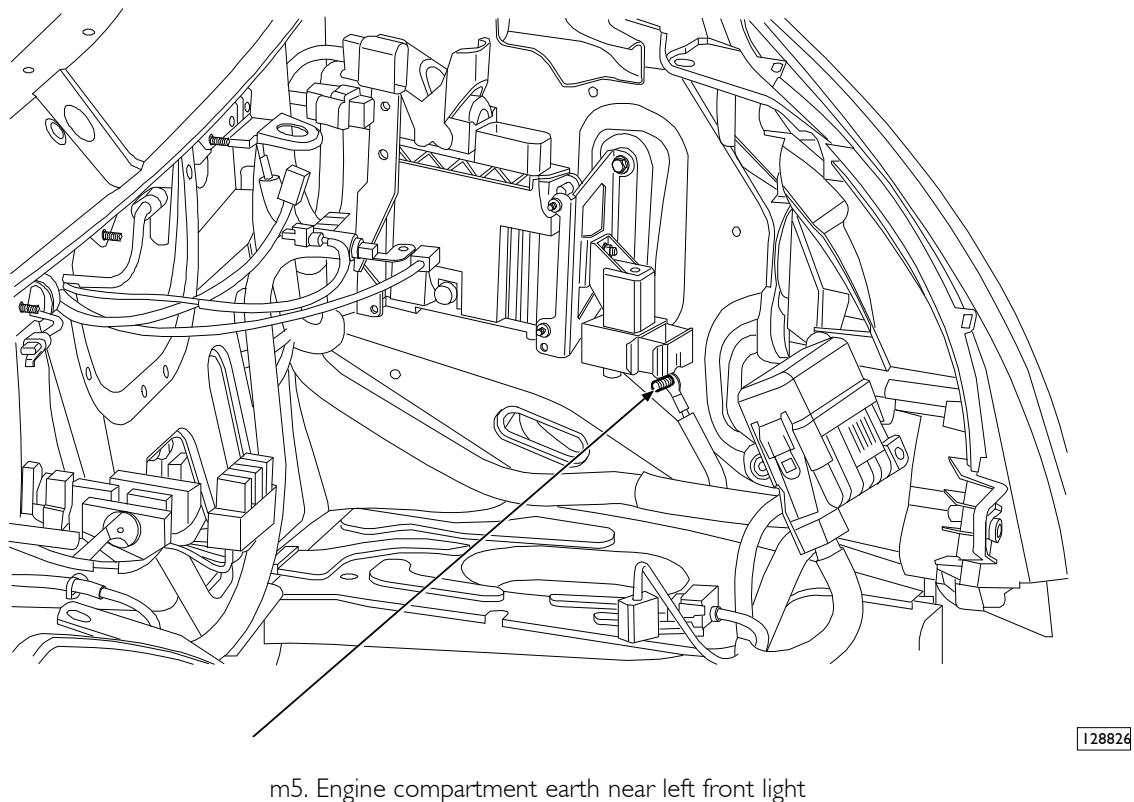
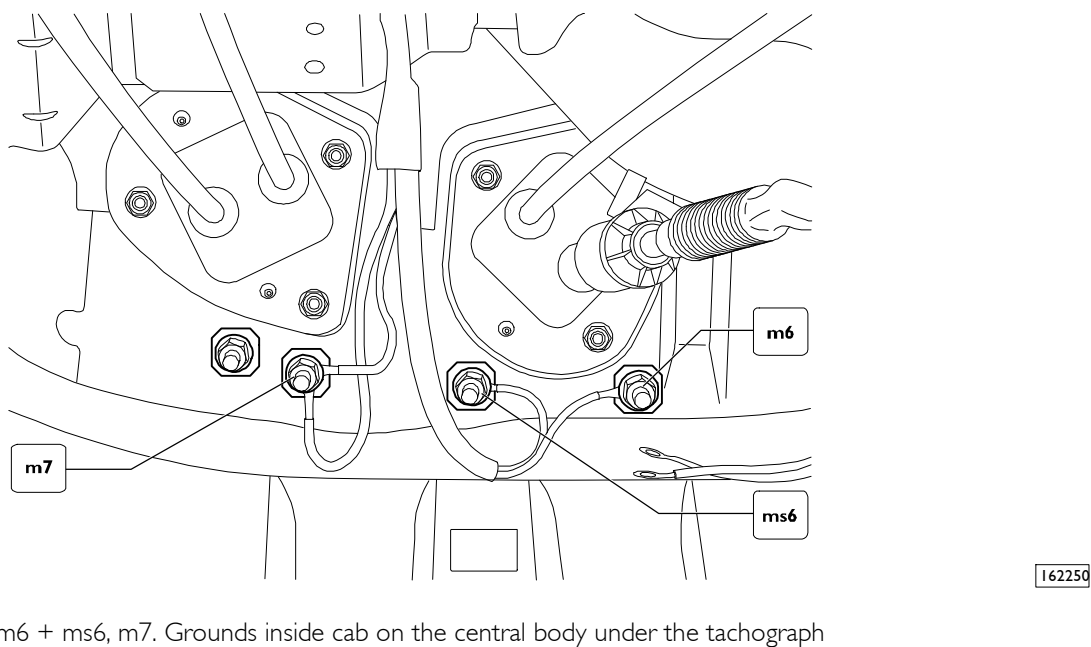


Figure 5.20

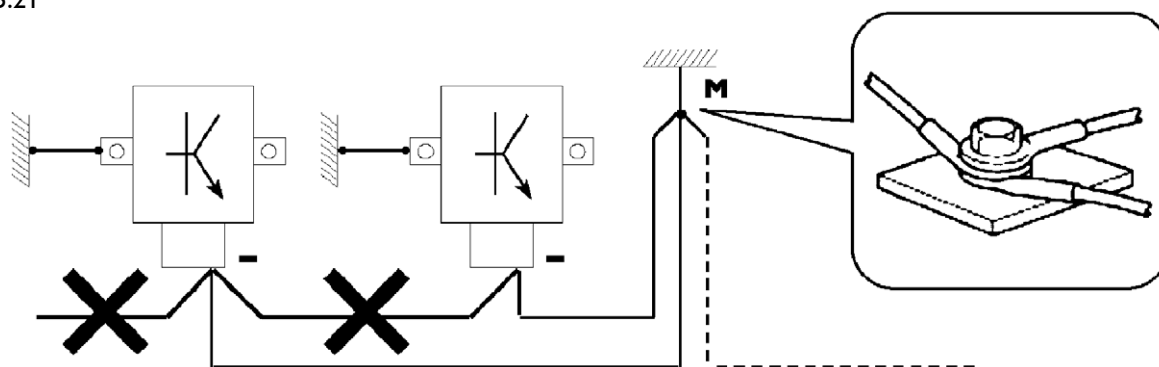


The negative leads connected to a ground point in the system must be as short as possible and must be connected to each other in "star" formation, while tightening must be done in an orderly and adequate manner.

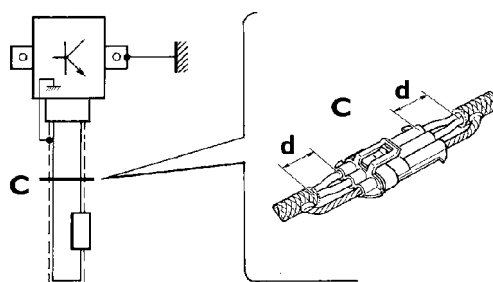
As far as electronic components are concerned, the following instructions shall also be followed:

- 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, connected 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 sheath 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 5.21



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



Metal-braid screening of a cable to an electronic component

114077

## 5.4.2 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:

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

The maximum excursion allowed for transition voltage with equipment powered by 12 V is +60 V measured on the terminals of the artificial network (L.I.S.N.) if tested on the bench. Alternatively, if tested on the vehicle, the excursion must be read at the most accessible point near to the conflicting device.

**NOTE** Devices powered by 12 V must be immune to negative interference such as -300 V spikes, +100 V positive spikes, bursts of +/-150 V.

**They must operate correctly during the phase when voltage drops to 5 V for 40 ms and 0 V for 2 ms.**

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

The maximum radiated emission levels measured at the bench and levels of conducted emissions generated by devices and also by 12 V power supplies are given in the following table:

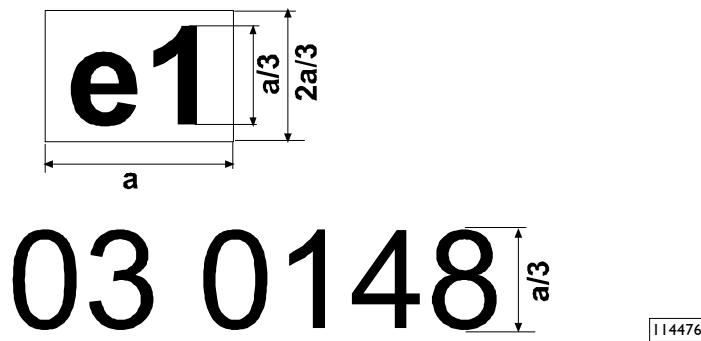
Table 5.6

Type of emission	Type of transducer	Type of disturbance	Type of detector	Frequency range and limits acceptable by noise in dB $\mu$ V/m									Unit of measurement
				150 kHz 300 kHz	530 kHz 2 MHz	5.9 MHz 6.2 MHz	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	dB $\mu$ V/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 50 $\Omega$ 5 $\mu$ H 0.1 $\mu$ F	Broad-band	Nearly peak	80	66	52	52	36	36	Not applicable			dB $\mu$ V
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 compatibility, i.e. use suitable components for vehicle applications "e." marked (the EC marking is not sufficient).

An example of the mark prescribed by the current European Directive on electromagnetic compatibility in the automotive field is shown below:

Figure 5.22



$a \geq 6 \text{ mm}$

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.

Whenever equipment is used that runs on mains power (220 V AC) for its primary or secondary source of power, it must be checked to ensure that its characteristics are in line with IEC regulations.

### 5.4.3 Two-way radio systems

The most frequent applications include:

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

#### General instructions

- a) The equipment must be approved according to the law and be of fixed type (not portable).  
The use of non approved transmitters or supplementary amplifiers could seriously impede the correct functioning of the electric/electronic devices normally supplied, with negative effects for the safety of the vehicle and/or the driver.
- b) The system already provided on the vehicle must be used to power the transmitters and they must be connected to terminal 30 on the Bodybuilder connector (and I5 where necessary) via a supplementary fuse.  
Any additional power lines must be created respecting the correct sizing of cables and protection.

- c) The coaxial antenna cable must be positioned taking care to:
  - use a low loss, top quality product, with the same impedance as the transmitter and the antenna (see Figure 5.24);
  - in order to avoid interference and malfunctioning, create a path that maintains an adequate distance (min. 50 mm) from pre-existing cabling or from other cables (radio, amplifiers and other electronic equipment), fixed keeping the minimum distance from the metal structure of the cab and using existing holes in the sheet metal;
  - do not shorten or lengthen; avoid unnecessary tangles, tension, folds and crushing.
- d) Outside the cab, the antenna must be installed on the vehicle on a metal base with a wide surface if possible; otherwise it must be fitted as vertically as possible, with the connecting cable pointing downwards and therefore following the Manufacturer's fitting instructions and warnings (see Figure 5.23).  
 Installation on the centre of the roof is to be considered the best by far, as the grounding surface is proportional in all directions, while fitting on a side or any other part of the vehicle makes the grounding area proportional to the grounding of that part. Inside the cab, the transmitter equipment must be positioned as shown in Diagram 5.25.
- e) The quality of the antenna, the mounting position and a perfect connection to the vehicle structure (ground) are factors of fundamental importance to guarantee the best performance of the transmitter equipment.

Some specific instructions are given below for each type of equipment

#### **Amateur equipment for CB (27 MHz) and 2m band (144 MHz)**

The transmitter part must be installed in a separate area from the vehicle's electronic components.

- The SWR ratio (Standing Wave Ratio) must be as close as possible to the unit (1.5 is recommended) while the maximum must not be greater than 2.
- The ANTENNA GAIN values must be as high as possible and guarantee a sufficient level of spatial uniformity, characterised by deviations in relation to the average value of the order of 1.5 dB in the typical CB band (26.965-27.405 MHz).
- The value of the RADIATED FIELD in the cab must be as low as possible, and therefore  $< 1 \text{ V/m}$ .  
 The limits imposed by the current European Directive must not be exceeded in any case.

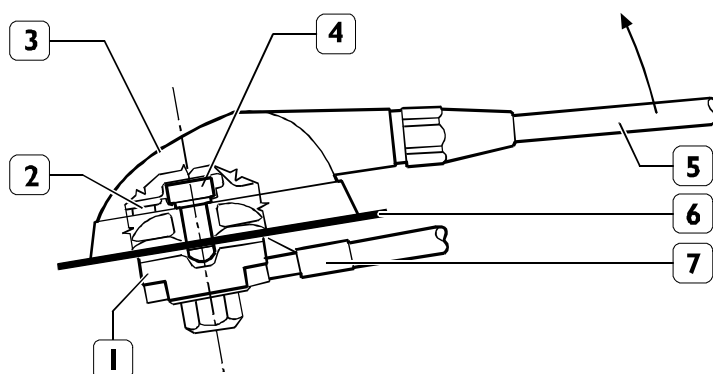
To determine whether the system is functioning well and to check that the antenna is calibrated, it is suggested that the following information is taken into account:

- 1) if the SWR is higher on the lower channels than on the higher ones, the antenna should be lengthened
- 2) if the SWR is higher on the higher channels than on the lower ones, the antenna should be shortened

After having calibrated the antenna, it is advisable to re-check the SWR value on all the channels.



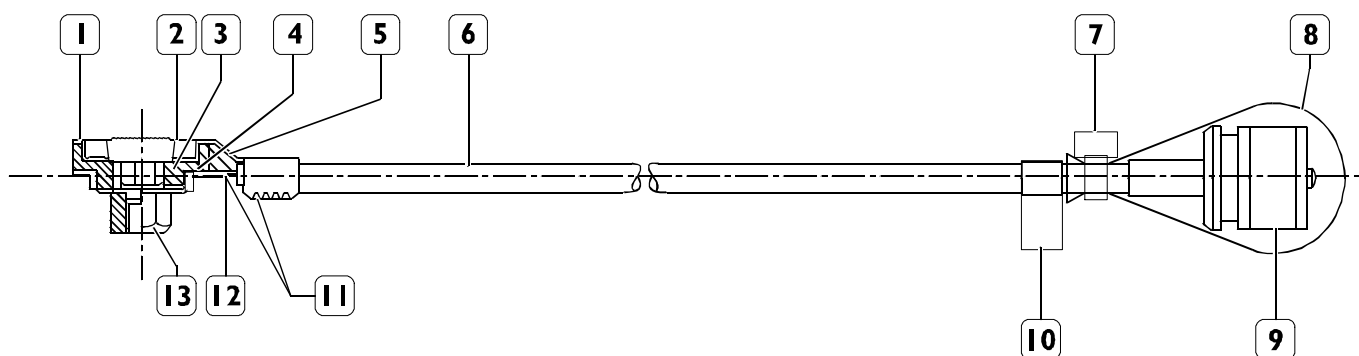
Figure 5.23



98915

1. Antenna support - 2. Gasket - 3. Fixed joint cover - 4. Fixing screw M6x8.5 (torque to 2 Nm) - 5. Antenna - 6. Roof - 7. Antenna extension lead

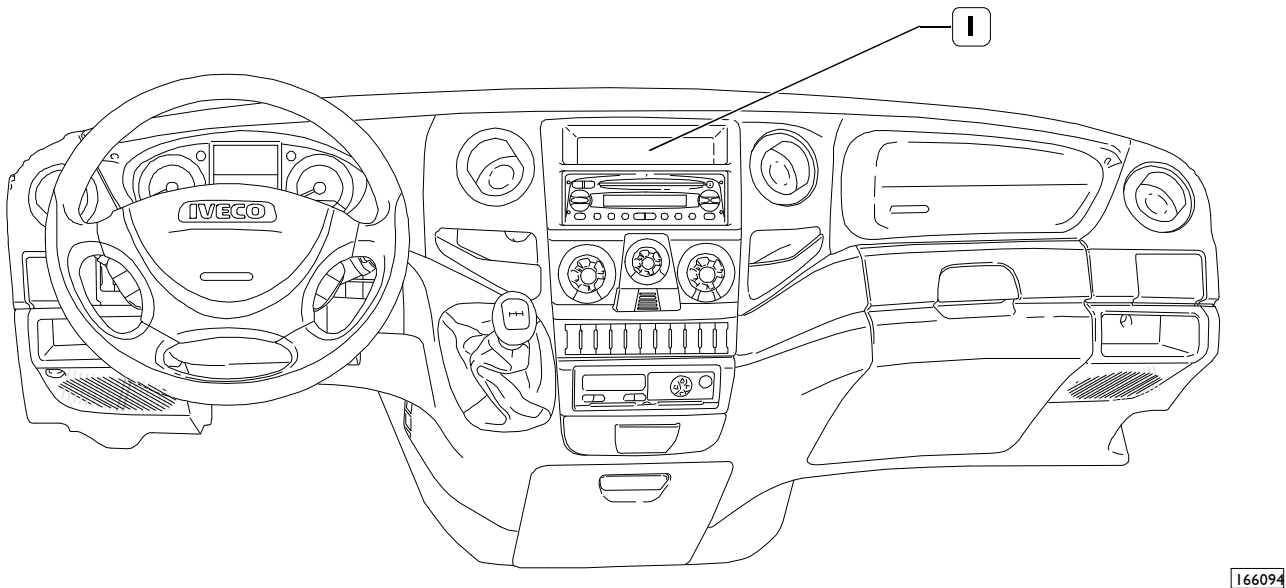
Figure 5.24



99349

1. Antenna connector - 2. Ground wire - 3. Insulator - 4. Signal wire - 5. Capacitor (100 pF) - 6. Cable RG 58 (characteristic impedance =  $50 \Omega$ ) - 7. Clamp - 8. Protective cap - 9. Connector (N.C. SO - 239) transceiver side - 10. Test executed sticker - 11. The 100 pF 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

Figure 5.25



I. Location of the CB transceiver unit (City Band)

### Equipment for cellular telephones

The transmitter part of the equipment must be installed in a flat, dry area, separate from the vehicle's electronic components and away from damp and vibrations.

- The SWR ratio (Standing Wave Ratio) must be as close as possible to the unit (1.5 is recommended) while the maximum must not be greater than 2.
- The ANTENNA GAIN values must be as high as possible and guarantee a sufficient level of spatial uniformity, characterised by deviations in relation to the average value of the order of 1.5 dB in the 870-960 MHz band and 2 dB in the 1710-2000 MHz band.
- The value of the RADIATED FIELD in the cab must be as low as possible, and therefore  $< 1 \text{ V/m}$ .  
The limits imposed by the current European Directive must not be exceeded in any case.

