# UPDATE DATA

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Foreword

This publication provides the data, features and instructions for vehicle fitting and modifications. It is intended for qualified, skill personnel. The Body Builder is responsible for designing the fitting, its modification and execution, and will have to ensure compliance with the provisions both of this publication and the law regulations in force.

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

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

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

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

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

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

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

In the event of any discrepancy between the contents of this publication and the actual vehicle, please contact the Product Manager for your market before carrying out any operations.

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.
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 sullo asse posteriore motore.

Nei casi di difficoltà, potranno essere interpellate l’IVECO, trasmettendo un schema con riportate lunghezza ed inclinazione della nuova trasmissione proposta.

Le indicazioni tecniche riportate sulla manuale del 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, limitare le rumorosità ed evitare l’impronte di sollecitazioni trasmesse dal gruppo motopropulsore; ciò non esenta tuttavia l’esecutore delle responsabilità dei lavori eseguiti.

2.8.1 Lunghezze ammesse

Le massime lunghezze di esercizio realizzabili, sia per i tronchi intermedi che sconnessi “LG” o “LZ” (vedi Figura 2.11), possono essere determinate in base al diametro esterno del tubo esistente sul veicolo e dal numero di giri massimo di esercizio (vedere formula) e sono riportate nella Tabella 2.13.

Qualora la lunghezza dell’albero indicato in Tabella 2.13, in funzione del diametro del tubo non risultasse sufficiente, si dovrà prevedere l’innestamento di un nuovo tronco con le stesse caratteristiche di quelli esistenti. In alternativa in alcuni casi potrà essere utilizzata un albero di trasmissione avente un diametro del tubo di maggiori dimensioni. La dimensione del tubo potrebbe essere determinata in base alla lunghezza necessaria e al numero di giri massimo di esercizio, direttamente dalla Tabella 2.13.
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SECTION I

General specifications

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1.1 Aim of Bodybuilders instructions

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

These instructions also inform Bodybuilders of:
- the quality level to be attained;
- their obligations in respect of operations with safety implications;
- their obligations in respect of objective product liability.

You are reminded that the collaboration with IVECO is based on the premise that the Bodybuilder will always do everything to the best of its technical and organisational abilities and that executions will always be completed in accordance with professional standards. The following information is not exhaustive and simply sets out minimum rules and precautions that can be used as a basis for the application of your own technical expertise.

Any faults or defects caused by total or partial failure to observe these rules may not be covered by the warranty on the vehicle and its mechanical parts.

1.2 IVECO approval for changes and fittings

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

The following may be carried out only with IVECO’s authorisation after submitting a copy (two for English Market) of the documentation required for technical evaluation of the proposed change (drawings, calculations, technical report etc.):
- wheelbase modifications, where the new wheelbase does not fall within the minimum and maximum wheelbase available within the IVECO range for the same vehicle;
- work carried out on the braking system;
- work carried out on the suspension system;
- steering wheel modifications;
- changes to the stabiliser bars and suspensions;
- changes to the cab, cab supports, locking and tipping devices;
- changes to the intake systems, engine exhaust and SCR components;
- engine cooling system modifications;
- power unit and driving component modifications;
- work carried out on front and rear axles;
- fitting additional axles;
- fitting decelerator brakes;
- fitting power take-offs;
- changing the tyre dimensions;
- coupling device (hooks, fifth wheels) modifications;
- electric/electronic unit modifications.

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

The authorizations issued by IVECO concern solely the technical/conceptual feasibility of the modification and/or fitting to be made on a genuine IVECO vehicle. However the Fitter remains responsible for the following:

- project of the modification or fitting;
- choice and features of the products used;
- workmanship of the modification or fitting;
- compliance of the project and its implementation with all the instructions provided by IVECO;
- compliance of the project and its implementation with all the current regulations in the country where the vehicle is registered;
- the functionality, safety and reliability and in general the effective performance of the vehicle and also the effects that the changes and the conversion may have on vehicle performance and specifications.
- 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.

1.4 Guarantees

The Bodybuilder/chassis converter who has built the body or who has modified the chassis must guarantee that the work was undertaken in a professional manner in full compliance with the specifications contained in this manual.

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

- these specifications have not been adhered to or where unauthorised equipment was installed, or unauthorised modifications were carried out;
- an unsuitable frame has been used for the required conversion or application;
- the specifications, standards or instructions issued by the Manufacturer for the flawless execution of the operations have not been heeded;
- original spare parts or components which the Manufacturer has made available for specific interventions were not used;
- during any work, the safety regulations and markings are not observed;
- the vehicle is used for any other purpose than that for which it was designed.

1.5 Request for approval

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

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

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

---

Maintaining the functionality of vehicle components.

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

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

The Bodybuilder must arrange to carry out operations at least in an equivalent manner.
1.6 IVECO technical documents available by means of computer

The following technical documents are available on the Internet at www.thbiveco.com:
- directives for transformation and equipping of vehicles;
- technical cards;
- chassis cab diagrams;
- chassis diagrams;
- other specifications concerning the vehicle range.

The Body Builder shall submit the modification and/or fitting to the competent authorities for approval.

1.7 Trademarks and Logos

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

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

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

Instruction for added assemblies

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

All the units that make up the same order will be equipped with components of the same brand, model and quality.

1.8 Legal Provisions

The Fitter must check that the end product complies, without exceptions, with all the applicable legal requirements at municipal/autonomous/national level in every Country in which it is registered and/or in which it must be driven (Highway Code, Official Regulations, etc.), and at international level (Directives of the European Union, ECE Regulations issued by UNO/Geneva, etc.). It must also respect all the requirements concerning accident prevention, instructions for assistance, the environment, etc.

The recommendations of a legal nature, the requirements concerning accident prevention or other indications of a legislative type quoted in this directive are exclusively those which, according to IVECO, may be considered the most important and which in no case aim to replace or eliminate the obligation and responsibility of the Fitter to ensure that he is always correctly informed.

For this reason IVECO does not hold itself responsible for the consequences due to errors resulting from insufficient knowledge or incorrect interpretation of the legal requirements currently in force.
1.9 Prevention of accidents

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

The structures and devices fitted to the vehicles must comply with the current regulations concerning the prevention of accidents and safety regulations in force in the countries where the vehicle is to be used.

All the precautions dictated by technical awareness must be adopted to prevent malfunction and functional defects. Compliance with these regulations will be the responsibility of the manufacturers of the structures and devices.

Components such as seats, coverings, linings, protective panels etc. may represent a potential fire hazard if they are exposed to an intense heat source. Arrange for their removal before working with welding equipment and flames.

1.10 Choice of material to use: Ecology - Recycling

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

In this connection:
- everyone must be aware of the prohibitions on using harmful or potentially hazardous materials, such as ones containing asbestos, lead, halogen additives, fluorocarbons, cadmium, mercury, hexavalent chrome, etc.
- Use materials whose processing produces limited waste and that permit easy recycling after their first use.
- With composite synthetic materials, use components that are compatible with each other, envisaging also their possible utilization with the addition of other salvaged components. Affix the markings required in compliance with the current regulations.
- Batteries contain substances that are very hazardous to the environment. When replacing batteries, we advise contacting the service network, which is suitably equipped for battery disposal in compliance with environmental policies and laws.

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

#### 1.11.1 Advice for acceptance of the chassis by the Fitter

The Fitter who receives a chassis/vehicle from IVECO or from a Dealer must make a preliminary check, reporting any missing items or damage to the carrier.

#### 1.11.2 Vehicle maintenance in the store

To keep the vehicle in perfect efficiency even during a period in store, it may be necessary to perform maintenance operations at set intervals. The expenses for performing these operations are borne by whoever owns the vehicle at that time (Fitter, Dealer or Customer).

#### 1.11.3 Delivery of the vehicle to the end customer

Before delivering the vehicle, the Fitter must:
- prepare your execution (vehicle and/or equipment) and check its functionality and safety;
- perform the checks required on the Pre-Delivery Inspection list available with the IVECO network for the items involved in the operation performed (obviously the other items of the PDI will remain at the charge of the dealer as stated in the warranty booklet);
- measure the battery voltage, 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.

Battery maintenance must be carried out at regular intervals until the vehicle is delivered to the Customer so as to avoid problems of insufficient charge, short circuiting 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. Any defects or troubles should be notified to the IVECO Assistance Service to check whether there conditions for including them in the PDI costs exist;
- prepare and deliver to the end customer the necessary instructions for servicing and maintenance of the fitted vehicle and of any added assemblies;
- 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.
### 1.12 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:

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<th>Engine rating (HP:10)</th>
<th>Version</th>
<th>Suspension</th>
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<td>10</td>
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<tr>
<td>50</td>
<td>C</td>
<td>15</td>
<td>C N G</td>
<td>- P</td>
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<table>
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<th>Suspension</th>
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<td>Truck</td>
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<td>S</td>
<td>single</td>
<td>3.5</td>
<td>V</td>
<td>Van</td>
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<tr>
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<td></td>
<td></td>
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<td>CNG</td>
<td>CNG engine</td>
</tr>
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</table>

**Suspension**
- mechanic
/P pneumatic
1.13 Dimensions and masses

1.13.1 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

As a result of production factors there could be at a ±5% variation in the published weights for models 29L, 35S and 35C and a ±3% for models 40C, 50C, 60C, 65C and 70C.

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.

On our vehicles, lights and rear-view mirrors are designed for widths of up to 2350 mm.
1.13.2 Determining the Centre of Gravity of the Body and Payload

Positioning on the longitudinal plane

To establish the location of the centre of gravity of the body and payload the following examples below may be used as guidelines. The technical documentation specific to each model (chassis cab drawing) give the positions permitted with the vehicle in its standard form. The masses and positioning of the single components of the vehicle are given in the chassis and weight distribution diagram.

Figure 1.1

\[ L_1 = \frac{W_1 \cdot L}{W} \] respectively \[ L_1 = \frac{W_2 \cdot L}{W} \]

W = Body + payload (kg)
W1 = Body and payload acting on front axle (kg)
W2 = Body and payload acting on rear axle (kg)
L1 = Distance of the 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
\( L_1 = \frac{W_1 \times L}{W} = 860 \) 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 order to determine the payload on the axles, it must be uniformly distributed except when the shape of the loading surface itself entails a different distribution of the load.

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

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

**Figure 1.2**

![Uniform load distribution](image1)

![Uneven load distribution](image2)

**Figure 1.3**

![Uniform load distribution](image3)

![Uneven load distribution](image4)

(beware of axle loads and minimum axle ratio)
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

Figure 1.4

![Diagram showing height of centre of gravity](image)

\[
\begin{align*}
H_t &= \frac{W_c \cdot H_c + W_b \cdot H_b}{W_c + W_b} \\
H_b &= \frac{(W_c + W_b) \cdot H_t - W_c \cdot H_c}{W_b}
\end{align*}
\]

\( W_c \) = 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>
<thead>
<tr>
<th>Models</th>
<th>Centre of mass height (mm)</th>
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<tbody>
<tr>
<td>29L</td>
<td>1400</td>
</tr>
<tr>
<td>35S</td>
<td>1500</td>
</tr>
<tr>
<td>35C (front transverse leaf spring)</td>
<td>1800</td>
</tr>
<tr>
<td>35C (front longitudinal bar) - 40C</td>
<td>1900</td>
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<tr>
<td>45C - 50C</td>
<td>1950</td>
</tr>
<tr>
<td>60C - 65C - 70C</td>
<td>2050</td>
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</table>

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 the guidelines in ECE Regulation 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

In outfits that are particularly high and cover a particularly extensive area (e.g.: advertising panels), the thrust centre generated in the event of a side wind must be assessed with great care.

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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

Supplementary stabilising or anti-roll bars, where available, spring reinforcements or the application of rubber components (in compliance with point 2.11) may increase the height of the centre of gravity of the payload which must be defined as each occasion arises. The modification must be carried out after careful consideration has been given to the specifications of the body type, to the wheelbase and to the distribution of the transverse forces acting on the suspension both at the front and at the rear of the vehicle.

Modification to the front axle may be made where the load is positioned behind the cab (e.g. crane) or where the body is very rigid (e.g. van conversion).
1.13.3 Observing the Permitted Weights

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

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

NOTE Ensure transverse loads are properly distributed when positioning auxiliary components and superstructures. A +4% variation on the rated load (50% of the load on the corresponding axle) is permissible for each wheel (for example: permissible load on axle 3000 kg; 1440 to 1560 kg allowed for each wheel side) in compliance with load allowed by tyres, without affecting braking properties and vehicle driving 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).

Variations in the Permissible Weight

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

Such exemptions, if they exceed the limits imposed by law, must be authorised by the Government Administrative Authority. The request for authorisation must include:
- vehicle type, wheelbase, identification number, designated use;
- unladen weight on the axles (e.g. vehicles equipped with crane) including positions for the centre of gravity of the payload;
- proposals concerning the reinforcement of the vehicle components where necessary.

The reduction in the permissible weight on the vehicle (derating) may involve changing various components such as suspension, brakes etc and may require recalibration of the load sensing valve where one is fitted. In these circumstances necessary instructions may be provided.
1.14 Instructions for the Correct Functioning of the Parts of the Vehicle and Accessibility for Maintenance

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

For example:

- free access must be guaranteed to the points that require inspection, maintenance or periodic checking (e.g., changing the battery, access to the pneumatic suspension compressor assembly), in the case of enclosed superstructures, special compartments and doors must be provided;

- the possibility of dismantling the various assemblies for servicing must be maintained. Jobs on the gearbox/clutch or adjustments (e.g., suspension bars) must be performed without having to dismantle important elements of the added structure;

- the cooling system (radiator cowlings, radiator, air passages, cooling circuit etc.) fuel supply (pump position, filters, pipe diameter, etc.) and the engine air intake must not be altered;

- the anti-noise panels must not be altered or moved in order to prevent changes in the approved noise levels of the vehicle. Should it be necessary to make openings (e.g., for the longitudinal runner of the body to pass through) these must be properly closed off using material with inflammability and soundproofing characteristics equivalent to those used originally;

- adequate ventilation of the brakes and battery case (especially in the case of vans) must be guaranteed;

- when positioning the mudguards and wheel arches, the rear wheels must be free to rebound even when used with chains;

- when the vehicle has been set up, for safety reasons, headlight attitude must be checked and adjusted as necessary. Perform the adjustment according to the instructions provided in the use and maintenance manual;

- in the case of parts which are supplied loose (e.g., spare wheel, chocks) it will be the responsibility of the Bodybuilder to position and secure them in an accessible and safe manner in compliance with possible national laws.
1.15 Quality System Management

For some time IVECO has been promoting Quality System development and training for Bodybuilders. This is a requirement due not only to compliance with domestic and international regulations on product liability, but also the growing demand for increasingly higher quality levels. The creation of new forms of organization in the various sectors and the quest for increasingly more advanced levels of efficiency.

IVECO believes it essential for Bodybuilders to be equipped with an organization where the following are defined and available:
- organization charts for functions and responsibilities;
- Quality System;
- quality goals;
- technical design documentation;
- process and control phases with relevant resources;
- product improvement plan, obtained also with corrective actions;
- after sales service;
- staff training;
- manufacturer liability documentation.

1.16 Vehicle maintenance

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

These directives for Fitters define:

- **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 centreline of the last axle and the rear end of the chassis frame structural members.

- **dimensions A, B and t of the chassis section**: those represented in the figure shown here.

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Chassis modifications

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2.14 Changing the Size of the Tyres

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2.15.2 Brake pipes

2.15.3 Fitting pipes on the vehicle
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<th>Section</th>
<th>Page</th>
</tr>
</thead>
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<td>2.15.5 ESP (Electronic Stability Control)</td>
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<td>2.16.3 Additional equipment</td>
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<td>2.16.4 Current drawing</td>
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</tr>
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<td>2.16.5 Additional Circuits</td>
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<td>2.22 Side Guards</td>
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<td>2.23 Chocks</td>
<td>2-109</td>
</tr>
</tbody>
</table>
2.1 General instructions for chassis modifications

Particular attention must be given to the following points:

- **Welding to the bearing structures of the chassis is explicitly prohibited** (with the exception of the items described at points 2.3.4, 2.4 e 2.5);

- **Holes in the flanges of the side members are not permitted** (except for the items described at point 2.3.4);

- Where riveted connections exist and can be modified as explained below, these can be replaced by flanged-head screws and nuts of min. class 8.8 or by hex screws of the next greater diameter and self locking nuts. Screws greater than M12 must not be used (max. diameter of hole 13 mm) unless otherwise specified;

- if connections that require screws to be used are restored, it is necessary to check that the screws are appropriate before reutilisation and to tighten them to a proper torque;

If safety components are remounted, the previously used screws can not be reutilised and it is necessary to tighten them to the specific torque required (contact the service network to find out the value).

- in the cases of remounting safety components and when rivets replaced with screws, you have to recheck the closing of the connection after covered distance of about 500 - 1000 km.

2.1.1 Specific Precautions

During welding, drilling, grinding and cutting operations near brake system pipes, and electrical cables, adopt the appropriate precautions for their protection. Remove them altogether if necessary (observe the requirements set out under points 2.15 and 2.16).

Figure 2.1
**Take precautions concerning the alternator and the electrical/electronic components.**

In order to avoid damaging the diode rectifier, never disconnect the batteries (or open the isolator) when the engine is running. If the vehicle has to be started by towing (a method highly advised against), make sure that the battery is charged and connected so as to guarantee the ECU the minimum operating voltage. If you have to charge the battery, disconnect it from the vehicle circuit. In order to run the engine with external means and in order to avoid current peaks which might damage the electric/electronic components, do not use the “start” function in conjunction with external charge devices if such devices are equipped with this function. Starting will have to be carried out only with the external battery trolley ensuring correct polarity.

**Ground connections**

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

- remove, mechanically, and/or with an appropriate chemical product, the paint on the chassis side and on the terminal side creating a resting plane free from indentations or ridges;
- apply appropriate high conductivity paint between the cable terminal and the metal surface;
- connect the earth within 5 minutes of applying the paint.

For signal level earth connections (e.g. sensors or devices with low power uptake), avoid using standardised points IVECO M1 (on the crankcase, near the starter motor) or M2 (battery earth connection) under all circumstances and make the earth connections of signal cables at points separate from power cables and cables that act as radio shields.