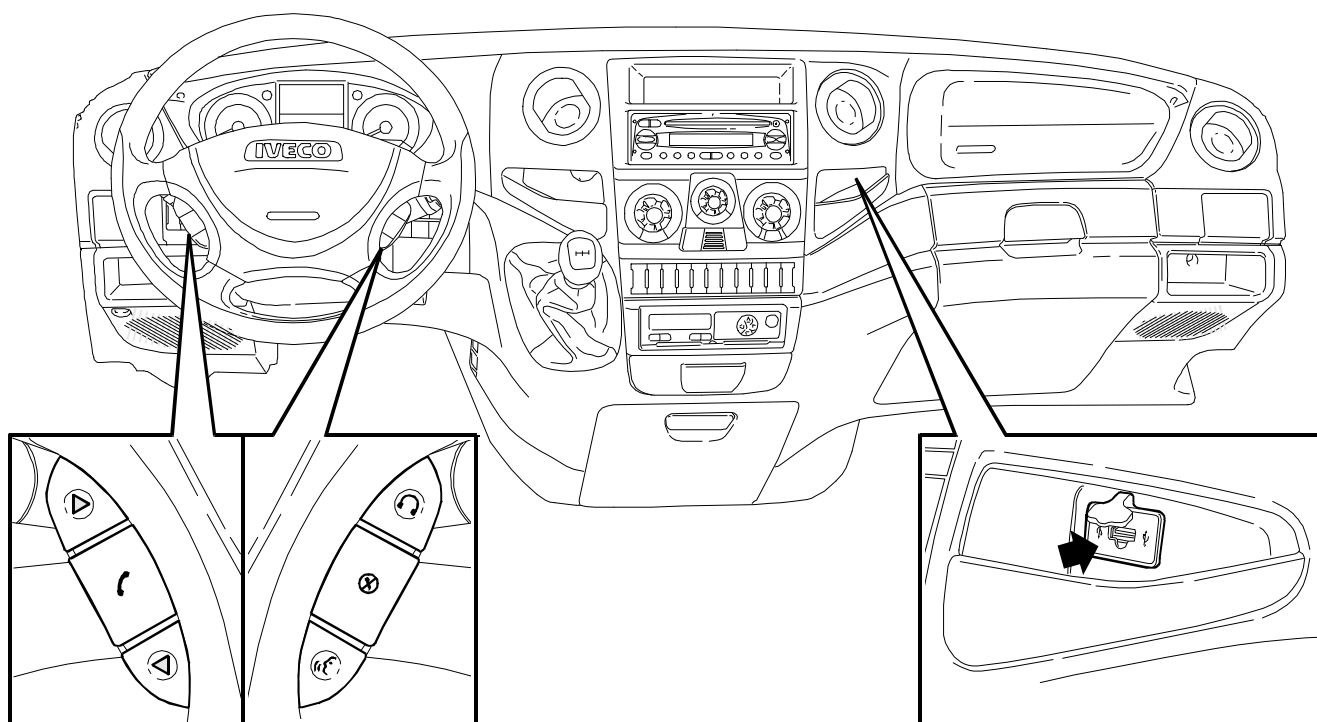
An optimum position for the antenna would be the front of the cab roof, at a distance of not less than 30 cm from other antennas.

### Blue&Me provision

The Blue&Me provision consists of:

- special control unit, positioned above the car radio and hidden by a plastic cover,
- buttons on the steering wheel,
- ceiling fitting with microphone,
- USB socket,
- cabling.

Figure 5.26



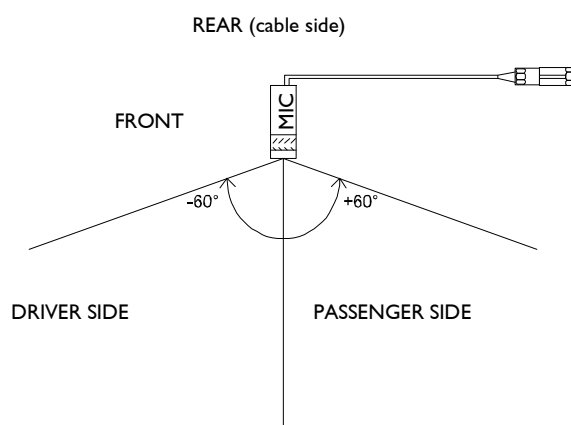
166093

Blue&Me provision components

In the case of shielded vehicles, the ceiling fitting with microphone is supplied in the equipment kit case.

If required by the installation in the cab, the microphone can be removed and replaced. It must however be positioned at a point distant from possible noise sources and according to the reception area described in the following picture.

Figure 5.27



166095

Figure 5.28

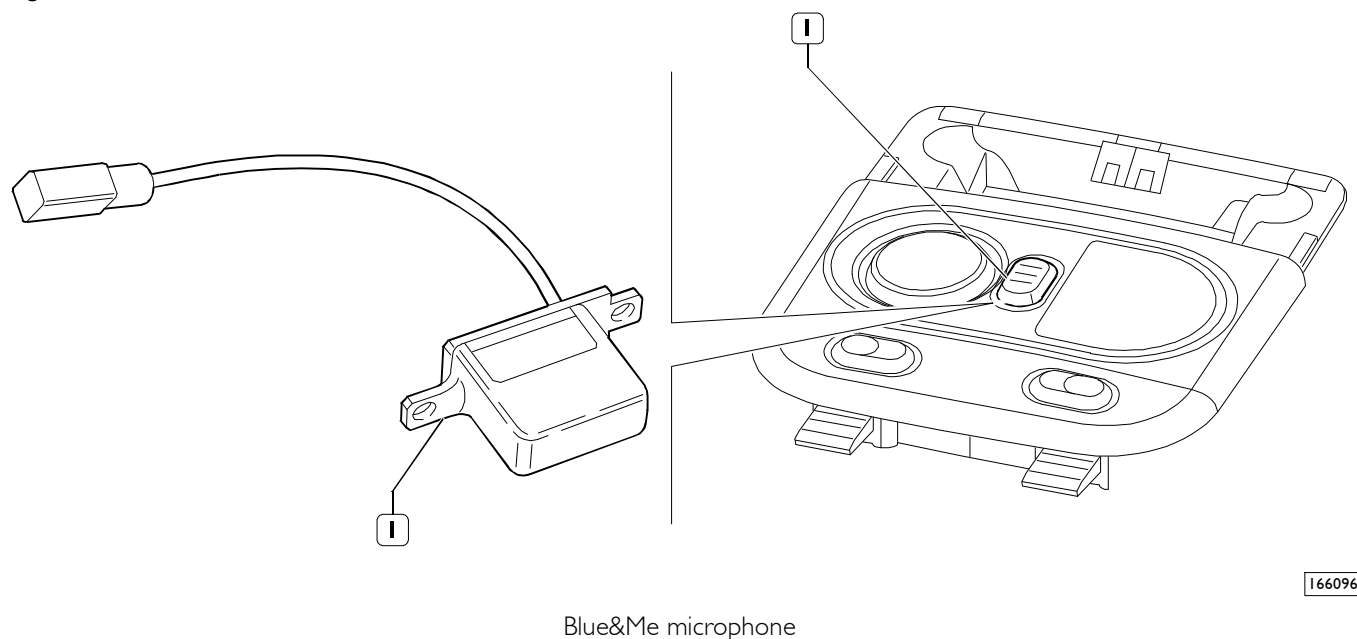


Table 5.7

Pin	Description	Cable		
1	Ground	White		
2	Signal + Vdc	Shielded		

The microphone connector, cab side cable, is with the associated connectors on the ceiling fitting.

### GPS reception and satellite navigation equipment

The transmitter part of the equipment must be installed in a flat, dry area, separate from the vehicle's electronic components and away from damp and vibrations.

The GPS antenna must be installed so as to have the maximum visibility possible of the sky.

In fact, as the signals received from the satellite are at very low power (around 136dBm), almost any obstacle can influence the quality and performance of the receiver.

The following should therefore be guaranteed:

- an absolute minimum angle of vision of the sky of 90°,
- a distance no less than 30 cm from any other antenna,
- a horizontal position that is never underneath any metal making up part of the cab structure.

Moreover:

- the SWR ratio (Standing Wave Ratio) must be as close as possible to the unit (1.5 is recommended) while the maximum must not be greater than 2 in the GPS frequency range ( $1575.42 \pm 1.023$  MHz).
- the ANTENNA GAIN values must be as high as possible and guarantee a sufficient level of spatial uniformity, characterised by deviations in relation to the average value of the order of 1.5 dB in the  $1575.42 \pm 1.023$  MHz band.

### Car radio installation

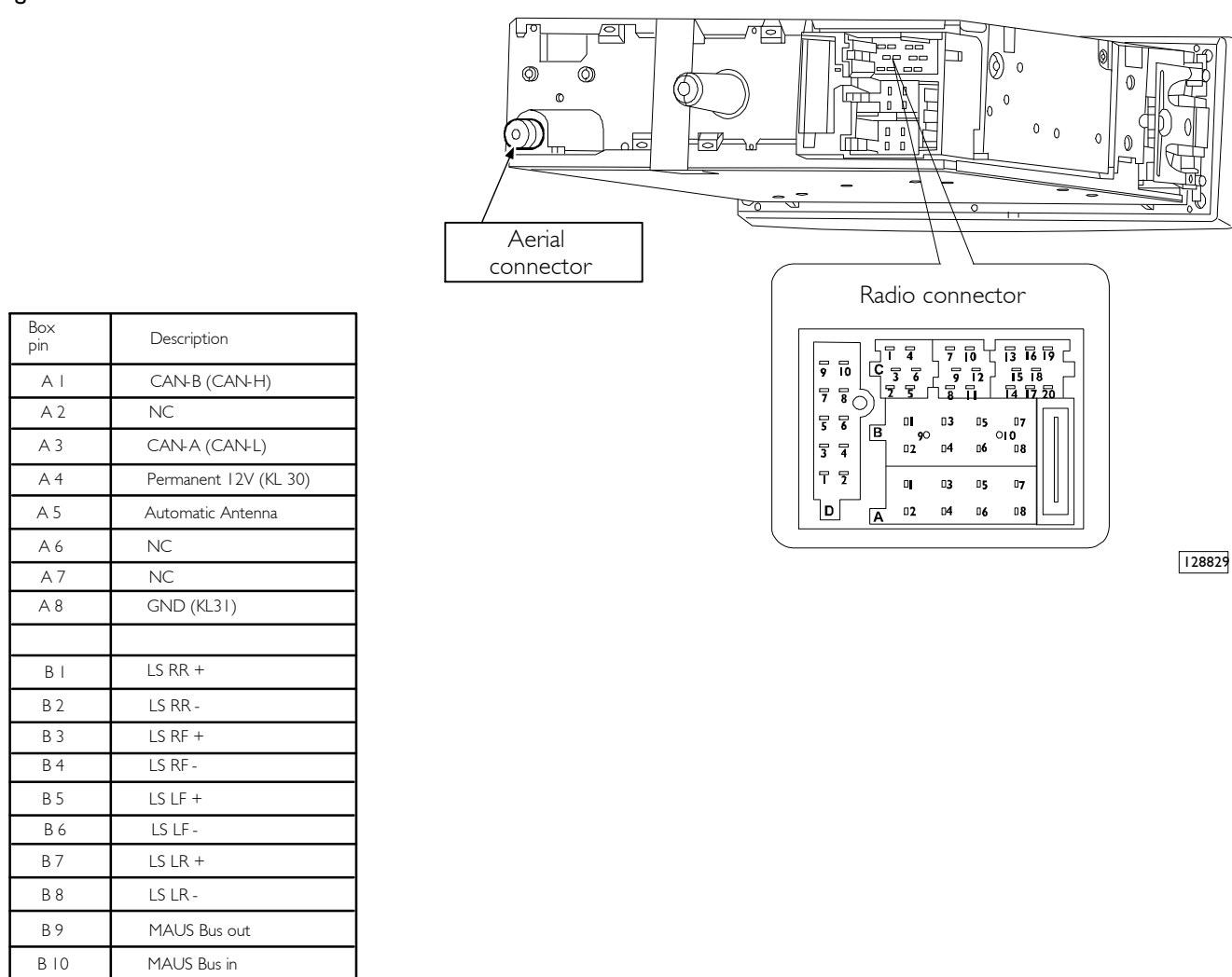
The original equipment (or aftermarket) IVECO car radio is integrated into the system on the CAN network and allows:

- message repetition to comfort control panel;
- volume adjustment according to vehicle speed;
- integration with Convergence V2 system;
- integration with the Blue&Me system;
- recognition/antitheft system with Body Computer.

Car radios of other types do not allow access to the previous functions.

The pins available for the installation are listed in fig. 5.29.

Figure 5.29



#### 5.4.4 Additional equipment

Power for the equipment, when the voltage required is different to that for the system, must be obtained using a suitable DC/DC 12 - 24 V convertor if not already provided. The power cables must be as short as possible, avoiding any twists (coils) and maintaining the minimum distance from the reference plane.



**If devices are fitted that could interact with the electronic systems already present (Retarders, Extra heaters, Power Take Offs, Air conditioners, Automatic transmissions, Telematics and Speed limiters) contact IVECO 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 vehicle system is designed to supply the power necessary for the equipment supplied, to each piece of equipment, as required by their respective functions, and specific protection and correct sizing of the cables is ensured.

Suitable protection must be provided for supplementary equipment used and the equipment must not overload the vehicle system.

The ground connection for additional users must be carried out with an adequate section of cable, as short as possible and created so as to allow any movement of the additional equipment in relation to the vehicle chassis.

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

In any case we recommend that the increase in the capacity of the batteries should not exceed 20 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 insertion of a supplementary battery into the vehicle circuit requires a separate charging system, integrated with that of the vehicle. In this case, supplementary batteries must be provided with an equal capacity to those fitted originally (110 Ah) for correct charging of all the batteries.

If the supplementary battery is installed, it is possible to use:

- recombination batteries (AGM or gel)
- 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:

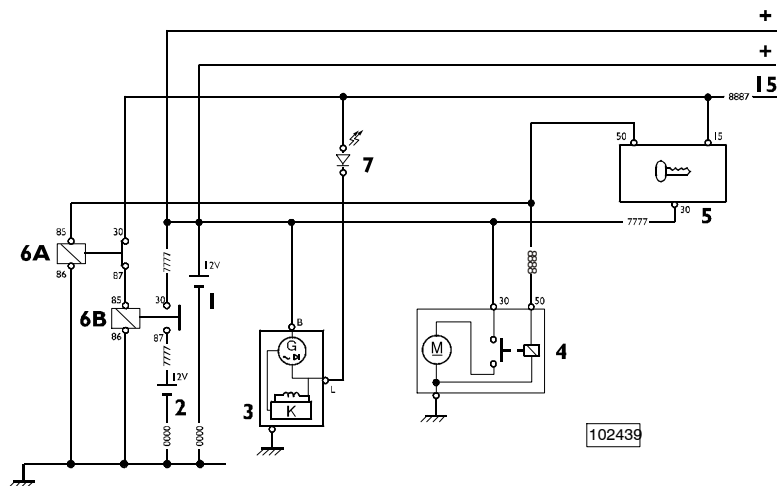
- a cover with a system for blowing the gas off to the outside, fitted with tube for conveying the acid spray to the outside;
- a flame anti-return system by means of a porous pellet (flame arrester).

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 5.30



**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 -  
6A. Load excluder contactor during start-up - 6B. Battery cut-off for supplementary battery -  
7. No battery recharge warning light



**All the lines downstream all the batteries shall be adequately protected, under any possible fault condition. Failure to ensure adequate protection may pose a fire hazard and a danger to the persons.**

### Auxiliary alternators

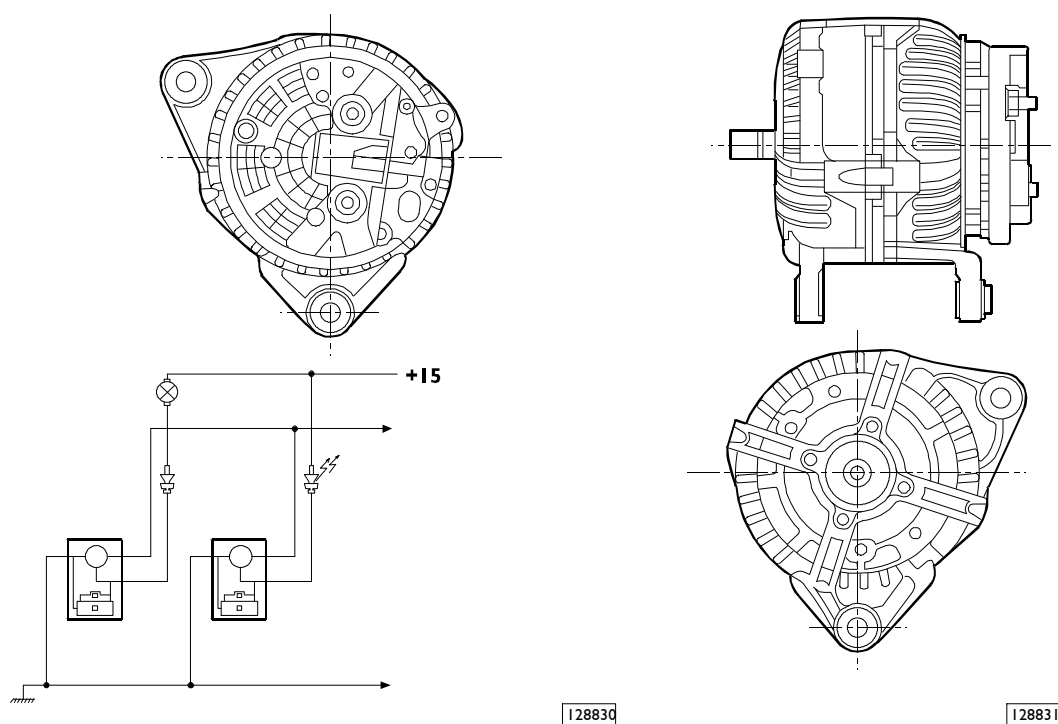
Suitable protection must be provided for supplementary equipment used and the equipment must not overload the vehicle system. In cases when it is necessary to use an additional battery in parallel to the standard one, it is recommended that a larger alternator is used, or an additional alternator is fitted.

The additional alternators must be the type with rectifiers with Zener diodes to avoid damage to the electric/electronic equipment, due to accidental removal of the batteries. Each alternator must also have a no battery charging warning light or led.

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

If it is necessary to make modifications to the system that are different to those described in this manual (for example, the addition of more batteries in parallel), the operation must be shared with IVECO.

Figure 5.31



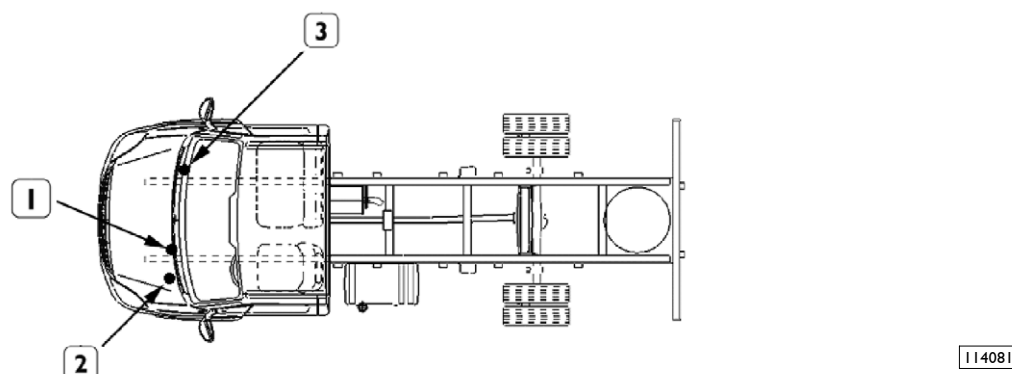
**NOTE.** THE DIAGRAM IS SHOWN FOR ILLUSTRATIVE PURPOSES ONLY



### 5.4.5 Current drawing

The following gives information related to the points where it is possible to draw off the available power and the instructions to observe.