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

**Braking and electrical system**

For further information regarding the braking and electronic system, refer to point 2.15 and 2.16.
2.2 Protection against Rust and Painting

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

2.2.1 Original components

Table 2.1 shows the protection and painting classes required for original vehicle components. Table 2.2 shows classes for unpainted or aluminium parts and Table 2.3 shows classes for painted parts.

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

NOTE Parts must be supplied only with cataphoretic coating or rustproofing (Schedule III). The enamel will be applied during the frame finishing stage.
Table 2.2 - Various unpainted and aluminium parts and components - IVECO Standard 18 - 1600 (Schedule IV)

<table>
<thead>
<tr>
<th>Type of protection</th>
<th>IVECO standard</th>
<th>Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>18-0506</td>
<td>yes</td>
</tr>
<tr>
<td>Geomet (HHH)</td>
<td>GEO 321-8</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>GEO 500-8</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GEO 321-8 PM</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GEO 321-8 PML</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GEO 321-8 PL</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GEO 500-8 PL</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GEO 321-5</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GEO 500-5</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GEO 321-5 PM</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GEO 321-5 PML</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GEO 321-5 PL</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GEO 500-5 PL</td>
<td>-</td>
</tr>
<tr>
<td>Galvanising (HH)</td>
<td>FE/ZN 12 II</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>FE/ZN 7 IV</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>FE/ZN 12 IV</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>FE/ZN 7 IV LUB</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>FE/ZN 7 IV S</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>FE/ZN 12 IV S</td>
<td>-</td>
</tr>
<tr>
<td>Aluminium</td>
<td>Anodic oxidation</td>
<td>18-1148</td>
</tr>
<tr>
<td></td>
<td>Painting</td>
<td>See Schedule III</td>
</tr>
</tbody>
</table>

1. Coupling with other metals must not generate battery effects.
2. Hexavalent chromium-free coatings.
3. Chromium-free coatings.
Protection against Rust and Painting

### Table 2.3 - Painted parts - IVECO Standard 18 - 1600 (Schedule III)

<table>
<thead>
<tr>
<th>Description of the cycle phase</th>
<th>Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td><strong>MECHANICAL CLEANING</strong></td>
<td></td>
</tr>
<tr>
<td>Superficial</td>
<td></td>
</tr>
<tr>
<td>Sanding/sandblasting</td>
<td>-</td>
</tr>
<tr>
<td>Brushing</td>
<td>yes ★</td>
</tr>
<tr>
<td>Sandpapering</td>
<td>-</td>
</tr>
<tr>
<td><strong>PRETREATMENT</strong></td>
<td></td>
</tr>
<tr>
<td>Iron phosphatation (only for non-precoated ferrous materials)</td>
<td>-</td>
</tr>
<tr>
<td>Zinc phosphatation ☆</td>
<td>-</td>
</tr>
<tr>
<td><strong>CATAPHORESIS</strong></td>
<td></td>
</tr>
<tr>
<td>High thickness (30-40 μm)</td>
<td>yes ★</td>
</tr>
<tr>
<td>Medium thickness (20-30 μm)</td>
<td>yes ★</td>
</tr>
<tr>
<td>Acrylic top coat (&gt;35 μm)</td>
<td>-</td>
</tr>
<tr>
<td><strong>RUSTPROOFING</strong></td>
<td></td>
</tr>
<tr>
<td>Dual component (30-40 μm)</td>
<td>-</td>
</tr>
<tr>
<td>Single component (30-40 μm)</td>
<td>-</td>
</tr>
<tr>
<td><strong>CHIP-RESISTANT PRIMER</strong></td>
<td></td>
</tr>
<tr>
<td>Single (130 °C) or dual component (30-40 μm)</td>
<td>yes ★</td>
</tr>
<tr>
<td><strong>ENAMEL</strong></td>
<td></td>
</tr>
<tr>
<td>Single (130 °C) or dual component (30-40 μm)</td>
<td>yes ★</td>
</tr>
<tr>
<td>Powder (40-110 μm)</td>
<td>yes ★</td>
</tr>
<tr>
<td>Single component, low temperature (30-40 μm)</td>
<td>-</td>
</tr>
</tbody>
</table>

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

All parts of the vehicle (cab, chassis, bodywork, etc.) which are added or subjected to modification must be protected from rust and corrosion.

There must be no unprotected areas on ferrous materials.

Table 2.4 (painted) and Table 2.5 (unpainted) show the minimum treatments required for modified or added components when it is not possible to provide the same protection as that used on IVECO original components. Different treatments are allowed on condition that the same level of protection against rust and corrosion is guaranteed.

Never use powder enamels directly after degreasing.

Parts in light alloy, brass and copper must not be protected.

Table 2.4 - Added or modified painted parts

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

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

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

<table>
<thead>
<tr>
<th>Type of protection</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A – B (1)</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>yes</td>
</tr>
<tr>
<td>GEOMET</td>
<td>-</td>
</tr>
<tr>
<td>Zinc treatment (1)</td>
<td>-</td>
</tr>
</tbody>
</table>

(1) = Hexavalent chromium-free.
2.2.3 Precautions

Suitable precautions must be taken to protect those parts whose preservation and operation could be damaged by paints such as:
- rubber or plastic pipes for the air and hydraulic installations;
- gaskets, parts in rubber or plastic;
- flanges of the transmission shafts or power take-offs;
- radiators;
- shock absorber and hydraulic or air cylinder rods;
- drainage and bleeder valves (mechanical components, air tanks, cold starting heater plug pre-heating tanks etc.);
- fuel sediment filter;
- nameplates and logos.

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

If it should be necessary to paint after removing the wheels or to repaint the drum covers of the brakes, the surface onto which the hubs are connected must be protected, avoiding increases in thickness and above all avoiding the accumulation of paint on the connecting flanges of the wheel rims and the mating surfaces of the fixing nuts/studs.

Ensure that the disc brakes are adequately protected.
The electronic components and modules must be removed.

---

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

When it is necessary to mount assemblies or auxiliary units on the chassis, as a general rule, the existing holes made at the factory should be used.

**Under no circumstances should the flanges of the supporting member of the vehicle be drilled unless in compliance with the indications given in point 3.3.1.**

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

**Position and Size**

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

The diameter of the holes must be proportional to the thickness of the steel. Under no circumstances must this exceed 13 mm unless otherwise specified. The distance from the centre of the hole to the edges of the side member must not be below 30 mm. The centres of the holes must never be located at a distance of less than 30 mm from each other or in relation to the existing holes. The holes must be staggered as shown in Figure 2.2. When moving spring or crossbeam supports, always maintain the original boring diagrams.

**Figure 2.2**

![Diagram showing the position and size of holes in the chassis](image)

2.3.1 Screws and nuts

In general, use connectors of the same type and class as those for similar fixings on the original vehicle (Table 2.6).

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

<table>
<thead>
<tr>
<th>Class of resistance</th>
<th>Usage</th>
<th>Tensile strength (N/mm²)</th>
<th>Yield point (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8</td>
<td>Non-load bearing screws</td>
<td>400</td>
<td>320</td>
</tr>
<tr>
<td>5.8</td>
<td>Low resistance screws</td>
<td>500</td>
<td>400</td>
</tr>
<tr>
<td>8.8</td>
<td>Medium resistance screws</td>
<td>800</td>
<td>640</td>
</tr>
<tr>
<td>10.9</td>
<td>High resistance screws</td>
<td>1000</td>
<td>900</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class of resistance</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.9</td>
<td>High resistance screws</td>
</tr>
</tbody>
</table>

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

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

### Table 2.7 - Material to be used to modify the chassis IVECO Standard 15-2110 and 15-2812

<table>
<thead>
<tr>
<th>Steel name</th>
<th>Tensile strength (N/mm²)</th>
<th>Yield point (N/mm²)</th>
<th>A5 elongation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVECO</td>
<td>FEE420</td>
<td>530</td>
<td>420</td>
</tr>
<tr>
<td>Europe</td>
<td>S420MC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>S420MC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>S420MC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 2.8 - Daily: chassis dimensions, section and thickness

<table>
<thead>
<tr>
<th>Class</th>
<th>Type</th>
<th>Wheelbase [mm]</th>
<th>Chassis rear overhang [mm]</th>
<th>A × B × t wheelbase area section [mm]</th>
<th>A × B × t rear overhang area section [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>29L - 35S</td>
<td>truck</td>
<td>3000</td>
<td>920</td>
<td>150 × 56 × 3</td>
<td>100 × 56 × 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3450</td>
<td>1355</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3750</td>
<td>1665</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3950 (camper)</td>
<td>1825</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>van</td>
<td>3000 short overhang</td>
<td>840</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3000 long overhang</td>
<td>1240</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3300</td>
<td>1460</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3950</td>
<td>1825</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35C</td>
<td>Light camper</td>
<td>3750</td>
<td>1665</td>
<td>150 × 56 × 3</td>
<td>100 × 56 × 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3950</td>
<td>1825</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35C - 50C</td>
<td>truck</td>
<td>3000 (1)</td>
<td>1240</td>
<td>182 × 70 × 4</td>
<td>122 × 70 × 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3450</td>
<td>1355</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3750</td>
<td>1665</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4100 (1)</td>
<td>1715</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4350</td>
<td>1885</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4750 (2)</td>
<td>2350</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35C - 40C</td>
<td>van</td>
<td>3000 short overhang</td>
<td>840</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3000 long overhang</td>
<td>1240</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3300</td>
<td>1460</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3950</td>
<td>1825</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45C - 50C</td>
<td>van</td>
<td>3000 short overhang</td>
<td>840</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3000 long overhang</td>
<td>1240</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3300</td>
<td>1460</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3950</td>
<td>1825</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60C - 65C - 70C</td>
<td>truck</td>
<td>3450</td>
<td>1355</td>
<td>184 × 69 × 5</td>
<td>184 × 69 × 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3750</td>
<td>1665</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4350</td>
<td>1890</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4750</td>
<td>2350</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3950</td>
<td>1825</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

### 2.3.3 Stresses on the chassis

Do not exceed the following stress values under static conditions:

<table>
<thead>
<tr>
<th>Range</th>
<th>Permitted static stress on the chassis $\sigma$ amm. (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>On road</td>
</tr>
<tr>
<td>Daily</td>
<td>120</td>
</tr>
</tbody>
</table>

When prescribed by national regulations, the bodybuilder must check that the stress limits are not exceeded.