Figure 5.32



1. Bodybuilders node - 2. Passage of wires between cab/engine compartment - 3. Bodybuilders' connector (cab interior)

### Drawing current from CBA (on battery)

The battery is fitted with a control unit to deliver the positive (+) and protect the services (CBA).

Figure 5.33

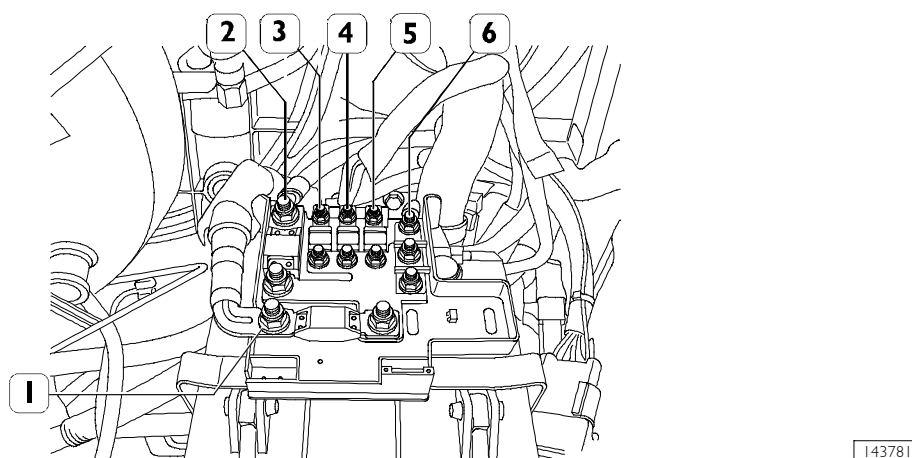


Table 5.8

Ref.	Function	Fuse rating (A)	Cable section (mm <sup>2</sup> )
1	+30 positive from F75 for starter motor, alternator and retarder (if present)	500	50 or 35
2	+30 positive from F70 for SCM BUS-BAR	150	35
3	+30 positive from F73 for pre-heating glow plugs	60	10
4	+30 positive from F72 for braking node	40	4
5	+30 positive from F71 for 1 <sup>st</sup> Body Computer power	80	16
6	+30 positive to F64 in SCM/A for IBS sensor for Stop & Start	-	4

## Precautions

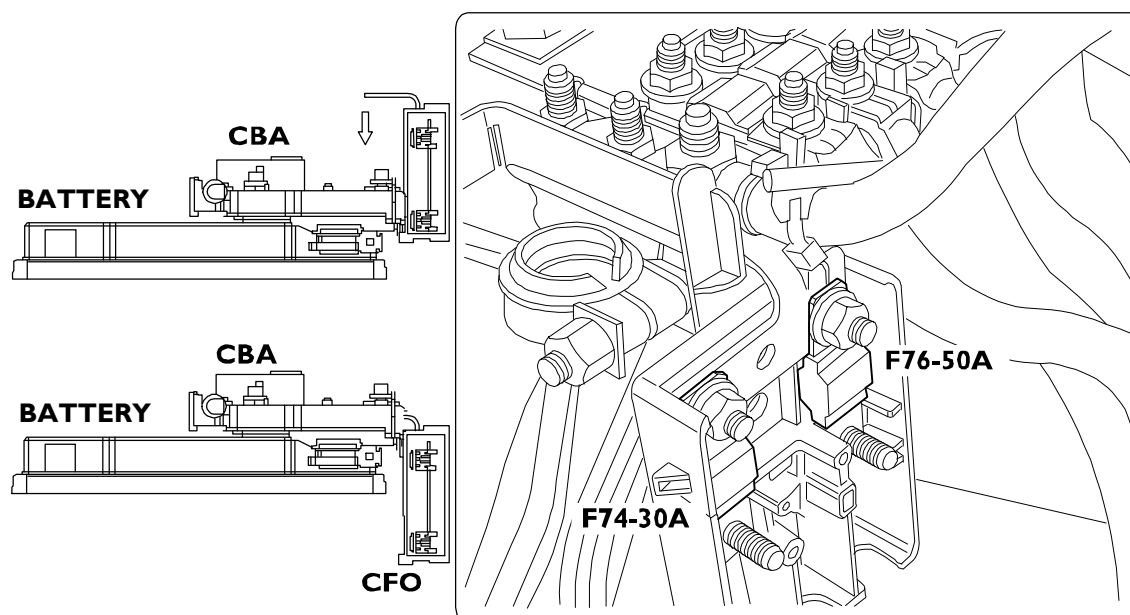
In general it is wise to:

- where necessary use appropriate fuses that can be fitted near the tap;
- protect the added cables in special sheaths or corrugation, installing them in compliance with point 5.4.6.

And in fitting the CBA it is necessary to:

- avoid removing fuses from their position;
- insert the terminals into the studs and secure them using the special nuts (M5 flanged nut, self-locking, etc.) tightened to torque ( $4 \div 6$  Nm);
- then fix the CFO control unit (optional fuse control unit) to the CBA control unit, as in Figure 5.34, fitting the hole of the strip on the stud bolt of the battery terminal (no. 6, incorporated in the CBA of Figure 5.33) and tightening the special nut to the required torque ( $8.8 \div 13.2$  Nm).

Figure 5.34



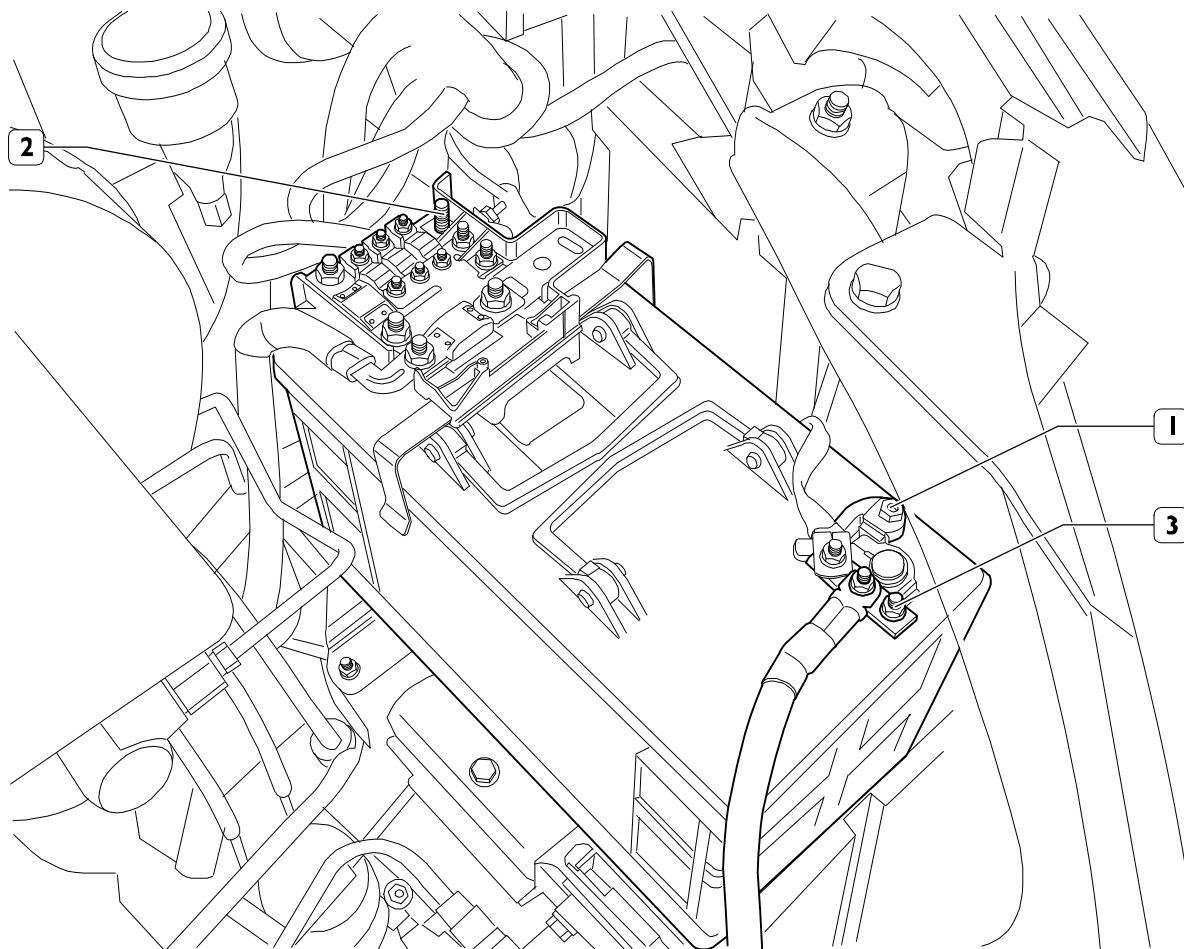
162237

Table 5.9

CFO	Power	Protection	Presence		Capacity	Type	EURO5 4x2	EUROV 4x2	BIFUEL
			S	OPT					
F74	30	Bodybuilder socket I	X		50	C0	X	X	X
F76	30	Bodybuilder socket I	X		50	C0	X	X	X

The only points (2) and (3) from which current may be taken are shown in the figure. It is absolutely prohibited to take current from points that are not shown.

Figure 5.35



162238

1. Lever for fast disconnection of battery negative terminal (-) from the electrical system - 2-3. Only current take-off points

To secure the additional terminal on the free pin (M6) of the negative battery terminal (3), tighten the nut with a tightening torque of 5,5 Nm.



**It is absolutely forbidden to draw power from unauthorized points.**

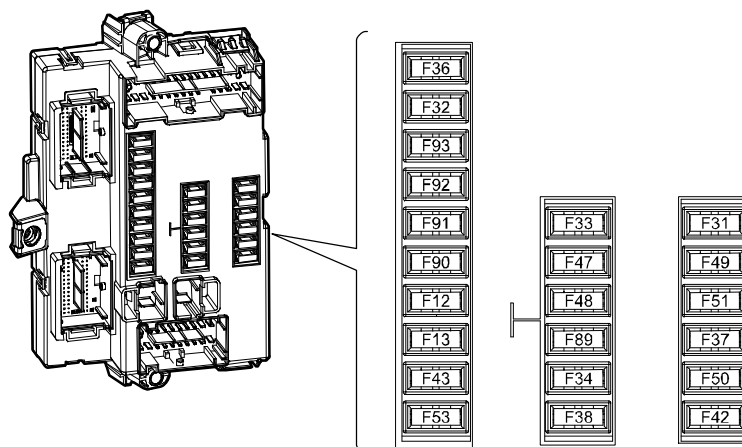
**RISK OF FIRE.**

### Fuse and relay box under the dashboard

Located in a special compartment, shut in a fitted drawer, it is on the left side of the dashboard.

The fuse layout is shown in fig. 5.36 (the relays are not visible).

Figure 5.36



I62235

### List of fuses under the dashboard:

Table 5.10

BC	Power	Protection	Presence		Capacity	Type	EURO5 4x2	EUROV 4x2	BIFUEL
			S	OPT					
F12	30	T1b relay (30-87) for right low beam headlight	X		7,5	A0	X	X	X
F13	30	T1a relay (30-87) for left low beam headlight - headlight adjuster	X		7,5	A0	X	X	X
F31	15/A	T54 relay (86) for headlight washers and T50 - T51 - T52 - T53 - elm motors and controls for electric windows	X		5	A0	X	X	X
F32	30	T44 relay (30-86) for battery removal with minimum voltage - internal lighting	X		7,5	A0	X	X	X
F33	30	outswinging door	X		15	A0	X	X	X
F34	30	fitter socket	X		20	A0	X	X	X
F36	30	T20 relay for MODUS car radio - tachograph - convergence - siren - parking sensor	X		15	A0	X	X	X
F37	15	instrument panel - stop lights - trailer socket	X		7,5	A0	X	X	X
F38	30	central locking		X	20	A0	X	X	X
F42	15	ABS9 or ESP9	X		5	A0	X	X	X
F43	30	T23a relay (86-87) for windscreen washer and T23b relay (86-87)	X		20	A0	X	X	X
F47	30	T25a relay (86-87) and T25b (86-87) for driver's side electric window		X	25	A0	X	X	X
F48	30	T26a relay (86-87) and T26b (86-87) for passenger side electric window		X	25	A0	X	X	X
F49	15	control panel - tachograph - exp. module - fitter socket - ASR control - Telma (coil) - video camera - outswinging - rear differential lock	X		5	A0	X	X	X
F50	15	airbag		X	5	A0	X	X	X
F51	15	green filter - car radio - toe-in - parking sensors - CAF			5	A0	X	X	X
F53	30	instrument panel - timer for supplementary heater	X		5	A0	X	X	X
F89		AVAILABLE				A0			
F90	30	T11a relay (30-86) for left full beam headlight	X		7,5	A0	X	X	X
F91	30	T11b relay (30-86) for right high beam headlight	X		7,5	A0	X	X	X
F92	30	T12a relay (30-86) for left foglight	X		7,5	A0	X	X	X
F93	30	T12b relay (30-86) for right foglight	X		7,5	A0	X	X	X

**List of relays under the dashboard:**

Table 5.11

BC	Power	Protection	Presence		Capacity	Type	EURO5 4x2	EUROV 4x2	BIFUEL
			S	OPT					
T01a	30	left low beam headlight - headlight adjuster	X				X	X	X
T01b	30	right low beam headlight	X				X	X	X
T11a	30	left high beam headlight	X				X	X	X
T11b	30	right high beam headlight	X				X	X	X
T12a	30	left foglight	X				X	X	X
T12b	30	right foglight	X				X	X	X
T23a	30	windscreen washer	X				X	X	X
T25a		driver's side electric window UP		X			X	X	X
T25b		driver's side electric window DOWN		X			X	X	X
T26a		passenger side electric window UP		X			X	X	X
T26b		passenger side electric window DOWN		X			X	X	X
T37a		rear doors central closing		X			X	X	X
T37b		central closing (common)		X			X	X	X
T37c		side doors central closing		X			X	X	X
T37d		rear door central closing		X			X	X	X
T44	30	battery removal with minimum voltage	X				X	X	X



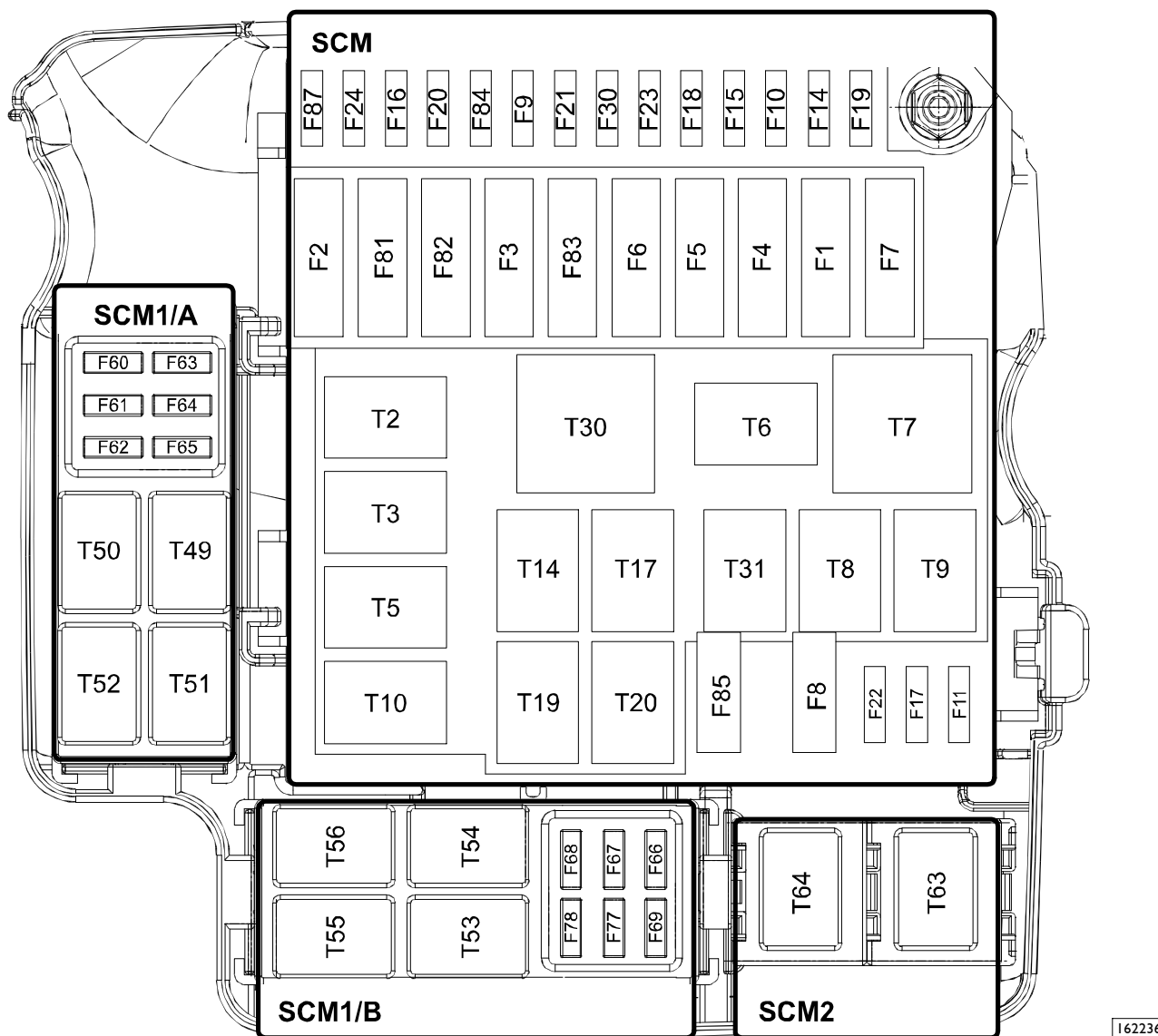
**Only use fuses of the type and with the rated current prescribed.**

**DANGER OF FIRE.**

Only replace the fuses after having eliminated the cause of them blowing and checked the integrity of the cables.