Welding activity will cause a deterioration in the characteristics of the material. Therefore, when checking the stresses in thermically-modified zones, consider a reduction of approx. 15% of the resistance characteristics.
### 2.3.4 Welding the Chassis

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

Welding is permitted:
- when joining structural elements to extend or shorten the wheelbase or rear overhang;
- for the application of reinforcing L section flitch on a side member that is to be modified as detailed below (see Figure 2.3).

**Figure 2.3**

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

As part of the procedure it will be necessary to remove the paint and deoxidise the parts of the chassis that are affected by the welding operation as well as those parts which may have to be covered by possible reinforcements. When work has been completed the modified part must be protected with adequate rustproofing (see point 2.2.2).

a) Cut the side members with a diagonal or vertical cut. (We recommend that the diagonal cut be used particularly for the section between the wheelbase) Cuts are not permitted in areas in which the profile of the side member as well as the chassis width change or in those where there is a high concentration of stresses (e.g. spring brackets). The cuts must not be made through the holes present in the side member (see Figure 2.4).

Figure 2.4

b) On the inner side of the side member give the parts that are to be joined a V-shaped chamfer of 60° along the entire length to be welded (see Figure 2.5).

Figure 2.5

c) Arc weld in stretches using carefully dried basic electrodes. The recommended electrodes are:
For S 500 MC (FeE490: QStE 500TM)
Diameter of the electrode is 2.5 mm, current intensity approx. 90A (max. 40A for each millimetre of diameter of the electrode).
Using MIG-MAG welding use a welding rod with the same characteristics as the material to be welded (diameter 1 to 1.2 mm).
Recommended welding rod: DIN 8559 - SG3 M2 5243
gas DIN 32526-M21 or DIN EN 439
If FeE490 is used at very low temperatures, we recommend:
PrEN 440 G7 AWS A 5.28 - ER 80S - Ni 1
gas DIN EN439-M21
Avoid current overloading. Welding must be free from marginal cuts and waste material.

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

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

f) Remove excess material resulting from the welding operations by grinding.
On the inner side reinforcing L-section flitches should be applied. These should be made of steel and have the same characteristics as the steel used for the chassis. The minimum dimensions are given in Figure 2.3. The reinforcements may only be fixed to the vertical web of the side member using welding beads, plug welds, bolts or rivets (Huck rivets may also be used). The cross-section and the length of the weld bead, the number and distribution of the plug welds, bolts or rivets must be adequate to transmit the bending and shearing moment of the section.

2.3.5 Closing of existing holes

If making new holes close to other existing holes (see Figure 2.2) the existing holes can be closed by welding. To ensure that the operation is successful, level the external edge of the hole and apply a copper plate to the inner part of the side member to secure the solder (same as that of the side member) and weld both sides of the side member. Grind the excess part of the material away. Levelled washers may also be used to close the holes.
2.4 Modifying the Wheelbase

2.4.1 General Specifications

Any modification to the wheelbase that involves the electrical circuit and/or the relocation of electric/electronic components requires approval and must be carried out in accordance with the instructions in point 2.16.

Generally, the wheelbase must be changed by operating on the standard production wheelbase that is nearest to the one that you want to create.

If the size of the superstructure allows it, it is preferable to create wheelbase values equal to those in standard production. This allows original propeller shafts and pre-established crossmember positions to be used.

However, note that if you want to create a measurement lower than the minimum allowed or greater than the maximum allowed written permission must be requested from IVECO.

For vehicles with ESP system, see point 2.15.5.

2.4.2 Authorisation

It is only possible to alter the wheelbase without obtaining specific approval from IVECO when:
- one of the other lengths specified in the brochure for the type of vehicle to be converted is constructed
- the structure (rail cross-section; crossmember number, types and positions), circuits and systems present on the standard frame corresponding to this length are replicated.

When these conditions are not met, whereby the layout of the converted frame is identical to the layout of an original frame, the modification must be approved.

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

Conversion must be carried out performed in compliance with these instructions by making the necessary changes and adjustments and taking the appropriate precautions (e.g., determining whether ECU parameters need updating, rearranging the exhaust pipes, ensuring compliance with specific load limits on the rear axle, etc.), by taking into due account the requirements specified for the original wheelbase lengths.

2.4.3 Consequences for steering

Generally, lengthening the wheelbase has a negative effect on the steering.

Whenever national regulations require it, the limits on the overall dimensions must be observed as well as the limits concerning the effort applied on the steering wheel and the relevant operation times (e.g., ECE standard or current EC Directive).

Table 2.10 contain, the wheelbase extension limits for the various models, with series drive, at max load admissible on front axle and with tires admissible on vehicle.

Should longer wheelbases be necessary for specially equipped vehicles, request the specific approval of IVECO and take all the necessary precautions to improve steering characteristics, such as reduction of the maximum load allowed on the front axle, or the use of tyres and wheels with a more limited offset.

The addition of a supplementary pump must be authorised by IVECO and fitted by a specialised company.
2.4.4 Effect on Braking

In general, wheelbase shortening has a negative effect on braking specifications. Wheelbase modification limits are shown in Table 2.11. Consult relevant IVECO departments to find out the conditions (brake cylinders, minimum tares, maximum permitted weights, tyres, centre of gravity height) under which these values are permitted.

<table>
<thead>
<tr>
<th>Model</th>
<th>Front suspension</th>
<th>Maximum wheelbase (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>29L, 35S</td>
<td>Transverse</td>
<td>4100</td>
</tr>
<tr>
<td>35C, 40C, 45C, 50C</td>
<td>Transverse (max. permitted value: 1800 kg)</td>
<td>4100</td>
</tr>
<tr>
<td>35C, 40C, 45C, 50C</td>
<td>Torsion bar (max. permitted value: 1900 kg)</td>
<td>4750</td>
</tr>
<tr>
<td>60C, 65C, 70C</td>
<td>Torsion bar</td>
<td>4750</td>
</tr>
</tbody>
</table>

Table 2.11 - Braking: wheelbase modification limits

<table>
<thead>
<tr>
<th>Model</th>
<th>Version</th>
<th>Wheelbase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Minimum (mm)</td>
</tr>
<tr>
<td>29L, 35S</td>
<td>Truck, van</td>
<td>3000</td>
</tr>
<tr>
<td>35C, 40C</td>
<td>Truck, van</td>
<td>3000</td>
</tr>
<tr>
<td>45C, 50C</td>
<td>Van</td>
<td>3000</td>
</tr>
<tr>
<td>45C, 50C</td>
<td>Truck</td>
<td>3450</td>
</tr>
<tr>
<td>60C, 65C, 70C</td>
<td>Truck, van</td>
<td>3300</td>
</tr>
</tbody>
</table>

The settings data must be updated in the case of vehicles equipped with an ASR system

2.4.5 Consequences for steering

To ensure the success of the conversion proceed as follows:
- arrange the vehicle so that the chassis is perfectly level, using the appropriate stands;
- disconnect the propeller shafts, the braking system pipes, the wiring harness and any equipment that might prevent the work being carried out correctly;
- identify the reference points on the chassis (e.g. pilot holes, suspension supports);
- mark the reference points with a light line of punch marks on the top flange on both side members after ensuring that their joining line is perfectly at right-angles to the longitudinal axis of the vehicle;
- when re-positioning the spring hanger brackets, identify the new position using the reference marks made previously.
  Check that the new measurements are identical between the left and right sides. Differences no greater than 2 mm should emerge from diagonal checking of the lengths less than 1,500 mm.
  Unless another tool is available, make new holes by using the supports and gussets of the cross members as a template. Fix the supports and cross members with rivets or bolts. If using bolts, fix the supports by reaming the holes and using class 10.9 calibrated bolts with nuts equipped with a device that prevents them from working loose. When space permits it use flanged-head screws and nuts;
Modifying the Wheelbase

- if the chassis is cut (to be carried out in accordance with guidelines given on page 2-16, point a), determine a second line of reference points so that the area affected by the operation lies between these and the previous points. In any case, allow for a distance of at least 1500 mm, considered when the operation is complete. Inside these two reference lines make points to mark out the area of the cut then proceed as indicated in point 2.3.4.

Before welding, ensure that the side members, including any added portion, are perfectly aligned and take measurements on both sides and diagonally to check, as previously described. Fit the reinforcements as instructed at point 2.3.4.

Further indications

- Protect the surfaces against rust as described in point 2.2.2.
- Restore the electrical and braking systems as described in points 2.15 and 2.16.
- For work on the drive line follow the instructions given in point 2.8.

2.4.6 Chassis Stress Level

When lengthening a wheelbase, in addition to local reinforcement on the side member joint, the Bodybuilder must provide sufficient reinforcements to achieve the section moduli of the side member section no lower than that designed by IVECO for the same wheelbase or for next size up. Alternatively, when permitted by local regulations, larger subframe sections can be used. The BodyBuilder shall verify that such stress is not greater than the one of the chassis with the original wheelbase, by assuming an evenly distributed load and the chassis being considered as a beam resting on the suspension supports. In any case, more restrictive limits (if any) set by the national standards shall be complied with.

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

2.4.7 Cross Members

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

Any supplementary cross members must have the same features as those already existing (flexural strength, torsional strength, quality of the material, connection to the side members, etc). In Figure 2.6 shows an example of the application. A cross member is mandatory for any extension over 600 mm.

As a general rule the distance between the two cross members must not be greater than 1000 to 1200 mm.

The minimum distance between two cross members must not be less than 600 mm, particularly for heavy-duty and off-road use; this limit does not apply to the "lightweight" transmission support cross member.

Figure 2.6
2.4.8 Chassis reinforcements

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

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

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

Figure 2.7

![Diagram of reinforcement examples]


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

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

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

When sizing the reinforcement, the static stress on the vehicle chassis shown in Table 2.9, must not be exceeded. Use the material shown in Table 2.7.

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

2.4.9 Changes to transmissions

See chapter 2.8 for admissible changes.
2.5 Modifying the Rear Overhang

2.5.1 General Specifications

In modifying the rear overhang it must be borne in mind that such modification entails changes in the distribution of the payload on the axles relative to the loads established by IVECO (see point 1.13). The limitations established by national laws must also be respected as well as the maximum distance from the rear edge of the body and the ground clearance prescribed for the tow hook and the underrun bar. The distance from the extremity of the chassis to the rear edge of the body must not, as a general rule, exceed 350 to 400 mm.

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

When the installation of a tow hook is planned an adequate distance (approximately 350 mm) must be left from the rear cross member to the next nearest cross member for mounting and removing the tow hook wherever necessary.

If the modifications are carried out competently and in compliance with the specifications contained in this manual, the towable weight originally established may be retained. In any case responsibility for the work rests with those who have carried it out.

2.5.2 Authorisation

The rear extensions of the chassis, as well as the shortening to the shortest standard value contemplated for each model, carried out according to the indications given here, need not be expressly authorised by IVECO.

For special use vehicles, where distribution of the load is pre-defined and fixed, it is possible to lengthen the rear overhang more than 60% of the wheelbase provided that the conditions set forth in chapter 1.13.3, Directive EEC 97/27 and relevant domestic implementations as far as the overall dimensions bracket is concerned.

2.5.3 Reducing the Overhang

When reducing the length of the rear overhang of the chassis the last cross member must be moved forward.

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

For vehicles with ESP system, see point 2.15.5.

2.5.4 Increasing the Overhang

Various methods of increasing the length are given in Figures, 2.8, 2.9 and 2.10.

Straight cutting is also allowed for the frame. The minimum reinforcement dimensions to be applied to the area affected by the change are shown in the Figure 2.3.

Figures 2.8 and 2.9 show the solution planned for elongations that do not exceed 300 + 350 mm; in this case, the reinforcement corner sections act as a link between crossbeam and frame and must have the same thickness and width as the original gusset plate. The originally riveted connection between crossbeam and plates may be created using 8.8 category bolts of the next diameter up and nuts with systems to prevent loosening.

For vehicles with ESP system, see point 2.15.5.
When the increase exceeds 350 mm, Figure 2.10 shows the procedure to be used.

Figure 2.8

Figure 2.9

Figure 2.10

When the extension reaches a certain dimension, it will be necessary to examine on a case by case basis, the feasibility of installing a supplementary cross member to give the frame sufficient torsional rigidity. Adding a supplementary cross member with the same properties as the standard production cross member is necessary whenever the distance between two cross members is greater than 1200 mm.
2.6 Installing a Towing Device

2.6.1 Adaptation for towing

A vehicle that was not originally designed for towing may be adapted for this purpose by adding a specific ‘towing section’, i.e. a set of parts shown in the type approval documentation of the towing version (for example: chassis crossmember, electric coupling joint, tachograph if the vehicle is category N1, tow hook, etc.). Conversion from a version type approved as non-towing to the corresponding version type-approved for towing is permitted without the need for specific authorisation by IVECO.

2.6.2 Partial installation of components and towing devices

Partial installation of type approved towing components and devices require special authorisation by IVECO; the Applicant remains totally responsible for checking their compliance with current regulations and the check is subject to approval by the Authorities responsible for subsequent inspection.

2.6.3 Precautions

If using trailers with one or more closely-spaced axles (mid-axed trailers), the rear vehicle crossmember is subject to considerable stress, particularly due to the effects of dynamic vertical loads. You are therefore asked to read the information given in point 2.6.2 with care.

The tow hook must be appropriate for the permitted loads and of the type approved by national laws. Because tow hooks are important safety components, they must not be modified in any way.

To secure the tow hooks to the crossmember, in addition to the tow hook manufacturer’s instructions, the limitations set by the current standards must be respected including the minimal spaces for the brake coupling and electrical system, maximum distance between the hook pin centre line and the superstructure rear surface.

If the holes in the hook attachment flange do not coincide with the holes on the vehicle rear crossmember, modification of the drilling on the crossmember may be authorised after applying appropriate reinforcements.

The Bodybuilder is obliged to construct and fit the superstructure in such a way as to permit the necessary manoeuvres and control of the attachment without impediment or hazards.

The trailer drawbar must be guaranteed freedom of movement.
2.6.4 Towhook for mid-axled trailers

The use of central axle trailers implies the use of tow hooks suitable for this purpose. A towing hook may be fitted, without obtaining prior approval only on crossmembers provided for this purpose and to vehicles on which IVECO provides for a towing hook to be installed. Subsequent installation on vehicles for which it was not originally designed must be authorised by IVECO.

Detail of rail reinforcement for installation of the tow hook.

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

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

For mechanical attachment devices designed for mid-axled trailers, the \( D_c \) and \( V \) values are defined by the following equations:

\[
D_c = g \cdot \frac{(T \cdot C)}{(T + C)}
\]

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

- \( D_c \) = representative value of the class of jaw (kN). This is defined as the technical reference force for the horizontal force between the towing vehicle and the trailer;
- \( g \) = acceleration due to gravity (m/s\(^2\));
- \( T \) = maximum weight (in tonnes) of the towing vehicle;
- \( T+S \) = maximum weight (in tonnes) of the towing vehicle + the vertical load of a trailer with a centre axle;
- \( R \) = maximum weight (in tonnes) of the trailer;
- \( S \) = value of the static vertical load (in tonnes) which, in static conditions, is transmitted to the point of attachment. \( S \) must be \( \leq 0.1 \cdot R \leq 1000 \) kg;
- \( C \) = sum of the maximum axle loads (in tonnes) of the trailer with a centre axle at maximum load. It is equal to the maximum weight of the trailer with a centre axle less the static vertical load (\( C = R - S \));
- \( V \) = value of the intensity of the theoretical dynamic vertical force (kN);
- \( a \) = for the equivalent acceleration at the point of attachment, as a function of the rear suspension of the towing unit, use the following values:
  - \( a = 1.8 \) m/s\(^2\) for air suspension;
  - \( a = 2.4 \) m/s\(^2\) for other suspension types;
- \( X \) = length of the load surfaces (m);
- \( L \) = theoretical length of the drawbar (distance between the centre of the drawbar towing eye and the centre line of the trailer axle (m)); \( X^2/L^2 \geq 1 \) if the result is less than 1, use the value 1.

Figure 2.11

Length of the load surface of the trailer and theoretical length of the drawbar
Example for calculating the class of towing gear for trailers with a centre axle

Let us consider a 65C15 vehicle with maximum weight 6250 kg that is to be used to tow a mid-axled trailer weighing 3500 kg with $S = 250$ kg, load surface length of 5m and theoretical drawbar length of 4 m. Therefore, from the data

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

we obtain:

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

2.6.5 Types of hook

Table 2.12 - Example of type-approved hooks available in production

<table>
<thead>
<tr>
<th>Type</th>
<th>Class</th>
<th>D (kN)</th>
<th>$D_c$ (kN)</th>
<th>V (kN)</th>
<th>EC approval no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GS500</td>
<td>A50-X</td>
<td>22.5</td>
<td>-</td>
<td>25.0</td>
<td>e 11<em>94/20</em>0533*00</td>
</tr>
<tr>
<td>GA381</td>
<td>S</td>
<td>22.5</td>
<td>-</td>
<td>25.0</td>
<td>e 11<em>94/20</em>1613*01</td>
</tr>
</tbody>
</table>

The following table shows the maximum permitted static vertical load values $S$ for production towbars, in the case of mid-axled trailers.