## Fuse box and relay in engine compartment

Figure 5.37



**SCM fuse list:**

Table 5.12

SCM	Power	Protection	Presence		Capacity	Type	EURO5 4x2	EUROV 4x2	BIFUEL
			S	OPT					
F01	30	air suspensions		X	40	B	X	X	X
F02	30	ignition switch	X		30	B	X	X	X
F03	30	cab climate control fans and engine coolant supplementary heater		X	40	B	X	X	X
F04	30	braking system (valves)	X		30	B	X	X	X
F05	30	air suspensions		X	40	B	X	X	X
F06	30	SCM1/A - SCM1/B - SCM2 power supply	X		40	B	X	X	X
F07	30	T7 relay (30-87) for power discharge from ignition switch	X		40	B	X	X	X
F08	30	T8 relay (30-87) for fuel pump	X		15	A	X	X	X
F09	30	automatic transmission	X		30	A0	X	X	
F10	30	T64 relay (30-87) for heated exterior mirrors and heated windscreen		X	15	A0	X	X	X
F11		EDC FIA (primary loads) from MAIN RELAY injectors (CNG)	X		15	A0	X	X	
F14	30	automatic transmission - MAIN RELAY T9 (86)	X		10	A0	X	X	X
F15	30	T2 relay (30-87) for BOSCH cooling pump	X		10	A0	X	X	
F16	15/A	cigarette lighter from T7	X		15	A0	X	X	X
F17		EDC FIC (secondary loads) from MAIN RELAY	X		10	A0	X	X	
		Smart Drive Unit (CNG)			15				X
F18	30	rear differential lock		X	30	A0	X	X	X
F19	30	T6 relay (30-87) for horn	X		7,5	A0	X	X	X
F20	30	I3 pin socket	X		10	A0	X	X	X
F21	30	T14 relay (30) for cylinder solenoid valves (CNG)	X		7,5	A0			X
F22		EDC FIA and FIC (primary loads) from MAIN RELAY - lambda probe	X		20	A0	X	X	
		waste gate (CNG) - lambda probes (CNG)			15				X
F23	30	T19 relay (30-87) for wipers	X		30	A0	X	X	X
F24	15/A	power socket from T7	X		15	A0	X	X	X
F30	30	T3 relay (30-87) for side marker lamps	X		7,5	A0	X	X	X
F81	30	automatic transmission	X		30	B	X	X	X
F82	30	body computer 2 <sup>nd</sup> power	X		70	B	X	X	X
F83	30	T30 relay (30-87) for heating fans inside cab	X		40	B	X	X	X
F84	30	T5 and T14 relays for Baruffaldi coupling solenoid valve power for the cylinders	X		7,5	A0	X		
					15				X
F85	30	T31 relay (30-87) for fuel filter and sediment filter heater		X	25	A	X	X	
F87	15	EDC - automatic transmission	X		5	A0	X	X	
		5SF - automatic transmission							X

**SCM relay list:**

Table 5.13

SCM	Power	Protection	Presence		Capacity	Type	EURO5 4x2	EUROV 4x2	BIFUEL
			S	OPT					
T02		BOSCH cooling pump	X		20		X	X	
		Baruffaldi coupling from trinary (CNG)		X					X
T03		side marker lamps	X		30		X	X	X
T05		1 <sup>st</sup> gear Baruffaldi coupling	X		30		X	X	X
T06		horn	X		20		X	X	X
T07		power discharge from ignition switch	X		50		X	X	X
T08		fuel pump	X		20		X	X	X
T09		MAIN RELAY	X		30		X	X	X
T10		engine start-up prevention	X		30		X	X	X
T14		2 <sup>nd</sup> gear Baruffaldi coupling	X		20		X	X	
		cylinder solenoid valves (CNG)							X
T17		windscreen wiper 1 <sup>st</sup> or 2 <sup>nd</sup> speed	X		10/20		X	X	X
T19		windscreen wiper speed activation	X		10/20		X	X	X
T20		diagnostics with MODUS	X		20		X	X	X
T30		cab heating fans	X		50		X	X	X
T31		fuel filter heater and sediment filter	X		30		X	X	X

**SCM1/A fuse and relay list:**

Table 5.14

SCM1/A	Power	Protection	Presence		Capacity	Type	EURO5 4x2	EUROV 4x2	BIFUEL
			S	OPT					
F60	30	supplementary climate control		X	30	A0	X	X	X
F61	30	T51 relay (30-87) for air conditioner compressor		X	7,5	A0	X	X	X
F62	30	T52 relay (30-87) for right heated rear window		X	10	A0	X	X	X
F63	15	and left heated rear window blow-by - unit heater - T56 relay (86) for compressor		X	10	A0	X	X	X
F64	30	IBS sensor for Stop & Start	X		5	A0	X	X	X
F65	15/A	T7 relay (30-87) for heated seats		X	20	A0	X	X	X

SCM1/A	Power	Protection	Presence		Capacity	Type	EURO5 4x2	EUROV 4x2	BIFUEL
			S	OPT					
T49		stop & start	X		30		X	X	X
T50		AVAILABLE							
T51		compressor activation from climate control		X	20		X	X	X
T52		heated rear windows		X	20		X	X	X



**SCM1/B fuse and relay list:**

Table 5.15

SCM1/B	Power	Protection	Presence		Capacity	Type	EURO5 4x2	EUROV 4x2	BIFUEL
			S	OPT					
F66	30	T54 relay (30-87) for headlight washers		X	15	A0	X	X	X
F67		AVAILABLE				A0			
F68		AVAILABLE				A0			
F69	30	optional 4448 for bus		X	5	A0	X	X	
F77		AVAILABLE				A0			
F78		AVAILABLE				A0			

SCM1/B	Power	Protection	Presence		Capacity	Type	EURO5 4x2	EUROV 4x2	BIFUEL
			S	OPT					
T53		unit heater		X	20		X	X	X
T54		headlight washers		X	20		X	X	X
T55		Power Take Off		X	10/20		X	X	X
T56		stop lights with TELMA retarder activated		X	10/20		X	X	X

**SCM2 relay list:**

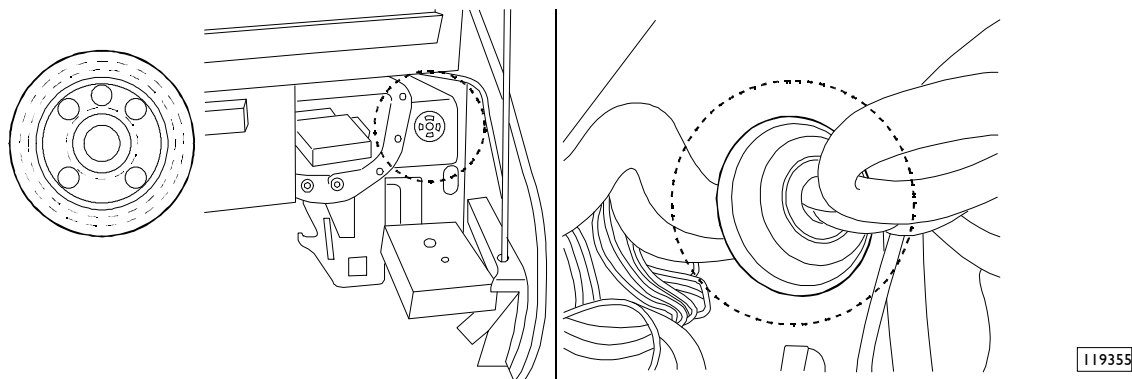
Table 5.16

SCM2	Power	Protection	Presence		Capacity	Type	EURO5 4x2	EUROV 4x2	BIFUEL
			S	OPT					
T63		AVAILABLE							
T64		external heated mirrors - heated windscreen		X	20		X	X	X

### Passing cables from inside the cab to outside

Electric cables may be passed from outside the cab to the engine compartment through five 10 mm diameter holes stamped in the bulkhead coupling near the brake servo. Seal the cable routing point to prevent fumes passing from the engine compartment to the cabin.

Figure 5.38



**Any damage caused by failure to comply with procedure is not covered by the warranty.**

### 5.4.6 Additional circuits

They must be separate and protected from the main vehicle circuit with a suitable fuse.

The cables used must be of a suitable size for their use and must be well isolated. They must be properly protected in sheaths (not in PVC) or in corrugated pipe ducting in the case of more functions (polyamide type 6 material is recommended for the corrugated pipe) and they must be correctly installed, **away from impacts and heat sources. Take care to avoid any chaffing with other components, particularly with live edges of the bodywork.** When passing them through structural components (cross members, profiles, etc.), suitable cable raceways or protection must be provided; they must be secured separately with isolating cable clips (e.g. nylon) at appropriate intervals (approx. 200 mm). It is forbidden to drill holes in the chassis and/or bodywork for passing cables through.

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.

The plug connections and terminals must be protected and weather resistant, by using the same type of component as that originally used on the vehicle.

Use cables and fuses with the characteristics shown in the following table in accordance with the current draw:

Table 5.17

Max. continuous current <sup>1)</sup> (A)	Cable cross-section (mm <sup>2</sup> )	Fuse capacity <sup>2)</sup> (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

<sup>1)</sup> For uses of more than 30 seconds.

<sup>2)</sup> 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.



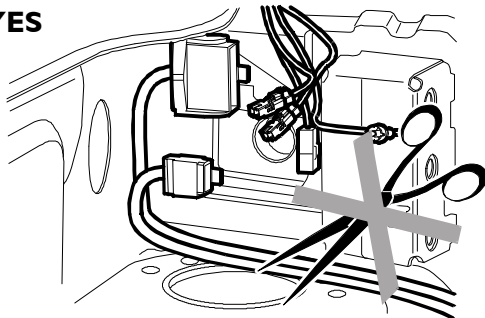
**The fuse must be connected as close as possible to the current take-off point.**

## Precautions

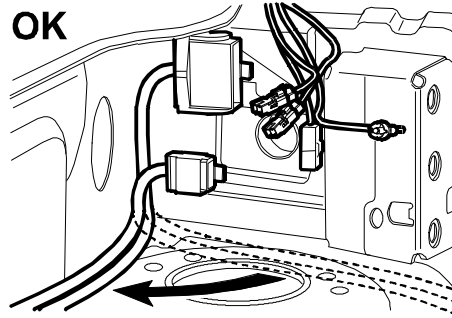
- Incorrect installation of electrical accessories may affect occupant safety and cause severe damage to the vehicle. Contact IVECO if you have any questions.
- Avoid coupling with signal transmission cables (e.g. ABS), for which a preferential path has been defined for electromagnetic requirements (EMI).  
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 with frequent engine start-ups, with limited current drawn and engine rotations (e.g. vehicles with refrigeration chambers), provide for periodic battery charging to maintain efficiency.
- 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.
- Whenever various applications or modifications should require assemblies (various components etc.) to be moved, this is permissible on the condition that their functionality is not compromised, that the original type of connection is restored and that their transverse position on the chassis is not substantially changed when required by their weight.
- 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 5.39

**YES**



**OK**



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

### 5.4.7 Harness modifications due to changes to wheelbase or overhang

If cable length on the frame is altered due to a new wheelbase and overhang, a watertight junction box must be used which has the same characteristics as those used on the standard vehicle. The components used such as wires, connectors, terminal blocks, conduits etc. must be of the same type as those used originally and be correctly fitted.

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

### 5.4.8 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 connector added by the Bodybuilder

If the vehicle is not ordered with a trailer point, a set may be ordered from parts. This consists of:

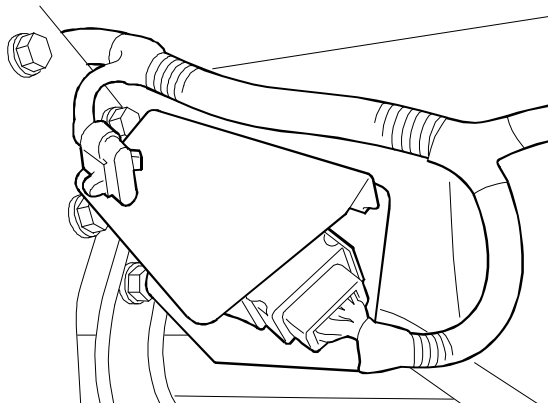
- electronic control unit;
- ECU mounting bracket with guard;
- chassis cable with provision for trailer;
- rear bridle for trailer socket.

#### Installation

For correct installation it is necessary to:

- mount the ECU on the bracket; also fit the guard on the cab;
- fit the bracket unit and the ECU on the chassis, as shown in figg. 5.40 - 5.41;
- replace the chassis cable with the new one provided for the trailer socket - fig. 5.43;
- fit the connecting bridle for the 13 pin socket according to the type of hook (high or low) - fig. 5.42.

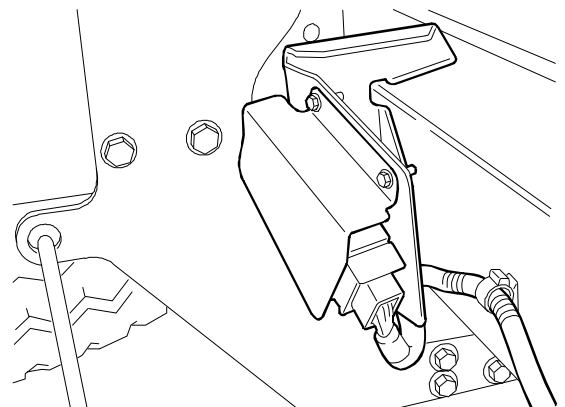
Figure 5.40



VAN - Rear View

162239

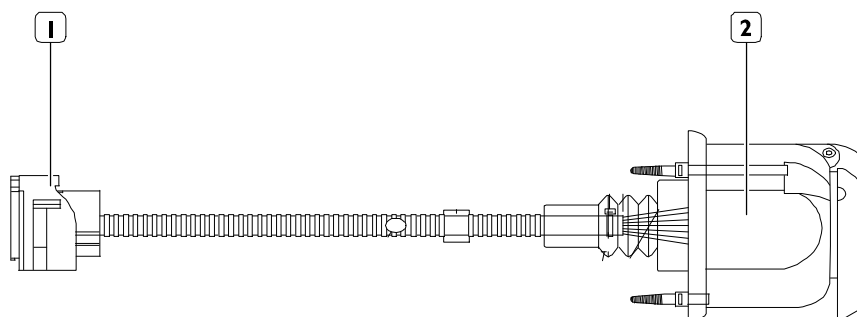
Figure 5.41



CAB - Rear View

162240

Figure 5.42



166056

1. To be connected to the chassis cable - 2. 13 pin socket for trailer

For more details on connections and assembling, ask IVECO for the wiring diagrams.

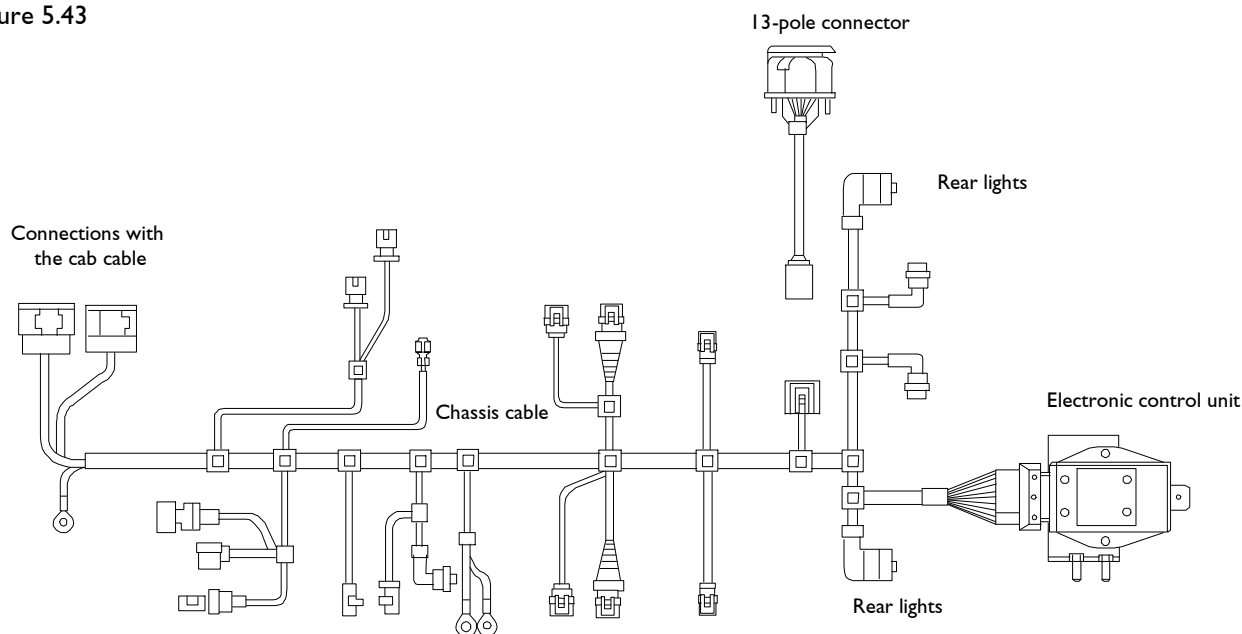


**Any damage to the lighting system caused by the failure to comply with the above procedure shall not be covered by the warranty.**

### 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.

Figure 5.43



162242

Chassis cable with 13 pin socket and trailer ECU

**NOTE** The diagram is shown for illustrative purposes only.

### Description of 13-pin interface

Table 5.18

13-pole connector pin	Cable no.	Description	Remarks
1	1120	Rear left turn indicator	1 bulbs (21 W- 12 V)
2	2283	Right rear direction indicator bulb	2 bulbs (21 W, 12 V)
3	0000	Ground	-
4	1125	Rear right turn indicator	1 bulb (21 W, 12 V)
5	3335	Front left and rear right parking light Left number plate light Left clearance light	3 bulbs (5 W, 12 V)
6	1175	Brake light power supply	2 bulbs (21 W, 12 V)
7	3334	Front right and rear left parking light. Right number plate light Right clearance light	3 bulbs (5 W, 12 V)
8	2268	Reversing light power supply	2 bulbs (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)	Signal to be supplied if the parking sensors are available
13	0000	Ground	-

### 5.4.9 Side marker lights

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

The Daily range vehicles are equipped with specific terminals to make the electric connection required to power the side marker lights.

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

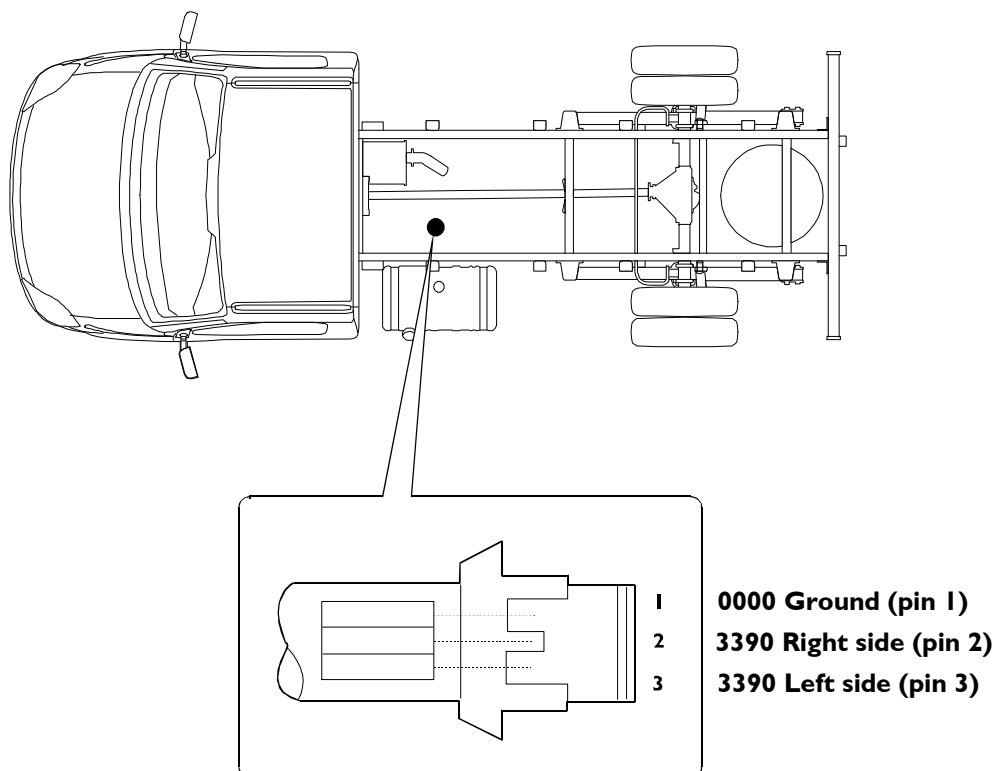
To ensure the electrical properties of the female connector contacts remain unchanged over time, leave the cap provided by IVECO in place.