Table 2.13

<table>
<thead>
<tr>
<th>Model</th>
<th>Maximum S (kN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>29L</td>
<td>140</td>
</tr>
<tr>
<td>35S, 35C, 40C</td>
<td>140</td>
</tr>
<tr>
<td>45C, 50C, 60C, 65C, 70C</td>
<td>140</td>
</tr>
</tbody>
</table>
• Ball hooks

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

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

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

• Pin hooks (automatic)

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

13-Pole connector

If not already fitted by IVECO, it can be retro fitted following the instructions given in point 2.16.7.

2.6.6 Lowered Rear Cross Member

If the type of trailer used requires that the tow hook be positioned lower than originally intended, IVECO may issue authorisation for the original cross member to be lowered or for an additional cross member (of the original type) to be fitted in a lower position. Figure 2.12 shows an example.

The installation of the new cross member in its new position must be carried out in the same manner as before, using the same type (diameter and class) of bolt.

Example of a towing crossmember reinforcement using a C-shaped section joined to the side member vertical web

Figure 2.12

1. Frame longitudinal member - 2. Low crossmember

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

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

Increasing the Towable Mass

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

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

These include possible reinforcements to the standard cross member (see Figure 2.12), the instructions for installing a reinforced cross member when available, and those on the brake system to be made.

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

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

Rating plates

Some countries require a plate to be fitted, near the towing device, giving the maximum permitted towable weight and vertical load. If not already fitted, this must be done by the Bodybuilder.

The body builder shall also take care that the above plate is properly fitted.
2.7 Installing a Supplementary Axle

Supplementary axles are not approved for use on the vehicle.

2.8 Modifying the Drive Line

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

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

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

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

2.8.1 Permitted lengths

The maximum operating lengths obtainable for both the intermediate shaft sections and the sliding shafts “LG” or “LZ” (see Figure 2.13) can be determined according to the external diameter of the tube existing on the vehicle and the maximum operating rotational speed (see formula). These are specified in Table 2.16.

For the propeller shaft length specified in Table 2.16, when the tube diameter is not sufficient, a new shaft section with the same characteristics as the existing shafts must be used. As an alternative, in some cases transmission shaft with a larger diameter tube can be used. The tube diameter required can be determined in compliance with the required length and the maximum rotational speed, directly from Table 2.16.

Figure 2.13

---

LZ  Intermediate sections
LG  Sliding sections
As far as sliding shafts are concerned, length “LG” is measured between the universal joint centres, with the sliding stub in the intermediate position. Always check both sections LG and LZ.

The maximum working revs can be obtained using the formula below:

\[ n_G = \frac{n_{\text{max}}}{i_G} \]

- \( n_G \) = maximum number of transmission shaft revs
- \( n_{\text{max}} \) = maximum number of engine revs, refer to Table 2.14
- \( i_G \) = gearbox ratio in the fastest gear, refer to Table 2.15

### Table 2.14 - Maximum number of engine revs

<table>
<thead>
<tr>
<th>Engine</th>
<th>Engine code (1)</th>
<th>( n_{\text{max}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>.10</td>
<td>F1AE0481F*A</td>
<td>3900</td>
</tr>
<tr>
<td>.10</td>
<td>F1AE0481F*B</td>
<td>3900</td>
</tr>
<tr>
<td>.11</td>
<td>F1AE0481U*A</td>
<td>3900</td>
</tr>
<tr>
<td>.11</td>
<td>F1AE0481U*B</td>
<td>3900</td>
</tr>
<tr>
<td>.12</td>
<td>F1AE0481G*A</td>
<td>3900</td>
</tr>
<tr>
<td>.12</td>
<td>F1AE0481G*B</td>
<td>3900</td>
</tr>
<tr>
<td>.13</td>
<td>F1AE0481V*A</td>
<td>3600</td>
</tr>
<tr>
<td>.13</td>
<td>F1AE0481V*B</td>
<td>3600</td>
</tr>
<tr>
<td>.14</td>
<td>F1AE0481H*A</td>
<td>3900</td>
</tr>
<tr>
<td>.14</td>
<td>F1AE0481H*B</td>
<td>3900</td>
</tr>
<tr>
<td>.15</td>
<td>F1CE0481F*A</td>
<td>3500</td>
</tr>
<tr>
<td>.15</td>
<td>F1CE0481F*B</td>
<td>3500</td>
</tr>
<tr>
<td>.14 EEV</td>
<td>F1CE3481L*C</td>
<td>3500</td>
</tr>
<tr>
<td>.18</td>
<td>F1CE0481H*A</td>
<td>3500</td>
</tr>
<tr>
<td>.18</td>
<td>F1CE0481H*B</td>
<td>3500</td>
</tr>
<tr>
<td>.17 EEV</td>
<td>F1CE3481C*C</td>
<td>3500</td>
</tr>
</tbody>
</table>

(1) = Check the engine code on the engine rating plate

### Table 2.15 - Gearbox ratio with the fastest gear

<table>
<thead>
<tr>
<th>Gearbox</th>
<th>( i_G )</th>
</tr>
</thead>
<tbody>
<tr>
<td>55300 - 2830.5</td>
<td>1</td>
</tr>
<tr>
<td>6AS400</td>
<td>0.8</td>
</tr>
<tr>
<td>6S400 - 2840.6</td>
<td>0.8</td>
</tr>
</tbody>
</table>

### Example of calculation of the maximum obtainable transmission length

Let us consider a 35C13 equipped with a ZF SS-300 gearbox. Let us assume you wish to use a propeller shaft LZ with an outer diameter of 76.2 mm.

From the data below:

1. \( n_{\text{max}} = 3600 \text{ rpm} \)
2. \( i_G = 0.8 \)

The following will be obtained:

\[ n_G = \frac{3600}{0.8} = 4500 \text{ rpm} \]

This value corresponds to a maximum obtainable length of 1,400 mm.

The universal joints on the same shaft should not be rotated.
The greater thickness of the tube depends on the class, i.e. on the torque that the original shaft has to transmit and on the design of the driveline (torque, ratios of kinematic chain, power axle load).

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

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

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

Table 2.16 - Obtainable propeller shaft characteristics

<table>
<thead>
<tr>
<th>Critical Transmission Speed</th>
<th>Pipe ( \Phi )</th>
<th>Maximum permitted rotating speed (rpm)</th>
<th>Distance between the LV joint centres (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1410</td>
<td>76.2 x 2.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1310</td>
<td>88.9 x 1.65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above obtainable maximum lengths refer to the original shafts. Shorter shafts (-10%) shall be provided for the sections resulting from the conversion.
### 2.8.2 Determining Driveshaft Positions

In the case of a drive line consisting of several sections, each shaft must be approximately the same length. As a general rule, the difference in length between an intermediate and a sliding shaft (see Figure 2.14) must not exceed 600 mm; while between two intermediate shafts the difference must be no greater than 400 mm. For sliding shafts there must be a margin of at least 20 mm between the minimum working length and the fully closed length.

Complying with the useful travel, position the static arrangement in an area as central as possible. When the required length of the drive line exceeds the permissible length, an additional driven shaft must be provided as illustrated in Figure 2.15.

**Figure 2.14**

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

The intermediate shaft and the inclination of the rear axle case must be aligned accurately under the vehicle's static load condition. The difference in their inclination relative to the engine-clutch-gearbox axis must not vary more than 1°. This may be achieved by placing a wedge between the rear axle case and the spring. The angle of the rear axle inclination must be within 4° and 6° (nominal 5°).
When the extension of the wheelbase is substantial, it may become necessary to fit a supplementary intermediate shaft as shown in Figure 2.15. In this case, the same inclination between engine-gearbox axis, second intermediate shaft and rear axle housing axis must be maintained in the vehicle's static load condition.

Figure 2.15


The elastic supports must be fitted with supporting plates at least 5 mm thick (see Figure 2.16) joined to cross members with similar specifications to the IVECO specifications.

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

Figure 2.16

The same holds true also for vehicles with separate gearbox. In addition to this, as a general rule, the wheelbase of such vehicles cannot be reduced beyond the measurement of the shorter wheelbase contemplated for standard production (dumpers for example).

The use of original drive line from IVECO is recommended for these modifications. Should this not be possible however, hardened steel tubes with a yield point of not less than 420 N/mm² (42 kg/mm²) may be used.

Modifications to the universal joints are not permitted.

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

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

2.9.1 Intake

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

Table 2.17 - Maximum back-pressure permitted at the intake and exhaust, at the rated engine speed and full load

<table>
<thead>
<tr>
<th>Engine</th>
<th>Engine Code</th>
<th>Back-pressure at the exhaust (kPa)</th>
<th>Minimum/maximum back-pressure at the intake (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.10</td>
<td>F1AE0481F*A</td>
<td>25</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.10</td>
<td>F1AE0481F*B</td>
<td>27</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.11</td>
<td>F1AE0481U*A</td>
<td>25</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.11</td>
<td>F1AE0481U*B</td>
<td>27</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.12</td>
<td>F1AE0481G*A</td>
<td>25</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.12</td>
<td>F1AE0481G*B</td>
<td>27</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.13</td>
<td>F1AE0481V*A</td>
<td>25</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.13</td>
<td>F1AE0481V*B</td>
<td>27</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.14</td>
<td>F1AE0481H*A</td>
<td>25</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.14</td>
<td>F1AE0481H*B</td>
<td>27</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.15</td>
<td>F1CE0481F*A</td>
<td>28</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.15</td>
<td>F1CE0481F*B</td>
<td>30</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.14 EEV</td>
<td>F1CE3481L*C</td>
<td>30</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.18</td>
<td>F1CE0481H*A</td>
<td>28</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.18</td>
<td>F1CE0481H*B</td>
<td>30</td>
<td>1.6 - 8.5</td>
</tr>
<tr>
<td>.17 EEV</td>
<td>F1CE3481C*C</td>
<td>30</td>
<td>1.6 - 8.5</td>
</tr>
</tbody>
</table>

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

2.9.2 Engine exhaust

Pipes must be laid as straight as possible, bend angles must not exceed 90° and radiiuses must be at least 2.5 times the outer diameter. Avoid constrictions and use effective cross-sections no smaller than the originals. Leave a big enough gap between the exhaust piping and the electric system, plastic piping, spare wheel (minimum 150 mm), plastic fuel tank (minimum 100 mm), etc. Lower values (e.g. 80 mm) may be approved if steel guard panels are used. Further reductions require the use of heat insulation or the replacement of plastic pipes with steel pipes. Modifications to the silencer body are not permitted and neither is it permitted to make changes to equipment (injection pump, regulator, injectors, etc.) that could impair efficient engine operation and affect exhaust gas emissions.
2.10 Modifications to the engine cooling and intake system

The proper functioning of the original system, especially in connection with the radiator, the free surface of the radiator and hoses (dimensions and layout) must not be tampered with.

In any case, should conversions have to be performed (ex: modifications to the cab) that require operations on the engine cooling system, bear in mind that:

- the intake compartment will have to be completely airtight, provided with rubber gaskets, which prevent the recirculation of hot air. The gaskets must be of a quality that enables them to support a constant temperature of 100°C with short periods at 120 °C without becoming deformed or suffering visible damage. The compartment must keep the air passage section effective during its whole route;
- the useful area for the passage of air for the cooling of the radiator must not be less than that which is available on vehicles with the standard cab. Maximum venting of air from the engine compartment must be ensured and care must be taken - possibly using shields or baffles - to avoid stagnant air pockets or back flow of air;
- the hot air must be able to exit;
- the performance of the fan must not be altered;
- if it is necessary to re-position the hoses this must be done without affecting the complete filling of the system (which must occur at a continuous flow, without forming blockages at the mouth) or the normal flow of water. The maximum stabilising temperature of the water must not be altered even under the most severe operating conditions;
- hoses must be located so that air pockets are not formed (i.e avoiding air traps and providing appropriate bleeding points) that could hinder the circulation of water. So, it is necessary to check that the water pump primes immediately on starting the engine and later operates with the engine idling (accelerate a few times, if necessary) even when the circuit is not pressurized. In addition to this check that the delivery pressure of the water pump, when the engine is running under no load and at maximum RPM, is not lower than 1 bar.

To check the operation of the cooling circuit, consider the supply, venting and circulation of water, proceeding as follows:

- open heating system feeding cocks and heater breathers;
- with engine off, top-up the water circuit with a constant flow of 8 - 10 l/min, and close the heater breathers once they are air-purged;
- start the engine and keep idling for 5 minutes; during this time, the water level in the supply tank must not fall below the minimum mark;
- gradually, rev up the engine, checking that the pressure on the water pump outlet pipe increases gradually and without pressure pulses;
- keep the engine revved up, until the thermostat opens, checking there are air bubbles passing through the transparent pipes installed between:
  - engine outlet and radiator;
  - filling reservoir and water pump;
  - engine deaerator and filling reservoir;
- check that there are no more bubbles in the circuit 15 minutes after opening the thermostat.
- with the thermostat on and the engine idling, the mean pressure in the water pump outlet pipe must be higher than 500 mm of water column.
2.11 Work on the Suspension

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

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

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

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

Modifications to suspensions are not permitted for vehicles equipped with ESP. See point 2.15.5.

Changing a Mechanical Suspension into a Pneumatic or Mixed Suspension

Modifications of this kind are generally permitted only for the rear axle. Possible solutions proposed by the Body Builders may be considered by IVECO upon submission of full documentation and installation drawings.

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

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

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

Changing the features of the rear spring (e.g., no. of leaves, spring rate etc.) requires adjusting the brake load apportioning valve so as not to alter the vehicle's braking performance. When work on the suspensions follows rather large changes in the permitted loads on the axle(s) or the total weight of the vehicle, it may be necessary to adapt the braking forces to permit compliance with the requirements for the brake regulations in force. The necessary instructions will be given on the documentation issued by IVECO.

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

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

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

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

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

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

Pneumatic spring protection

The bodywork should include a bulkhead separating the wheels from the pneumatic springs, so that these are protected against sand, mud or stones. The bulkhead will leave a free diameter of 350 mm around the spring and should allow easy access for inspection and maintenance operations for the pneumatic springs and other suspension components.
2.12 Heating/Air conditioning system modifications

2.12.1 Installation of a Supplementary Heating System

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

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

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

Furthermore:

- ensure correct operation of the vehicle components and equipment (i.e. cooling system);
- check the electrical system to ensure that the battery capacity and alternator output is sufficient for the higher current requirements (see point 2.16). Provide the new circuitry with a protection fuse;
- connect the intake of the newly added fuel system to the reservoir connected to the engine fuel return line. Direct feed from the vehicle fuel tank is permitted only if this is independent from the engine fuel system and the new circuit is perfectly leakproof;
- trace pipe and cable paths, the location of brackets and hoses bearing in mind that the overall dimensions and heat affect the various units on the chassis. Avoid runs and arrangements that could lead to hazards when the vehicle is running. Use shields or armouring if necessary.

The complete installation should be designed to ensure good accessibility for quick and easy servicing.

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

- special care must be taken when defining the connections between the supplementary equipment and the main one; refer to IVECO, if necessary; The added pipes must be made of brass or another alloy resistant to corrosion by the cooling liquid and the coupling sleeves must respect the requirements of IVECO Standard 18-0400;
- determine a rational arrangement for piping, avoid neckings and siphonings;
- install proper venting valve (bleeding points) to ensure proper filling of the system;
- ensure that the circuit may be fully drained by providing additional plugs if necessary;
- proper insulation should be used to prevent heat dissipation.

b) When air heaters are used and when the installation is to be made directly in the cab, make sure that the engine exhaust system does not touch the added installation (to prevent combustion gas circulation inside the vehicle) and have the correct warm air distribution by avoiding direct air flows.
2.12.2 Installing an Air-Conditioning System

When the installation of an air conditioning system is deemed necessary, it is advisable to use the types recommended by IVECO. If this procedure is not applicable, the installation must be carried out in accordance with the supplier's instructions and the following points:

- the installation must not interfere with the correct operation of the vehicle components and of equipment which may be connected with the installation;
- check the electrical system to ensure that the battery capacity and alternator output is sufficient for the higher current requirements (see point 2.16.3). Provide the new circuitry with a protection fuse;
- in liaison with IVECO, establish a method for installing the compressor; if it is fitted to the engine, use the original IVECO compressor;
- trace pipe and cable paths, the location of brackets and hoses bearing in mind that the overall dimensions and heat affect the various units on the chassis.
  Avoid runs and arrangements that could lead to hazards when the vehicle is running. Use shields or armouring if necessary;
- the complete installation should be designed to ensure good accessibility for quick and easy servicing. At vehicle delivery, the Bodybuilder will supply all service and maintenance instructions which are deemed necessary.

Furthermore, according to the system operations:

a) equipment installed inside the cab:

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

b) equipment fitted on the cab roof:

- when the equipment (condenser, evaporator, blower) is fitted on the cab roof, make sure that its mass is not higher than that permitted for roof installation. Furthermore, the Bodybuilder should provide for proper reinforcement to the roof frame if necessary, in relation to the mass of the unit and the extent of the modification introduced;
- for specific applications with compressors not supplied by IVECO (e.g. fridge box), contact the IVECO offices in charge.
2.13 Operations on panels

2.13.1 General Specifications

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

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

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

Controls and equipment (power take-off engagement control, external operating cylinder control etc.) may be fitted in the cab provided that:
- they are positioned, properly and are easily accessible to the driver;
- safety, control and warning devices are fitted which meet the requirements of use and safety of the vehicle and its equipment as well as the requirements of national legislation.

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

Provide the necessary protection from corrosion for all modifications to the structure (see point 2.2).

When the body is cut and untreated panels are welded, in order to prevent the joints rusting, we suggest using panels that are galvanised on both surfaces (I.S. 18-1317 class ZNT/F/10/2S or I.S. 18-1318 class ZNT/10/2S) and have also undergone a surface protection cycle.