Below is an illustration of the position for the above terminal on the chassis-cab.



**It is not possible to draw current from side parking lights.**

Figure 5.44



140848



Table 5.19

Connector on the vehicle	IVECO code	Interface to be used	IVECO code	Quantity
Female connector	98435344	Male connector	98435331	1
		Half shell		1
		Cable terminal		3
		Gasket (rubber piece)		3

Connector pin-out:

Table 5.20

Pin	Cable code	Function	Cable section (mm <sup>2</sup> )	Max. current (A)
1	0000	Ground	1	10
2	3390	Vehicle right-side marker lights	1	10
3	3390	Vehicle left-side marker lights	1	10

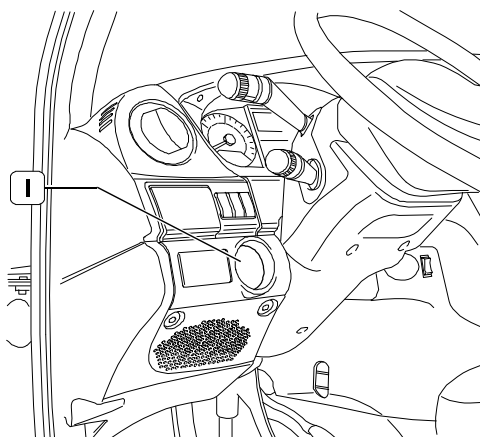
As regards the vehicles on which the side dimmers are not compulsorily required, the respective connectors are in any case available. In the event that the side dimmers need be installed, the vehicle shall be delivered to an IVECO service centre, in order to have the body computer enabled.

Side marker lights are compulsory for vehicles of total length greater than 6 m.

#### 5.4.10 Operation of emergency control on dashboard (option)

The dashboard central emergency control is used in hazardous situations.

Figure 5.45



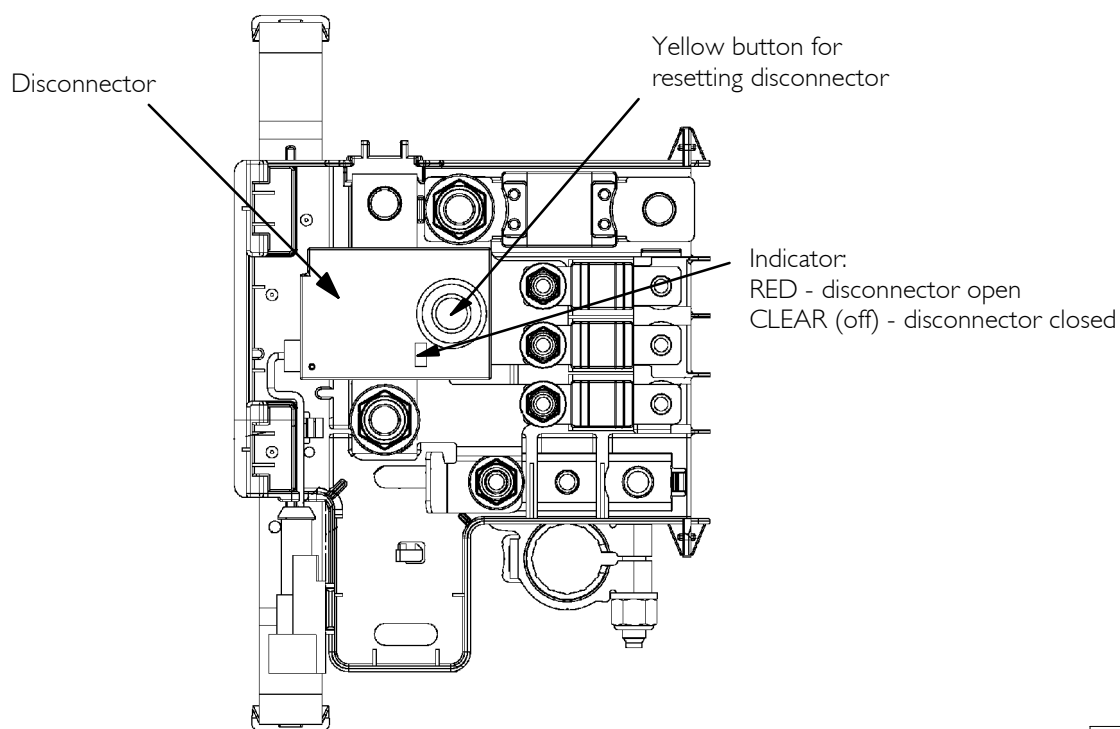
1. Emergency control

140844

When the central emergency control on the dashboard is pressed, the vehicle behaves as follows:

- the engine goes off;
- the turn signals come on;
- the disconnecter on the battery (CBA) operates to disable secondary loads;
- the locks are released and the turn and slide door opens (if an original IVECO part)
- the courtesy lights remain active
- the side lights go off and all loads are inhibited

Figure 5.46



120379

Circuit breaker reset button and relative indicator on battery control unit (CBA)

To restore the vehicle to its original conditions:

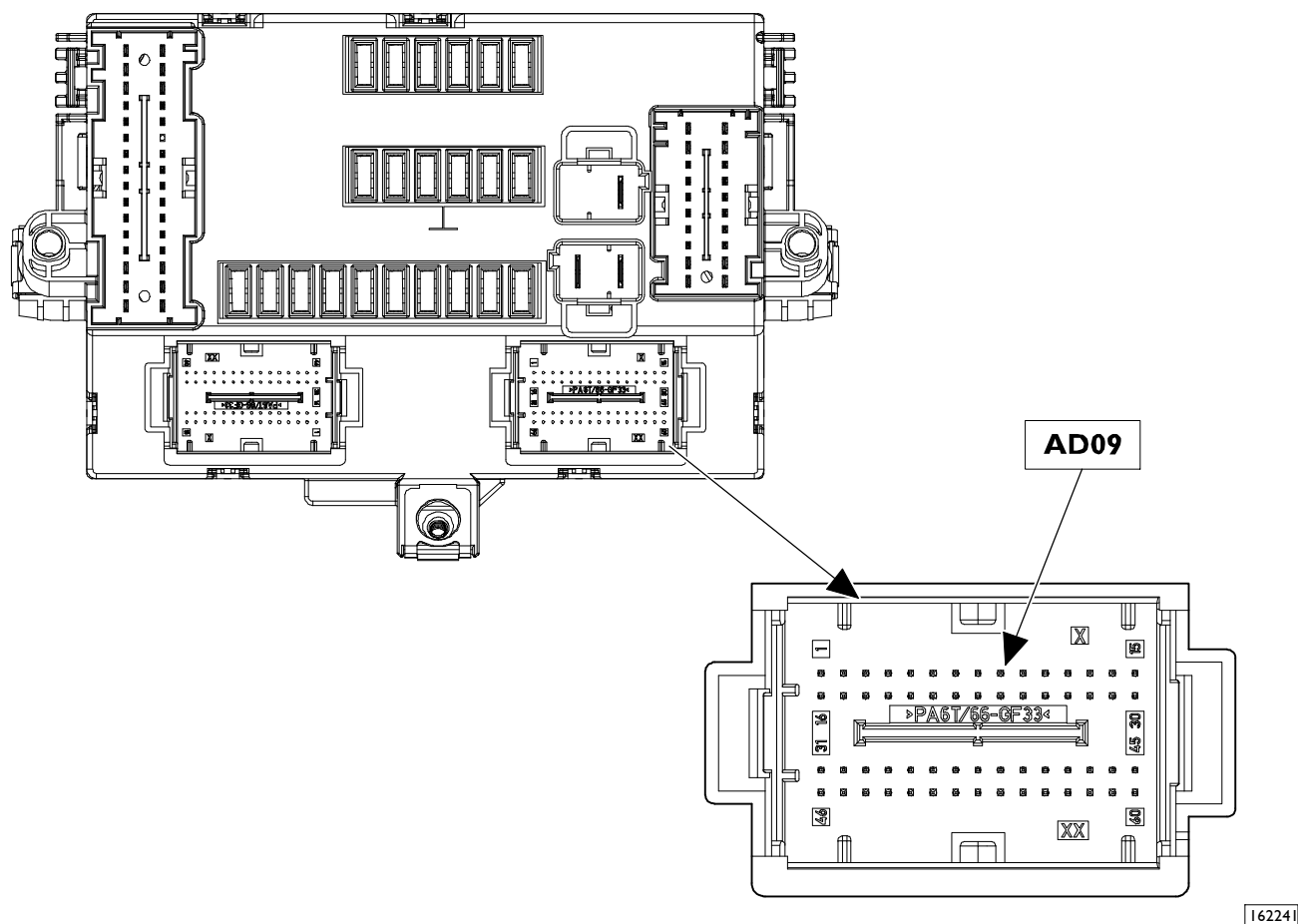
- press the central emergency control again;
- open the bonnet and press the yellow button on the CBA to reset to the disconnector;
- turn the key to STOP;
- re-start the vehicle.

### External hazard control

In some cases, activation of the direction indicators is required according to the functioning of the version.

This functionality can be managed by supplying an unstable negative signal (via a button) to pin AD09 of connector D (see fig. 5.47) on the Body Computer.

Figure 5.47





## APPENDIX A

## Daily PASSENGER TRANSPORT

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**NOTE** Keep to what is prescribed in the previous sections for everything not specified in this appendix.



## **A.1 Chassis**

### **A.1.1 Transport**

The chassis without the bodywork is not drivable and must therefore be transported using a transporter.

### **A.1.2 Lifting for transportation by ship, rail etc.**

When the chassis must be loaded onto ships, railway freight trucks etc., it is essential that it be lifted by the axles or wheels only.

---

**NOTE It is expressly forbidden to attach crane cables to the cross-pieces or side members.**

---

The chassis must only be secured to the transporter by fastening the axles only, and the weight must only be supported by the wheels.

### **A.1.3 Delivery**

The chassis is subjected to detailed quality checks prior to delivery.

At the time of delivery, the Bodybuilder must perform an inspection to check for missing materials or faults that may have occurred during transportation.

IVECO accepts no claims subsequent to delivery that are not recorded in the specific forms signed by the vehicle transporter.

The vehicle identification number must be quoted in any claims: this number may be found on the core of the right side-member, in the wheel arch near the suspension.

### **A.1.4 Storage**

If the vehicle is to remain unused for a prolonged period of time, it is essential that it is protected in an effective manner, suitable for the environmental characteristics of the area.

The Bodybuilder is particularly responsible for protecting the instrument panel, batteries, fuse box and relays, etc., the lifespan and reliability of which must not be compromised.

### **A.1.5 Weights and weighing**

The bodywork, position of the seats and the goods compartment must be designed without the total and individual axle permitted loads being exceeded.

To take into account the manufacturing tolerances, data relating to the weights of the models: 40C, 50C and 65C have a tolerance of  $\pm 3\%$ .

Therefore, prior to fitting, it is good practice to verify the vehicle weight (cab, van or chassis) and its distribution over the axles.

## **A.2 General rules for fixing the bodywork to the chassis**

Particular attention should be paid to the joints between chassis components and the sides of the bodywork: since these joints must guarantee perfect transmission of forces.

At the same time, the localised application of forces resulting in high pressures at the joints should be avoided.

The structure of the bodywork must be designed as a load-bearing unit together with the chassis; bending, torsional and thrust stresses must be absorbed by the entire structure.

This is necessary due to the relative flexibility of the chassis. For further information, contact IVECO Quality Department.

Fittings may be fixed to bodywork by welding or using screws.

Mixed type joints are not recommended.

In any case, bodywork components must be fixed using sandwich plates.



## **A.3 Building the bodywork**

This chapter provides instructions for assembling the bodywork, with the main technical aspects and regulations. The definition of the bodywork is left to the Bodybuilder's decisions, according to requirements.

### **A.3.1 Main dimensions**

For all vehicles, the entry and exit angles must be greater than or equal to 7°.

Construction of the bodywork must allow the vehicle turning circle parameters established in ECE Regulation 107 or the equivalent Regulations in force in the country where the registered vehicle will be on the road.

At the rear of each wheel, vehicles must be fitted with mudguards reaching a distance of 75 mm from the ground.

The configuration of the bodywork must allow inspection of the vehicle identification number.

### **A.3.2 Vehicle interior configuration and capacity**

For all vehicle classes the surface area available for the number of seats must comply with the provisions of ECE Regulation 107 or the applicable regulations in the country of sale.

### **A.3.3 Characteristics of the driver's seat**

#### **Heating system**

Provision of a sufficient output of hot air for demisting the windscreen is obligatory.

#### **Sun visor**

The driver must be able to make use of a sun visor, which must be capable of being adjusted in height and reversed while driving. A sun roller blind assembly or partial or fully tinted glass may also be fitted.

#### **Driver's seat (if different from the one provided)**

The height, angle and longitudinal distance of the steering wheel must be adjustable, and each of these adjustments must be independent. The seat must offer sufficient support and be covered with breathable material.

#### **Driver station - ergonomics**

In the case where the instrument unit supplied with the vehicle is disassembled and reassembled into a custom built dashboard, it is recommended the relative positions of the instruments and controls be maintained for optimal ergonomics.

In addition, since the dashboard supplied complies with the Directive in relation to "signals, controls and luminous dials", after each modification it will be necessary to verify this aspect and, if necessary, obtain new authorisation.

Care must be paid when fitting the driver side flooring and coverings so as not to restrict the movement of the pedals.

### **A.3.4 Requirements concerning the fire-proofing materials**

The covering materials used inside the engine compartment must be inflammable and non-absorbent for fuel and lubricants, unless said material is coated with an impermeable layer.

The remainder of the materials used for the bodywork must be "flame retarder" or self-extinguishing, depending on the number of passengers that can be transported and/or the applicable regulations in the country for which the vehicle is intended.

Polyamide pipes or bundles of electrical cables passing close to hot parts of the engine (exhaust manifold or pipes, turbocharger etc.) must be protected by an aluminium or stainless steel screen covered with insulating material.

### A.3.5 Seat supporting structures, and their fixing

Changing the seat positioning or creating special solutions (e.g. wheelchair transport) is possible subject to IVECO authorisation. Direct anchoring of seats to the floor or the wheel arches is not permitted and as such a specific structure (framework) must be provided for to distribute the load across the whole floor surface.

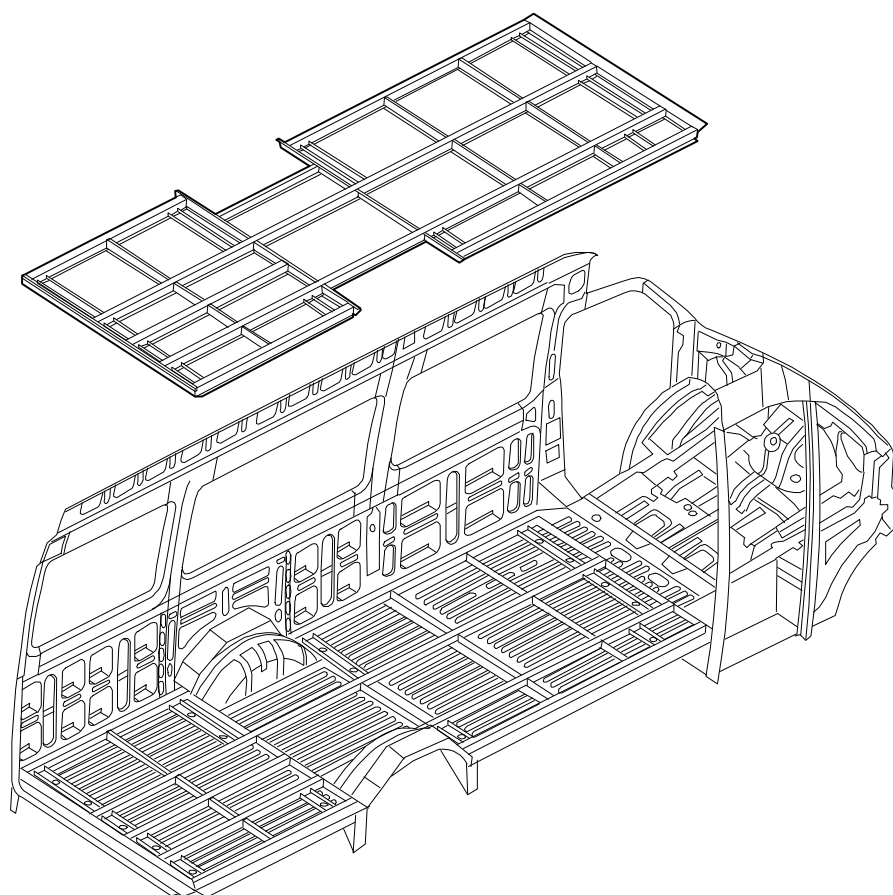
**NOTE** Since the anchoring of the seats to the framework is of primary importance for safety, adopting IVECO original solutions immediately ensures relevant regulations are complied with. Other solutions, on the other hand, shall remain the full responsibility of the Bodybuilder, including the execution of (destructive) testing.

On standard production vehicles the framework is made from zinc plated sheet (thickness: 2 mm) and with transversal plates (thickness: 3 mm) for housing the fasteners.

The following figures illustrate some details of the structures and the methods for fastening fixed and rail-mounted seats, extracted from IVECO drawings no. 504156623, 504208108 and 504208109.

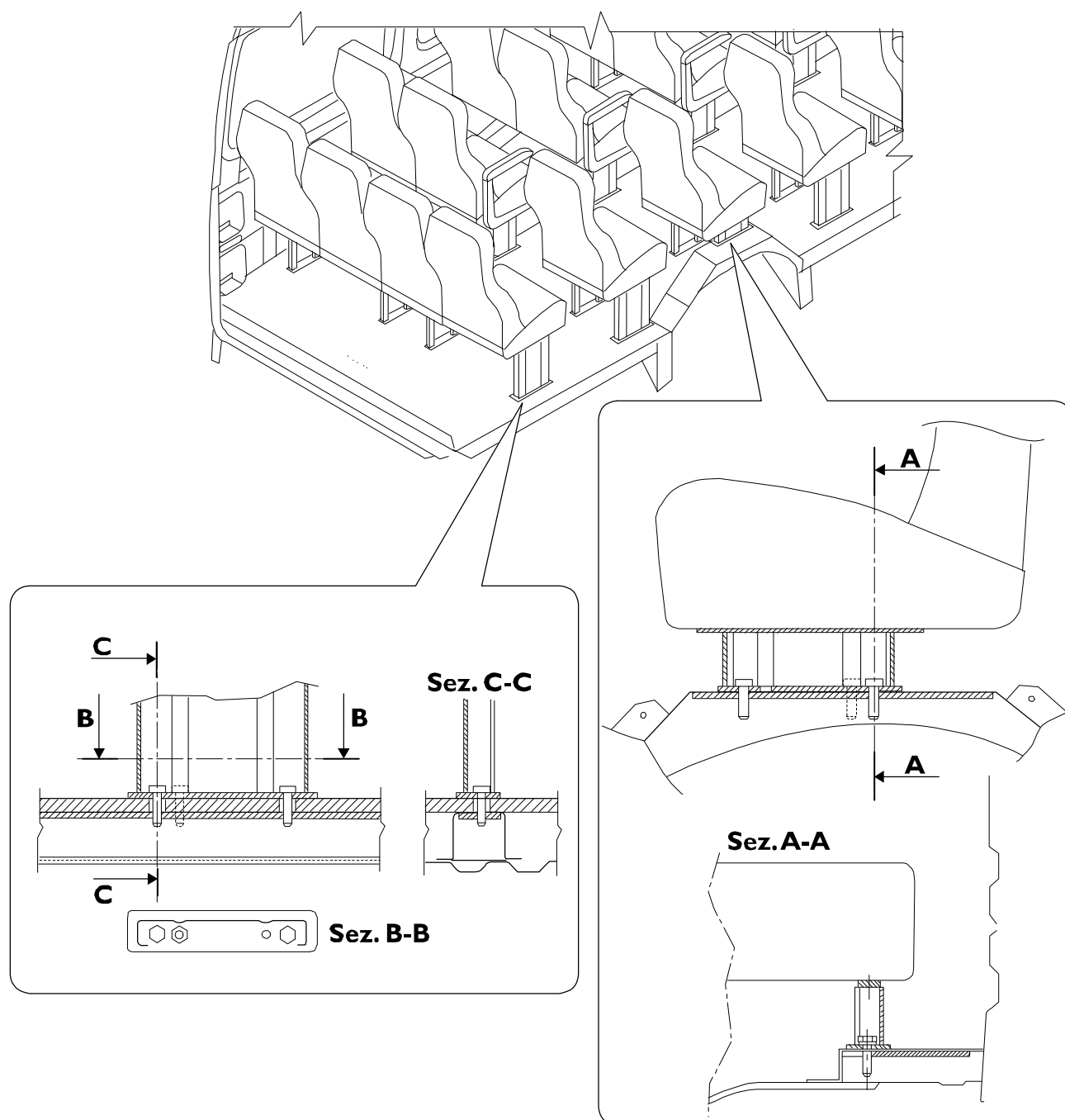
The complete drawings can be requested at [www.thbiveco.com](http://www.thbiveco.com).

Figure A.1



Floor frame for fixing seats

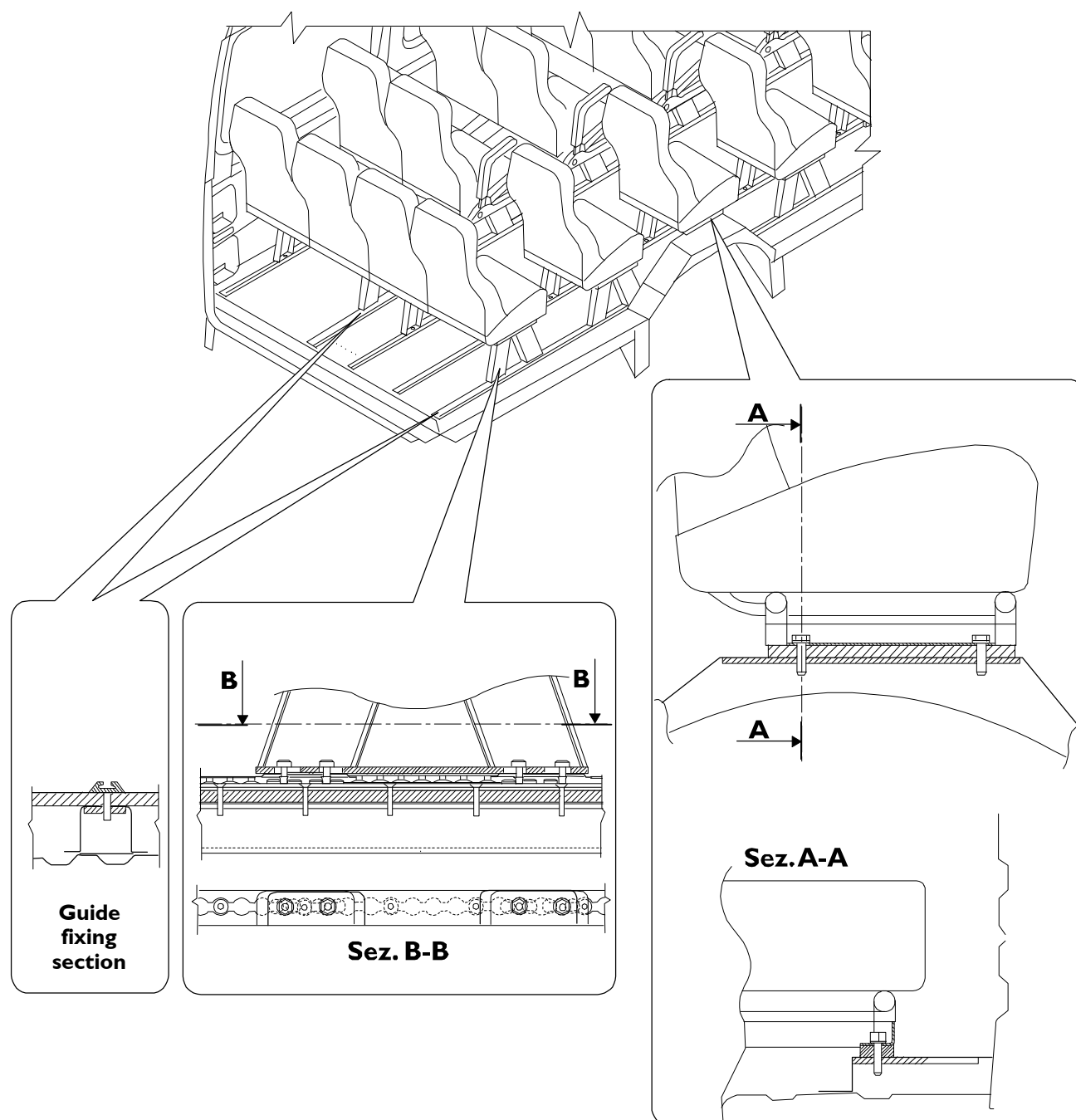
Figure A.2



173265

Diagram for installing fixed seat (see drawing 504208108)

Figure A.3



173266

Diagram for installing seats on guides (see drawing 504208109)

### A.3.6 Rear baggage compartment

The baggage compartment volume depends on the maximum weight technically permissible for the vehicle and its axles; the size and position must be validated by structural tests and calculations.

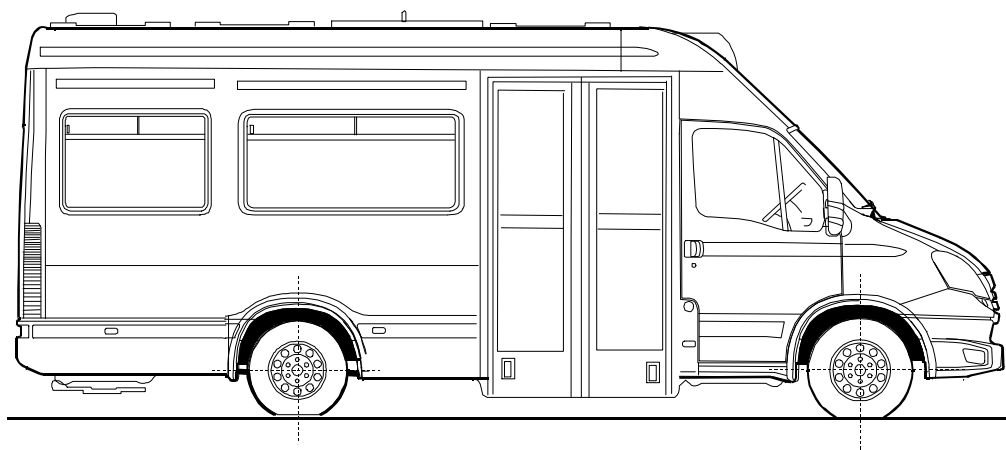
### A.3.7 Side access door

Creation of the door frame must guarantee that the structure in the area of the frame itself be non-deformable.

**NOTE** Only the upper or lower sections of door compartments in the original body shell may be modified, but not both.

European Directive 2001/85/EC or ECE107 must also be respected with regard to the access bay and steps.

Figure A.4



162233

### A.3.8 Inserted structures and handrail fixing

The handrails must be installed in such a way as not to entail risks of injury for passengers, their surface must be in a contrasting colour with a non-slip finish. Construction and application on the vehicle must respect European Directive 2001/85/EC or ECE107. The zones where the handrails are anchored to the original vehicle structure must be properly reinforced.

### A.3.9 Fixing the disabled persons ramp and lift to assemble the wheelchair area

For the transport of wheelchair users, the access door must be equipped with a ramp and lift; a reserved space with specific dimension must also be provided inside the vehicle. In any case European Directive 2001/85/EC or ECE107 must be respected. Where the rear door is used, it is necessary to refer to the methods for fixing the tail lift described in section 3.9.

## A.4 Noise emissions and thermal insulation

The Bodybuilder must ensure that the finished vehicle complies with the recommendations relating to noise emissions, specific for each case, and is also obliged to have the vehicle approved/reapproved, if necessary.

### A.4.1 External noise

According to Directive 2007/34/EC, noise emissions for Daily "People Carrier" vehicles must not exceed 79 dB(A), with regard to the exhaust silencer.

### A.4.2 Internal noise

Measurements must be performed in compliance with the provisions set out in ISO 5128, and at constant speed:

- a) 60, 80 and 100 km/h in the second-last gear
- b) 80 and 100 km/h in top gear

whether with manual or automatic transmission.

With regard to the position of the noise meter, it is essential to distinguish between:

- rear area: centre of second-last row of seats, at the height of the passenger's ears.
- front area: at the height of the driver's ears.

Under these conditions, in no case may the results obtained exceed the following values:

Table A.1

Vehicle	Without air conditioning at maximum power	With air conditioning at maximum power
Front area	72 dBA	74 dBA
Rear area	74 dBA	76 dBA

### A.4.3 Soundproofing insulation

In order to achieve good insulation, care must be taken to ensure installation of the soundproofing materials is as continuous as possible, avoiding any interruptions; it is very important that the communicating hatchways between the passenger compartment and the engine compartment, gearbox, rear axle etc., be well sealed.

It is recommended panels at least 15 mm thick with a layer of interposed septum be used for covering the floors, door wells and steps.

Step compartment fasteners should have no cracks or interruptions allowing noise to enter; the same is also valid for the areas under the doors.

Insulating and sound absorbent materials must be fixed in a manner that is sturdy and durable in order to prevent them becoming detached and coming into contact with hot spots or moving parts. The use of good quality adhesives or metal meshes or other holding devices is recommended.

### A.4.4 Thermal insulation

From the thermal viewpoint, the most critical areas are near the turbocharger, manifold and exhaust pipes, silencer and the rotors of the electric retarder.

When a non-metallic component of the bodywork is located near a critical area it must be protected, for example by means of a layer of insulating felt covered with a sheet of aluminium, capable of withstanding a constant temperature of 250°C and with maximum coefficient of thermal conductivity of 0.1 W/mK.

In any case, the minimum distance between a critical point and the insulation must be no less than 80 mm.

When the available space is limited, especially to protect the polyamide piping and the electrical wiring harnesses, it is advisable to shield them by means of an aluminium plate with sandwich insulation. The plate must have a conduction coefficient equivalent to the felt coefficient value. Between the protected component and the shield there must be a minimum distance of 20 mm.

In order to maintain a pleasant temperature inside the vehicle, the insulation located inside the engine/gearbox compartment must have a minimum coefficient of conductivity of 0.08 W/mK and a minimum temperature of 85°C.

This acoustic-thermal insulation must cover the entire partitioning surface between the engine housing and the interior, including steps, bulkheads and other potential heat penetration surfaces.

In areas where acoustic insulation is not necessary, such as near the electric retarder, thermal insulation using polyurethane foam, with characteristics similar to those described, is acceptable.

Some points are not critical from the point of view of heat transmission, but must be taken into account to keep them away from the bodywork components or installations which can be damaged by an excessive temperature.

### A.4.5 Insulation for cold climates

The insulation on vehicles intended for cold climates must guarantee that the temperature of the engine cooling water does not drop below 80°C during constant running.

The thermostat fitted in the circuit ensures correct engine operation if the opening temperature is  $68 \pm 2^\circ\text{C}$

If, despite the insulation, the engine runs at less than 80°C and the temperature of the water reaching the heater is not sufficiently hot enough, then it is necessary to install a pre-heater capable of providing at least 25000 kCal/h.

The pre-heater becomes compulsory when the vehicle operates routinely at temperatures below 0°C.

Having defined the insulation for the engine, it is necessary to measure its efficacy by testing the capacity of the cooling system and the capacity of the heating system.

After the tests it may be necessary to complete preparation by:

- increasing the power or the insulation if the heating test temperatures are low;
- increasing the air passage and reducing the insulation if the temperatures obtained in the cooling test are too high.

It is recommended that IVECO be informed of the results obtained and consultancy be sought regarding any modifications for fine tuning.

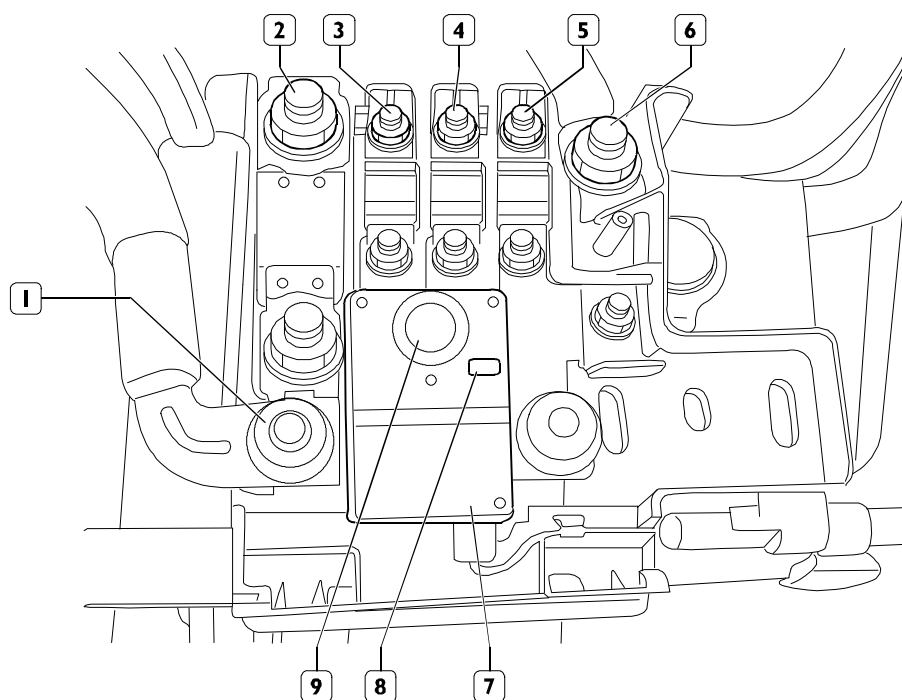


## A.5 Electrical power draw-off

### A.5.1 People transport version CBA

The CBA distribution and protection control unit for passenger transport versions is fitted with a disconnecter to turn off loads in emergencies.

Figure A.5



119378

Table A.2

Pin	Function	Cable cross section mm <sup>2</sup>	Fuse rating A
1	power supply +30 from F75 for starter motor and TELMA	50 or 35	500
2	power supply +30 from F70 for SCM BUS	35	150
3	power supply +30 from F73 for pre-heating glow plugs	10	60
4	power supply +30 from F72 for braking node	4	40
5	power supply +30 from F71 for Body Computer	16	80
6	power supply +30 from F64 in SCM/A for IBS sensor for Stop & Start	4	-

- 1) Starter motor and Telma power supply
- 2) SCM power supply
- 3) Pre-heating glow plug power supply
- 4) Braking node power supply
- 5) Body Computer power supply
- 6) Wiring for Bodybuilders' interface
- 7) Disconnecter
- 8) Disconnecter status indicator (red = open; off = closed)
- 9) Yellow button for resetting disconnecter

After disconnecting the loads, to restore the vehicle to its original conditions:

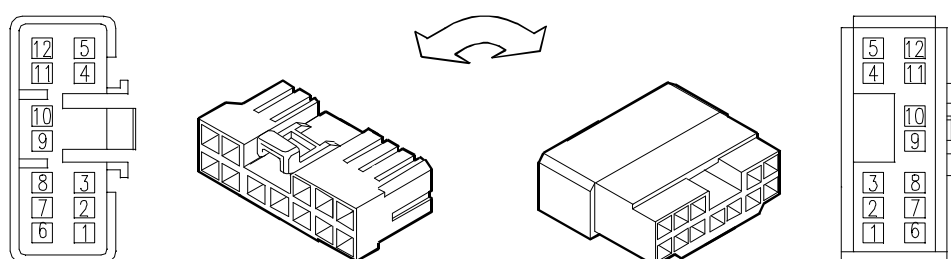
- press the central emergency control again;
- open the bonnet and press the yellow button on the CBA to reset to the disconnecter;
- Turn the key to STOP;
- re-start the vehicle.

## A.6 Bodybuilder connectors

**NOTE** For information regarding the 20 PIN connector (61071) please refer to Section 5.

### 12 PIN connector (72068) for People Carrier

Figure A.6



Existing parts on the vehicle

Counterpart to be connected

101554

Table A.3

Code number	Description
500314814	12-way male holder joint
500314820	Male contact for 0.3 to 0.5 mm <sup>2</sup> cable
500314821	Male contact for 1 to 1.5 mm <sup>2</sup> cable

Table A.4 - Basic functions of the 12 pin connector for People Transport

Pin	Description	Signal	Remarks
1	Hazard warning light repetition	Output max. 500 mA	A repeater led may be supplied with an intermittent positive signal, in time with the hazard warning lights
2	Speed limiter programming	Input max. 10 mA	Applying ground activates/deactivates the current speed restriction Max. Open circuit = no action. Ground = speed limiter ON/OFF.
3	Turn and slide door status	max Output 10 mA (interface with uncoupling diode)	Indicates when the door is open Ground = door closed. Open circuit = door open.
4	Speed signal (B7)	See specification 1 - Section 5	
5	Door status	Output max. 500 mA	With central locking, an led indicates door status +12 V = doors closed. Open circuit = doors open.
6	Not connected		
7	Supplementary acoustic signal control	Output max. 10 mA	Additional horns (interfaced by relay) or duplicate of horn control Ground = horn ON. Open circuit = horn OFF.
8	Emergency handle lock	max Output 10 mA (interface with uncoupling diode)	Extension of central locking to the emergency handle Ground = handle locked Open circuit = handle open
9	Turn and slide door operation	max Output 10 mA (interface with uncoupling diode)	Indicates out-swinging door malfunctioning Ground = door closing failed. Open circuit = normal condition.
10	Engine revs (r.p.m.)	See specification 2 - Section 5	
11	Not used		
12	Not used		

## A.7 Road tests

- a) The following checks must be performed, with the vehicle stationary, prior to beginning functional testing:
- tyre pressure;
  - oil level in the engine, gearbox and axle, brakes and steering, water in the cooling tank, state of the batteries and level of battery fluid;
  - operation of the parking brake;
  - operation of the doors, sensitivity of the emergency buttons, control lights, windscreen wipers, windscreen washers, horn, outside lights, switching off engine from the cab;
  - alignment of the bodywork with respect to the chassis and suspension heights;
  - absence of interference in the steering controls, in the whole path of the rotations of the steering wheel and of the wheels;
  - visibility and correct operation of the indicating lights and acoustic warnings.
- b) The following parameters must be verified during a 50 km drive over various roads (level ground, curves, uphill, downhill and uneven surface):
- absence of vibrations or unusual noises due to gearbox, axle, transmission or other assemblies of the chassis or bodywork;
  - correct operation of the mechanical gearbox;
  - gradual braking and absence of excessive force on the pedal;
  - gradual clutch operation;
  - gradual steering without resistance or jolts, maintaining the direction of the vehicle without continuous corrections.
- With regard to "system" function, it should be verified that:
- no fault message appears on the instrument panel and no danger or warning signal remains lit which should not be present;
  - the electric retarder has a short reply time and determines a gradual action in each point of operation;
  - the speed limiter does not cause jolts;
  - the operation of the emergency button stops the engine, activates the warning and deactivates the batteries;
  - the speedometer is sealed;
  - the heating and air conditioning are efficient;
  - internal and external noise levels comply with the regulations;
  - there are no infiltrations during and after passing through an arch simulating rainwater/washing with a pressurised jet.
- With regard to ergonomics, the following should be verified:
- travel, stiffness, any interference of the gear levers with the dashboard and seat;
  - position, adjustment of leg distance and backrest of the driver's seat;
  - any visual interference of the steering wheel with the instrument panel and the brightness and lighting of the instrument panel.
- c) On completion of the route, it is necessary:
- check for any leaks of water, oil, fuel and brak, steering and clutch fluid;
  - Check and retighten the wheel nuts to 290-350 Nm.

## APPENDIX B

**Daily CNG and CNG with Recovery Mode**

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**NOTE** Keep to what is prescribed in the previous sections for everything not specified in this appendix.



## B.1 General information

Natural gas is a mixture that consists essentially of methane (main component), ethane, propane, carbon dioxide and nitrogen. To make it more recognisable, an odourising agent (THT) is added to give it its characteristic smell of sulphur.

Natural gas composition may vary considerably and its chemical and physical properties may also differ significantly.

Natural gas is compressed in cylinders for transport and use on the vehicle; hence its name of CNG, Compressed Natural Gas. In the Daily vehicle range, CNG and CNG with Recovery Mode positions represent IVECO's contribution to a transport system that is as eco-friendly as possible.

These versions differ from the others due to specific solutions applied to certain engine components, due to their specific electronic management system and due to the presence of the gas cylinders and their piping on the frame.

On versions with recovery mode, a small petrol tank is also present that is activated automatically to enable the vehicle to cover short distances if the gas runs out.

The greater technical complexity must therefore be taken into consideration by the Bodybuilder during the design of the conversion and above all during its implementation.



**The highly flammable properties of compressed gas mean that authorisation cannot be given for vehicles to be outfitted or converted for firefighting applications or for applications in potentially critical environments (e.g. airports, refineries etc.)**

**NOTE IVECO designs, type-approves and builds CNG vehicles in accordance with ECE Regulation 110 currently in force.**

**Operations on the engine fuel system that:**

- a) use components other than those approved by IVECO (even if approved as Independent Technical Units)**
- b) modify the original architecture (for example: movement or addition of cylinders, type of cylinder fixation)**

**involving reapproval of the vehicle.**

**For this reason, the Authority responsible may request all the documentation (calculations, diagrams, test reports) attesting compliance with ECE Regulation 110 for all modifications made to the original system.**

**Vehicle reapproval costs are to be met by the Bodybuilder.**

## B.2 Safety rules

### B.2.1 During refuelling

- The gas is usually compressed to 200 bar during refuelling. Small amounts of natural gas may be released during this operation. The cooling that follows its rapid decompression may cause frostbite symptoms if it comes into contact with the skin. Wear protective gloves during refuelling.
- Do not smoke, handle open flames or flammable lights.
- Before filling the pressurized gas system, check that it has no visible defects.
- Vehicles to be refuelled must be blocked to prevent them from moving. The engine must be off and the ignition key must be extracted from the switch.
- Keep fire extinguishers of suitable class (class A, B, C) with other fire extinguishing devices at hand. Class C fire extinguishers are particularly suitable for methane.
- Avoid releasing the content of cylinders or pressurized gas pipes into the atmosphere.

### B.2.2 In the event of leaks



**If there are leaks, there is the DANGER OF EXPLOSION so it is important to not only follow all the rules set out by the law and competent authorities, to but also observe the following safety rules.**

- Close the shut-off taps on the gas cylinders, the refuelling pump and the refuelling station tank.
- Switch off the main switch of the electric system of the building or refuelling area.
- Block access to the hazardous area and have unauthorized people move away from the area.
- Promptly notify the competent authorities and ask for a restoration operation.
- Ventilate the entire surrounding environment thoroughly.

### B.2.3 In case of fire

- Do not extinguish the flame; if possible, cool the object that has caught fire.
- Close the cylinder cocks and the cocks on the filling risers and tanks.

#### **BURNING GAS = GAS UNDER CONTROL**

- If the flames spread to the surrounding environment, proceed in the usual manner with fire extinguishers to extinguish the fire. Immediately remove the vehicles from the immediate surroundings from the danger zone.
- In the case of fire, promptly inform the local FIRE BRIGADE and proceeding with the fire extinguishing operations.
- Rescue the injured immediately. Rescue operation come before fire extinguishing.
- Switch off the main switch of the electric system of the building or refuelling area.



## B.3 Operations on the system

### B.3.1 General warnings

**NOTE** It is essential to repeat the type approval if any change is made to the system layout.

Observe the following warnings when carrying out operations that involve fuel system components.

- Before any operation, close the taps on the solenoids of each gas cylinder, then start the engine and leave running until all the gas in the lines has been used up and the engine stalls. For versions with an additional fuel tank, the engine must be left running until the vehicle switches to recovery mode, i.e. begins to run on petrol.
- Make sure the parts are cleaned, ensuring that no sludge or foreign bodies enter during handling and installation. For this purpose, the protective covers on parts and sensors must not be removed until immediately prior to positioning.
- Observe the direction of installation for all electrical connections.
- All threaded connections must be tightened to the specified torque (see point B.3.3)



**Fuel system components cannot be serviced and must be replaced if they are not efficient.**

**Washers, tapered washers, self-locking nuts and seals deform to improve tightening and they are also of a special type. They must therefore be replaced whenever refitted.**

**New minor components must be systematically restored to their original positions in accordance with the original installation sequence.**



**After valve replacement or any repair to the high pressure system, a HYDRAULIC LEAK TEST (300 bar) must be carried out by an IVECO DEALERSHIP able to issue a test certificate if the outcome is positive.**

### B.3.2 Repainting of outfitted frames

The paintwork must be protected:

- stainless steel pipes of the methane fuel system;
- pipe connection fittings;
- hose from pressure reduction unit to rail on engine;
- solenoids and coils on gas cylinders;
- gas system pressure reduction unit;
- identification plates.

### B.3.3 Tightening torques

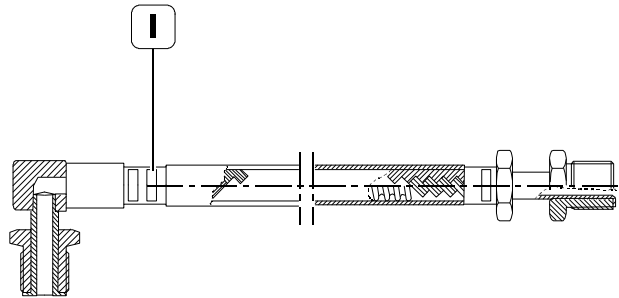
PART	TORQUE	
	Nm	kgm
<b>Methane gas system</b>		
High-pressure hose connection (M12x1) to refuelling filler (Italy) - Figure B.2	24 ÷ 26	2.4 ÷ 2.6
High-pressure hose connection (M12x1) to refuelling filler (CEE) - Figure B.2	33 ÷ 37	3.3 ÷ 3.7
High-pressure hose connection (M12x1) to VBE 498 solenoid check valve - Figure B.2	33 ÷ 37	3.3 ÷ 3.7
High-pressure hose fittings - Figure B.3	38 ÷ 42	3.8 ÷ 4.2
Medium-pressure hose connection (M18x1.5) to pressure reducer Figure B.1	67 ÷ 73	6.7 ÷ 7.3
Medium-pressure hose connection (M18x1.5) to fitting on cylinder head Figure B.1	67 ÷ 73	6.7 ÷ 7.3
Stainless steel stiff pipe connection (M12x1) to pressure reducer	33 ÷ 37	3.3 ÷ 3.7
Stainless steel stiff pipe connection (M12x1) to VBE solenoid valve (side opposite check valve)	24 ÷ 26	2.4 ÷ 2.6
Stainless steel stiff pipe connection (M12x1) to VBE solenoid valves	24 ÷ 26	2.4 ÷ 2.6
Blank plug (M12x1) on solenoid valve	33 ÷ 37	3.3 ÷ 3.7
Fittings (M14x1.5) connecting pipe to T fittings and cross-fittings - Figures: B.4 - B.5 - B.6	74 ÷ 82	7.4 ÷ 8.2
Fittings (M14x1.5) fastening cross fitting to chassis	67 ÷ 70	6.7 ÷ 7.0
Refuelling filler fastening to support (M24x1)	60 ÷ 70	6.0 ÷ 7.0
Solenoid valve fastening to cylinders (W28.8x1/14")	260 ÷ 280	26.0 ÷ 28.0
Cylinder support bracket and rear crossmember fastening (M14x2)	151 ÷ 184	15.1 ÷ 1.84
Cylinder support strip fastening (M10x1.5)	33 ÷ 35	3.3 ÷ 3.5
Bracket fastening to cylinder support rear crossmember (M12x1.75)	74 ÷ 90	7.4 ÷ 9.0
Cylinder support rear crossmember fastening (M10x1.5)	42 ÷ 51	4.2 ÷ 5.1
Cylinder shelf fastening (M8x1.25)	21 ÷ 26	2.1 ÷ 2.6

**NOTE** The tightening torques indicated only refer to special original equipment components.

### B.3.4 Parts list

#### Medium-pressure gas line

Figure B.1



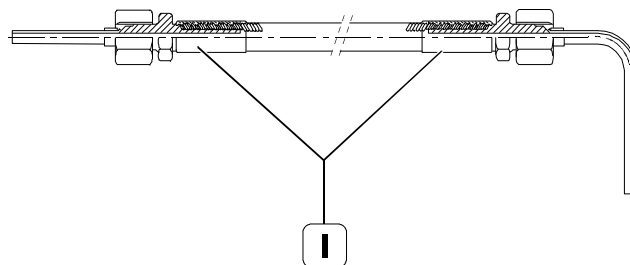
117679

I. Tublex-product code - Manufacturing date - Lot.

The gas hose connecting the reducer to the rail is a flexible AISI 321 stainless steel helical structure, internal diameter of 6.5 mm, protected by a AISI 304 stainless steel braid in turn coated when a shrink-wrap sheath and AISI 303 stainless steel fittings.

#### Refuelling high-pressure gas lines

Figure B.2



117680

I. Manufacturing date

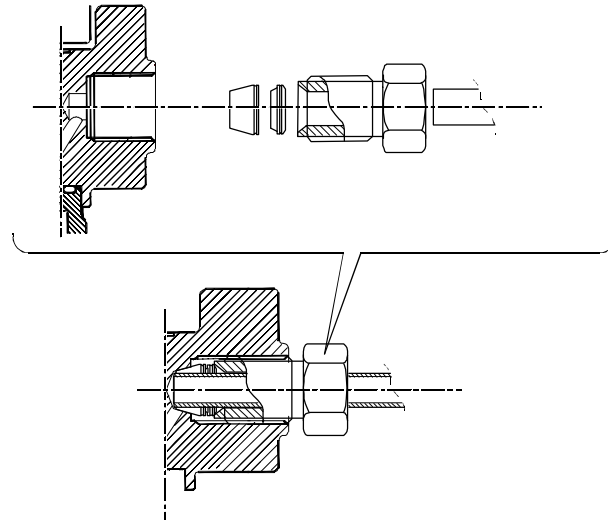
The gas hose connecting the VBE refuelling solenoid valve of the first cylinder is of the type. It is made of ISO 84342 stainless steel, diameter 6.4x11.8 mm, with high-tech polymer coating and reinforced with two aramid fibre braids. ISO 84342 stainless steel fittings.

### VBE solenoid valve connection lines

The VBE solenoid connection pipes are in AISI 304 steel without welded joints, with outer diameter of 6 mm and bore of 4 mm.

### Fittings

Figure B.3



117681

AISI 303 stainless steel front tipped fitting.  
For installation instructions refer to point B.3.7 - Figure B.18.

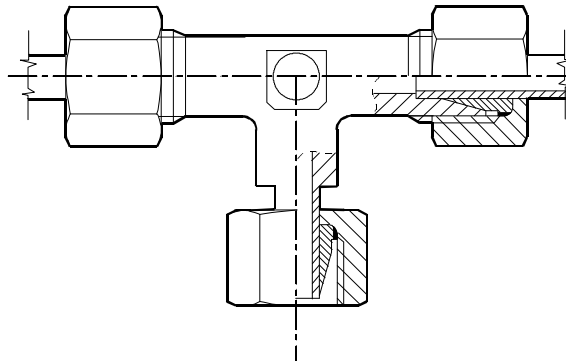


**For safety reasons, both during bodybuilding and servicing, IT IS FORBIDDEN to use gas pipes as brackets for other pipes.**

**In specific cases where space is restricted, it is acceptable to fasten only electrical cables to the gas pipes (by means of PVC collars) provided that the pipes only serve as a guide and do not act as a support. During maintenance operations, make sure that the tubes are not damaged and do not present scratches, rubbing, cuts or deformation visible to the naked eye.**

**If necessary, pipes must be properly protected.**

Figure B.4

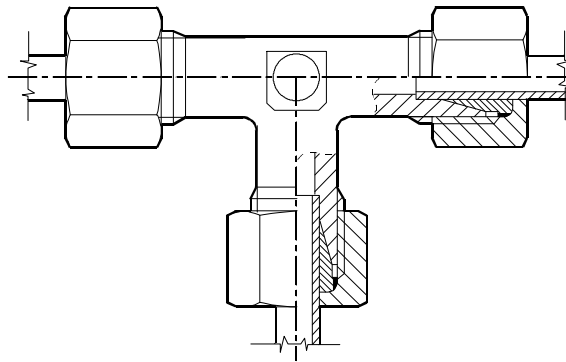


117682

ADJUSTABLE "T"-FITTING

Front tipped, AISI 316 TJ stainless steel

Figure B.5

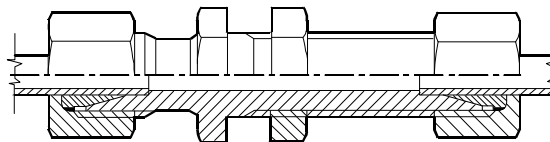


117683

INTERMEDIATE "T"-FITTING

AISI 316 TJ stainless steel front tipped fitting.

Figure B.6



117714

STRAIGHT FITTING

AISI 316 TJ stainless steel front tipped fitting.

### B.3.5 Emptying the gas system



**Before performing significant operations (such as welding) or servicing the engine, the gas circuit must be completely ventilated with air.**

It is usually sufficient to partially empty the system (i.e. to empty the pipes and leaving the cylinders as are) but the entire system (pipes and cylinders) may need to be emptied in some cases.

Decide which procedure is required on a case-by-case basis according to the severity and type of intervention to be performed. If in doubt, choose the safest solution (complete emptying).

If the engine conditions so allow (e.g. no leakages), it is advisable to use up all the gas by running the engine.

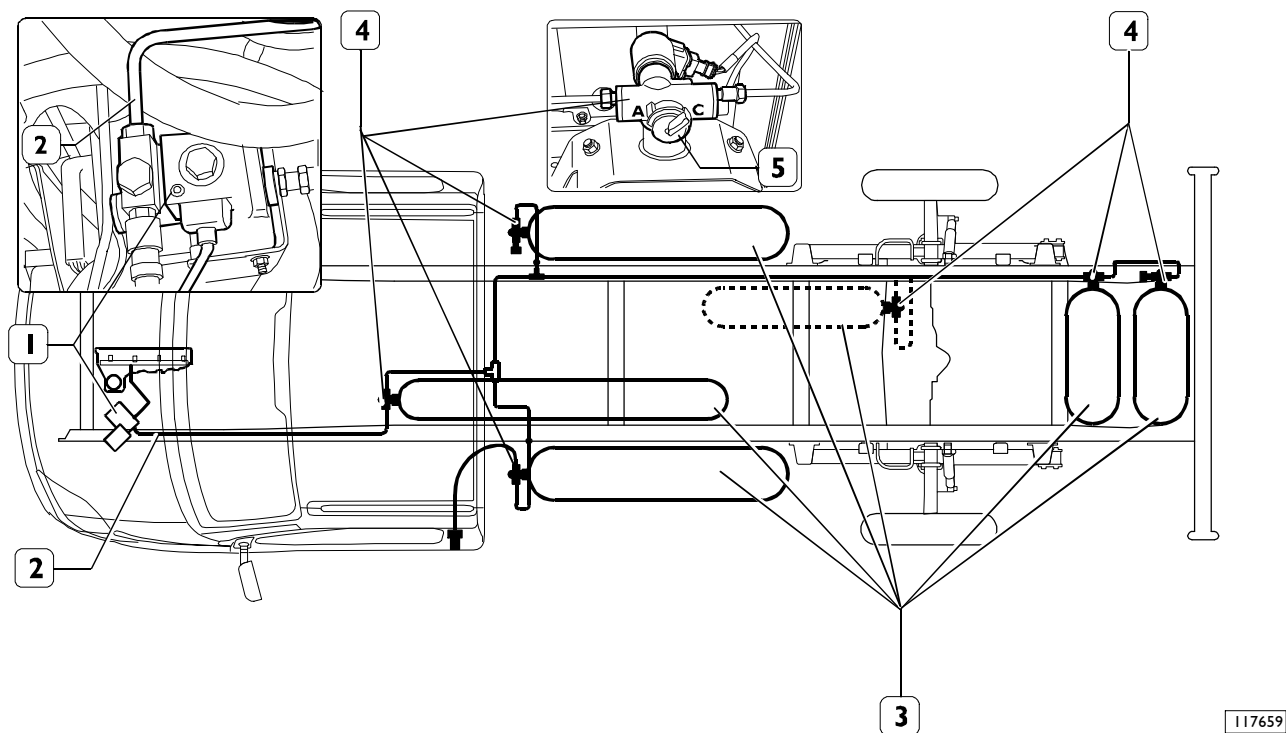
Running the engine with system pressure under 20 bar does not ensure the correct fuel metering.

**NOTE**      **Below 20 bar, the engine must be run at idle speed only to prevent damage to the catalytic converter.**

Perform the emptying operations described below with the engine off and in the open-air. Maintain a spark-free area of at least 5 meters around the vehicle.

## Partial emptying procedure

Figure B.7



1. Pressure reducer - 2. High-pressure gas pipe - 3. Cylinder - 4. VBE solenoid valve - 5. Manual valve  
A. Open valve - C. Closed valve.



**This operation only ensures ventilation of the system downstream of the cylinders. It is therefore essential to ensure that work is carried out at a distance of under 5 m from the cylinders that could generate sparks (welding, cutting, grinding, drilling) or that involves the use of electric equipment or naked flames.**

- Disconnect power from the electrical system by operating the master switch (where fitted).
- Disconnect cables from the battery.
- Connect the vehicle to earth.
- Check that the cocks (5) of the solenoid valves (4) on all cylinders (3) are closed: cock (5) on position C.
- Disconnect gas delivery pipe (2) from pressure reducing valve (1) by slowly undoing it and paying attention to the effects caused by the gas pressure in the pipes.
- Connect a rubber pipe (methane-compatible) with the gas deliver pipe (2) to dispose of the gas: the free end of the tube must be at least 5 metres away from sparks.  
During this operation, the cooling subsequent to rapid decompression may cause freezing. Be careful.
- Check that the pressure in the system is equal to zero.

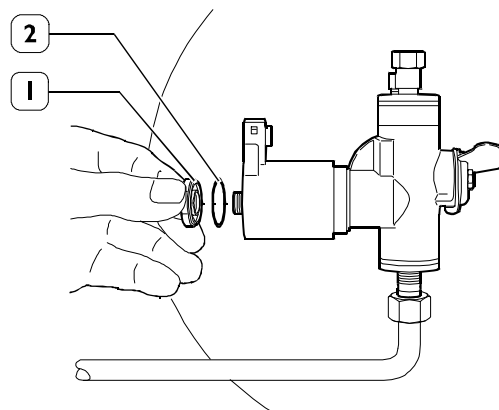
## Complete emptying procedure

When the system is fully drained down, the cylinders must also be ventilated. To allow the gas to be evacuated in safety, remove the VBE valve plungers and the system must be ventilated downstream of the manual cylinder taps.

- Proceed with the partial emptying procedure described in the paragraph above.
- Check that the taps (5) on the solenoid valves (4) on all the cylinders (3) are closed: valve (5) turned to position C and proceed as described below.

## Removing solenoid mobile equipment and/or cylinder replacement

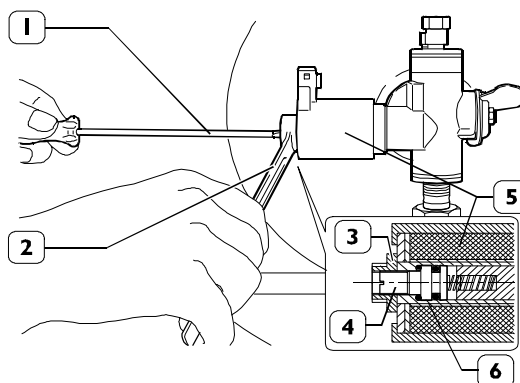
Figure B.8



117660

- Disconnect the electrical connection from the coil.
- Unscrew the outer nut of coil (1) with its O-Ring (2).

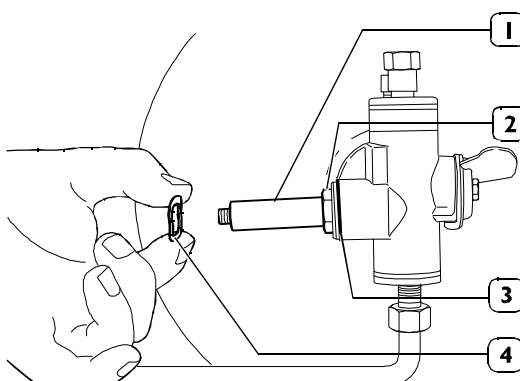
Figure B.9



117661

- With a screwdriver (1), stop rotation of the threaded pin (4) and use tool (2) to remove the nut (3) fastening the coil (5). Remove the coil (5) from the sleeve (6).

Figure B.10



117662

- Remove the washer (4).

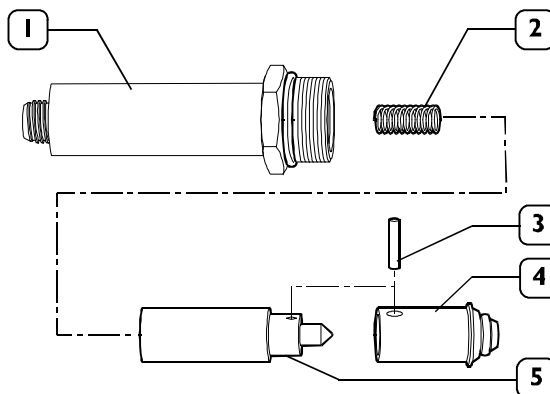


**A small amount of high-pressure gas will remain in the valve. To prevent damage to the operator, it is advisable to decrease the pressure by slowly unscrewing ring nut (2) from the coil sleeve (1).**

- With no residual pressure, proceed with the disassembly procedure and remove the coil holder sleeve (1) with its O-Ring (3).



Figure B.11



87391

- Remove the piston (5) with shutter (4) and the spring (2) from the coil holder sleeve (1) being very careful not to misplace the pin (3) fastening the shutter to the piston.
- If the VBE valves do not need to be replaced, check the conditions of the removed parts, including the o-rings. Replace them if needed during assembly.
- Fasten the empty coil holder sleeve with its o-ring and fasten the ring nut at a torque of 28 Nm.
- Repeat the operations on all the VBE valves of the cylinders.

### Emptying

- Open the manual valves half way (5) (Figure B.7).



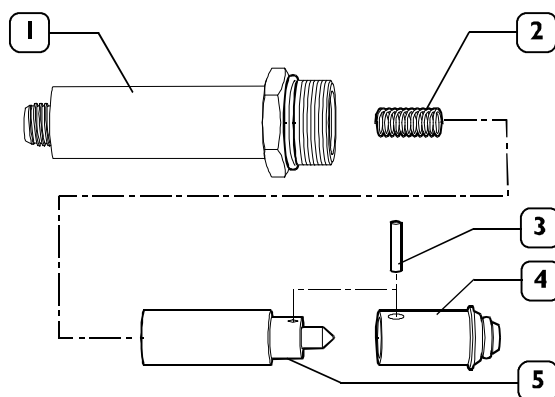
**This operation ensures that pressurised gas enters the pipes: for this reason, exercise maximum care.**  
**After emptying operations, check that the engine cannot stop.**

If the VBE valves are not replaced after the complete emptying procedure, refit the previously removed parts (which were either carefully put aside or replaced) as shown in the following paragraph.

### Introduction to solenoid valve plunger

Remove the empty coil sleeve (1) with the o-ring.

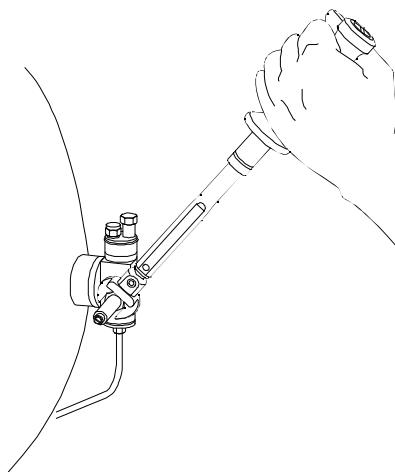
Figure B.12



87391

- Insert the piston (5) in the shutter (4) and lock it with the pin (3).
- Insert the spring (2) and push well into the specific seat in the piston (5).
- Fit the resulting assembly into coil sleeve (1) with the tapered part of plunger (4) turned toward the outside of the coil carrier sleeve.
- Check the presence and conditions of the o-ring on the sleeve (1).

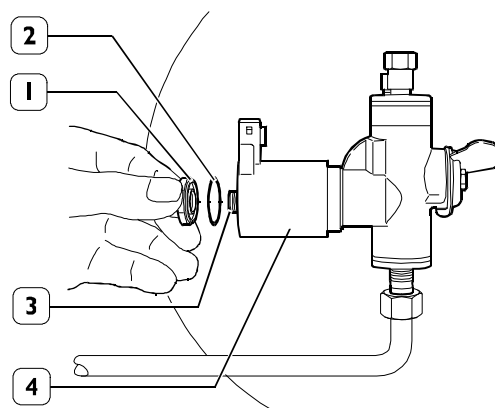
Figure B.13



87392

- Fasten the coil holder sleeve ring nut and tighten at a torque of 28 Nm.

Figure B.14



117663

- Check that coil (4) does not present signs of damage. Replace the coil if necessary.
- Fit the washer (4, Figure B.10) and the coil (4, Figure B.14) on the sleeve (1, Figure B.10).
- Screw in inner nut (3) securing coil (4) and tighten to 8 Nm.
- Screw in nut (1) with o-ring (2) and tighten and tighten to a torque of 7 Nm.
- Connect the electrical connection to the coil (4).
- Repeat the previous operations on all VBE valves of the cylinders.

### B.3.6 VBE solenoid valve replacement

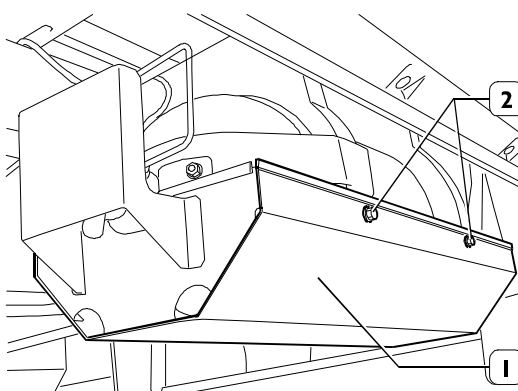
#### Removal

**NOTE** VBE solenoids may be removed as a result of a fault or during periodic overhaul of the cylinders. Because removed solenoids cannot be reused, they must always be replaced whatever the reason for their removal. It is advisable to scrap them immediately after removal.



**Before disconnecting the solenoid valves, empty the system completely following the procedure described in the "Emptying the gas system" chapter.**

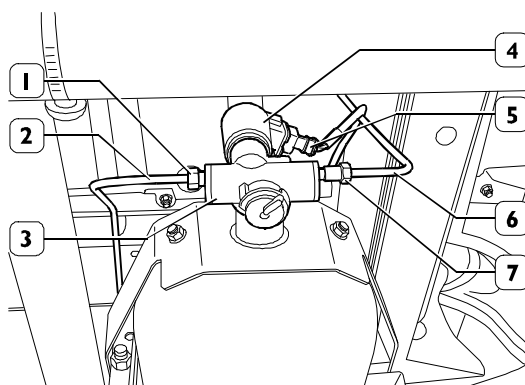
Figure B.15



117664

- Remove the screws (2) and remove the cover (1).

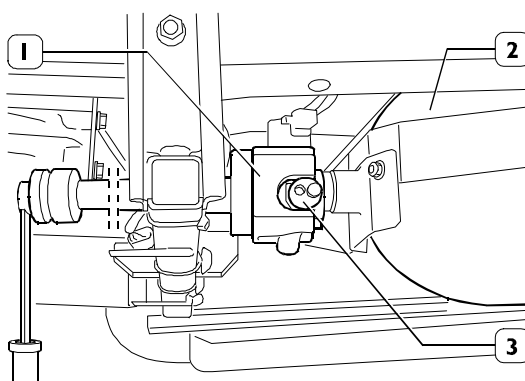
Figure B.16



117665

- Loosen the fittings (1 and 7) and disconnect the pipes (2 and 6) from the VBE valve fittings (3). Disconnect the electrical connection (5) from the coil (4).

Figure B.17



117666

- Using special wrench 99355018 (1), undo and remove the VBE valve (3) from the cylinder (2).

### Refitting

Reverse the removal sequence to refit and observe the following precautions:

- the VBE valve protective caps must not be removed to avoid damage to the valve during assembly. The use of percussion pneumatic screw runners or of any other tool which could deform the valve body and compromise functionality must be avoided.
- if the cylinder is off-vehicle, secure the cylinder preferably in vertical position with the collar facing upwards.
- fasten the threading of the valve seat with 2-3 layers of Teflon.
- manually screw the valve in by several turns. Subsequently, using the special wrench combined with a torque wrench, tighten to  $270 \pm 10$  Nm.

**NOTE** While doing so, take care not to damage the VBE valve's thermal fuse with special wrench 99355018.

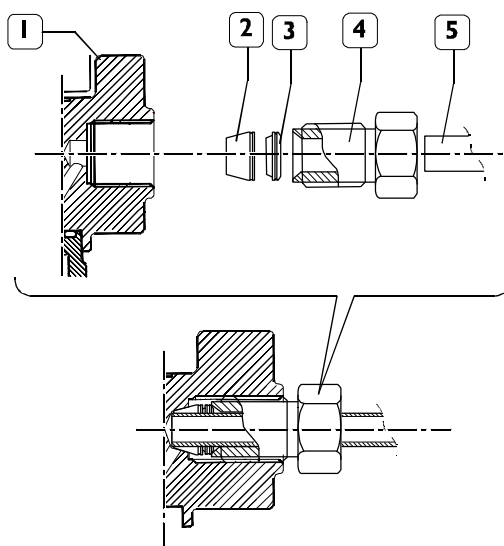
### B.3.7 Repair interventions on fittings and pipes

If gas leaks occur from the pipe or fittings, replace the pipe assembly. The pipe is not provided with the fittings and these must be obtained separately.

- Remove the pipe to be replaced together with its end fittings.
- Check the condition of the new pipe that is pre-formed into the same configuration as the pipe to be replaced and fit new fittings and o-rings at its ends.
- Fit the pipe by fitting its ends into the seats of the components to be connected and ensure that they are fitted fully home.
- Check the pipe end centre line is aligned with the centre line of the fitting to which it is to be connected to prevent pretensioning.
- Pre-tighten the fitting nuts by hand and then tighten to the specified torque. For EMER fittings, follow the procedure described in the relevant chapter.
- Apply the fastening brackets checking that the tube is not subjected to excessive tension.
- Restore system operation by carrying out a hydraulic seal test following the procedure described in the warnings at the beginning of the chapter.

#### Fitting assembly

Figure B.18



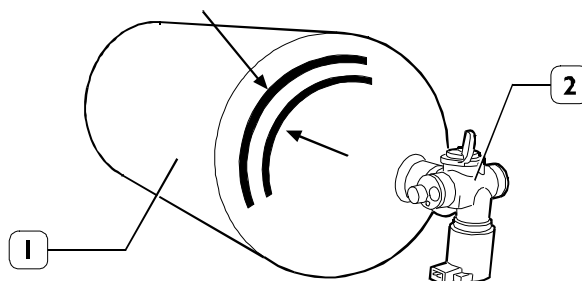
- Fit the seals (2 and 3) on the pipe.
- Insert the pipe (5) in the valve seat (1), appropriately orienting the cylinder to avoid pulling the pipe.
- Keeping the pipe in the seat, fasten the fitting (4) at the specified torque.
- Loosen the fitting (4) and check fastening of the seal on the pipe.
- Fasten the fitting at the specified torque.
- Have the system hydraulically tested as indicated in the warnings at beginning of the chapter.

118974

**NOTE** In case of subsequent disassembly, replace the seals with new parts.

## B.4 Cylinders

Figure B.19



117674

1. Cylinder - 2. Solenoid valve.

The methane (CNG) is stored in compressed form at a pressure of 200 bars in a certain number of cylinders positioned in the chassis and protected by metal guards.

The cylinders are connected in series to each other and are filled by a refuelling valve provided with check valve. A second check valve is inserted in the solenoid valve fitted on the first cylinder and connected to the refuelling filler. The check valves are used to prevent the release of gas into the outside environment when the valve is extracted after the refuelling operation.

**NOTE** A faulty flow valve or solenoid valve may lead to incorrect indications regarding the cylinder contents. Refer to the solenoid valve inspection and replacement procedures in the corresponding paragraph B.3.6.

Important information concerning the cylinders is punched into their upper surface (→).

CNG ONLY - DO NOT USE AFTER

(1) (2)

FABER 01/1234/123 (3) L (4) KG (5) 15°C (6) MPaE (7) 10R-

(8)

CNG-I USE TESTED FABER CYLINDERS ONLY

(9) (10)

01/1234/ 123 = FABER serial numbers

- (1) = expiration month,
- (2) = expiration year, after 20 years
- (3) = nominal capacity
- (4) = cylinder weight
- (5) = working pressure in MPa
- (6) = test pressure in MPa
- (7) = country where the cylinder was approved
- (8) = ECE/ECE type approval number
- (9) = test month/year
- (10) = inspector punch

### B.4.1 Periodic overhauling

In accordance with the ECE/ONU R110 regulation, gas cylinders for automotive use must be checked **AT LEAST EVERY 48 MONTHS** from the date of initial registration, unless otherwise specified.

Said overhauling must be carried out by an authorised body which is recognised by the regulating Authority.

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**NOTE** The expiry date is located on the cylinders and in the documentation which accompanies the vehicle.

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- Any cylinders subjected to impact during collision of the vehicle must be inspected by a body authorised by the Manufacturer, unless otherwise indicated by the appropriate Authority. Such cylinders may only be reintroduced into service if they have not been damaged in any way; otherwise they must be returned to the Manufacturer to undergo detailed damage assessment.
- Cylinders exposed to any type of incendiary situation must be inspected by a body authorised by the Manufacturer, or declared unsuitable and withdrawn from service.

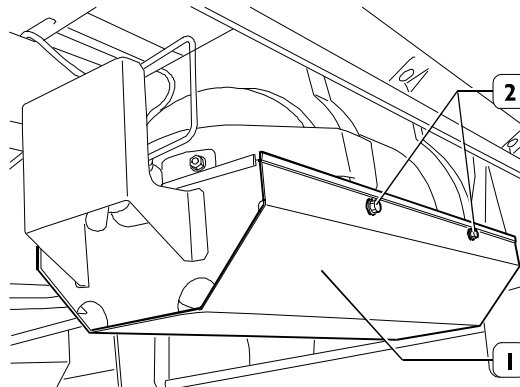
## B.4.2 Cylinder replacement

### Removal



**Before disconnecting the cylinders, empty the system completely following the procedure described in the "Emptying the gas system" chapter.**

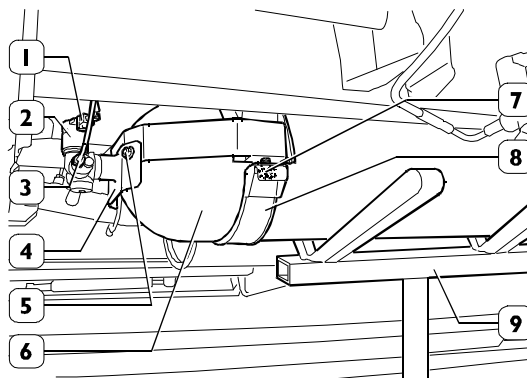
Figure B.20



117664

- Remove the screws (2) and remove the cover (1).

Figure B.21



117715

- Remove the nuts (5) and remove the cover (4).
- Disconnect the electrical connection (1) from the coil (2) of VBE solenoid valve.
- Disconnect the gas pipes (3) from the solenoid valve (2).
- Support the cylinder (6) with an appropriate support (9).
- Remove the screws (7), turn the brackets (8) and remove the cylinder (6) from the chassis.
- Disconnect the VBE valves (2) from the cylinder (6) as described in the corresponding chapter.

### Refitting

Reverse the removal sequence to refit and observe the following precautions:

- Position the cylinders in the basket directing the VBE valves so as to be able to connect the pipes.
- "Fasten the VBE valves (2) and pipe fittings to the specified torque observing the precautions shown in the "Repair interventions on fittings and pipes" chapter.
- After refitting, check hydraulic tightness of the system as described in the corresponding chapter.



## **B.5 Fuses and relays**

### **B.5.1 Fuse box and CNG relay under dashboard**

See specific section 5.4.

## **B.6      Bodybuilder connectors**

**NOTE**    For information on **Bodybuilders'** connectors, see **Section 5 - Paragraph 5.2.**

## **B.7 Power Take Off**

The PTO engagement and disengagement procedures are analogous to those described in Section 4 for diesel engine vehicles, except for the need (during engagement) to run the engine at 1200 rpm prior to pressing the button in Figure 4.6 on the PTO control panel.