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

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

The Bodybuilder must check that the body still complies with regulatory requirements both inside and outside after the operation.
2.13.2 **Roof Panel Modifications**

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

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

Proceed as follows if an opening must be made:
- the connection radii are not less than 50 mm;
- do not modify any ribs that may be present;
- do not change the curvature of the roof.

**Fitting a spoiler**

Versions produced by IVECO are available as an option. It is advisable to use such products because they are appropriately designed and checked.

When fitting a spoiler other than the previous versions, observe the specific guidelines supplied by the Manufacturer.

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

**Modifications to the roof panel and the cab rear wall**

In the event that the rear wall has to be fully removed - and the roof panel partially removed (e.g., motor caravans), the operation must be carried out in accordance with the instructions below:
- make the cut as illustrated in Figure 2.17, taking care to comply with the minimum joining radii indicated. Remove the structure for the rear cross member at the level of the roof assembly. In order for the upper mounts of the seat belts to remain effective, it is necessary to restore the resistance with a suitable structure capable of ensuring the pillars will not deform. For this a structure with compression strength of at least 800daN must be fitted;
- make the connection with the new structure by following the general instructions previously specified.
Figure 2.17

2.13.3 Van and combi bodywork modifications

Fitting roof rails

Roof rails must only be used on the “low roof” or the “medium roof” vans and must only be fitted using the specially designed fixings provided on the roof panel for this purpose (see figures) using the following guidelines.
- the fixing element must include the anchoring device, by ensuring the necessary resistance to the longitudinal and transverse forces. A total of 3+3 fixings are provided for all the wheelbases;
- in order to guarantee good stability when cornering, the total value of 150 kg must not be exceeded;
- the weight permitted for each fastener shall not exceed 25 kg.

Table 2.18

<table>
<thead>
<tr>
<th>Dimensions (mm)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Van, wheelbase: 3000, low roof - short overhang</td>
<td>1760</td>
<td>754</td>
<td>932</td>
<td>1548</td>
<td>1548</td>
<td>1548</td>
</tr>
<tr>
<td>Van, wheelbase: 3000, low roof - long overhang</td>
<td>1760</td>
<td>954</td>
<td>932</td>
<td>1548</td>
<td>1548</td>
<td>1548</td>
</tr>
<tr>
<td>Van, wheelbase: 3000, medium-height roof - short overhang</td>
<td>1895</td>
<td>734</td>
<td>932</td>
<td>1229</td>
<td>1229</td>
<td>1229</td>
</tr>
<tr>
<td>Van, wheelbase: 3000, medium-height roof - long overhang</td>
<td>1895</td>
<td>734</td>
<td>932</td>
<td>1229</td>
<td>1229</td>
<td>1229</td>
</tr>
<tr>
<td>Van, wheelbase: 3300, medium-height roof</td>
<td>2549</td>
<td>1082</td>
<td>935</td>
<td>1229</td>
<td>1229</td>
<td>1229</td>
</tr>
<tr>
<td>Van, wheelbase: 3950, medium-height roof</td>
<td>2769</td>
<td>1512</td>
<td>1315</td>
<td>1229</td>
<td>1229</td>
<td>1229</td>
</tr>
</tbody>
</table>
Modifications to the roof panel

a. Fitting a translucent roof

The translucent roof option is available direct from the factory. This should be specified whenever possible. Vehicles that have already been built, the modification is possible by proceeding as follows, taking the necessary precautions.

- Procure the following components from the Spare Parts department:

<table>
<thead>
<tr>
<th>Component</th>
<th>Part number</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Translucent roof</td>
<td>500360077</td>
<td>1</td>
</tr>
<tr>
<td>Crosspiece</td>
<td>500360079</td>
<td>2</td>
</tr>
<tr>
<td>Support</td>
<td>500360089</td>
<td>2</td>
</tr>
</tbody>
</table>

- Identify the area for cutting; one possible solution is illustrated in the diagram below:

Figure 2.19

- Leave approximately 25 mm of the original roof joint area (see Figure 2.19);

- Weld (using the most convenient, efficient and safest method) the four roof support crossmembers to the remaining part of the roof using the 25 mm that was left for this purpose when the roof was cut;

- Glue the translucent roof (500360077), by placing it down from above, on to the roof support crossmembers in place using suitable gluing compounds (e.g. Betafil, Gurit, Essex, etc.) taking care to ensure the complete joint is waterproof.
b. Fitting a trap door

A hatch may be applied to the roof, provided that the operation does not affect the hoops and the construction guarantees the watertightness and strength of the modified part. Figure 2.20 illustrates an example of installation.

Figure 2.20
c. Modifying the roof panel height

There are three internal heights of the roof panel available:
- low roof = 1595 mm
- medium roof = 1900 mm
- high roof = 2300 mm

Adjusting the roof height once the vehicle has come off the production line is a highly demanding and costly operation. Moreover, it is restricted to the medium-height and high roof versions which have the same roof structures.

Figure 2.21 shows the arrangement for the two versions: where it is possible to see that the roof panel is a one-piece structure.

The Bodybuilder will need to make a side panel framework with suitable modification to the roof hoops to permit correct connection with the original roof panel.
d. Making side windows

Making windows on vans involves following the specific precautions and measures shown below.

The sheet metal must be cut as shown in Figure 2.22, taking care to maintain a circumferential profile with a minimum width of:
- 15 mm (in case of windows secured with a rubber seal);
- 20 ± 25 mm (in case of windows secured by gluing).

An internal supporting structure must be made (see to Figure 2.22), in order to ensure the necessary strength. The connection must be made as shown in the figure.

Remove the pillar in the area of the windows provide an adequate reinforcement to the base node.

Figure 2.22
e. **Internal shelves**

The shelves shall be made and arranged in such a way that they are sufficiently stiff and are self-supporting. The bottom support must be supported by the floor framework (cross members and longitudinal sections) and be made so as to distribute the load evenly. The fixing to the side structure must be made without creating any effects of pre-loading and may involve:
- the boxed uprights, where there are already holes;
- the top connecting rails.

f. **Work on the structure and floor**

Observe the guidelines and precautions given above, and in particular:
- when drilling the box sections avoid areas where there is a higher concentration of stresses;
- the holes for fixing to the floor will need to be protected and sealed against ingress of water, dust and exhaust gas.

**Figure 2.23**

**NOTE**  
**Special Conversions:**  
*When working on the bodies of vehicles with torsion bar front suspension, access must be provided to the vehicle ride setting adjustment device.*
2.13.4 Crew Cabs

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

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

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

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

Take particular care when preparing the surface of the elements to be welded by applying a zinc primer, taking the necessary precautions to ensure that the primed surface is properly prepared for subsequent painting (see point 2.2).

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

When working out a suitable cab suspension system, the following points must be observed:
- the cab’s attitude, designed for the standard vehicle, must not be altered;
- the weight of the added cab section must not affect the standard cab or rest on its suspension;
- ensure normal oscillation of the cab along the vertical, longitudinal and transverse plane.

When modifications are made to the cab, such components as the air intake and filter may be affected. The use of original elements, previously provided for similar body versions, may represent a good solution and make it possible to comply with the law regulations.

---

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

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

Any modification to these components may jeopardize the safety of the passengers and compliance with legal requirements.

Airbag/Window bag

No modifications, operations or component installations must be carried out in areas that could inhibit the correct operation of the airbag.

This category includes:
- changes to the front structure of the vehicle, to the floorpans, to the bulkhead, to the side panels and to the dashboard fastening points;
- alterations to the control unit installation area (positioned under the floor between the front seats), to the points involved in the sensor system and the associated wiring;
- installation of components close to the opening in the dashboard for the airbag;
- changes to the steering column;
- replacement or installation of seats with an H point other than the original.

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

NOTE With an airbag is fitted on the passenger’s side, observe all legal requirements for installing and using children’s safety seats.

The auxiliary circuits shall be separated and protected, by means of a special fuse, from the vehicle’s main circuit.

Anchoring safety belts

Any work carried out in the areas of the seat belt fixing points may affect their compliance with EC certification.

The company carrying out the work must verify compliance with all legal requirements in force.

Seats

The seats have been fixed to the floor structure in compliance with legal requirements on locking systems.

Moving or fitting additional seats requires making suitable fixing areas in the structure under the floor, similar to the IVECO installation, in order to ensure compliance with the legal requirements.
2.14 Changing the Size of the Tyres

Replacing the tyres with others of different sizes or with a different loading capacity with respect to those considered at the time of vehicle type-approval must be approved by IVECO and it is also necessary to check for the need to reprogram the EBL or EBS system. Changing the size of the tyres may involve replacing the wheels with others of a correspondingly greater loading capacity. In this case check whether the spare wheel carrier needs to be changed. Mounting tyres of different sizes or types of construction on the same axle is prohibited. Changing the size of the tyres may affect the ground clearance of the rear underrun guard, therefore the compliance with the national legal requirements must be verified. Its supporting brackets, where necessary, may be replaced with other appropriate, type-approved brackets. See point 2.19.

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

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

Replacing the tyres with others having a different external diameter influences the vehicle performance (e.g. speed, max. negotiable gradient, pulling force, braking capacity, etc.); therefore the Body-computer (which comprises the speedometer, tachograph and speed limiter) must be recalibrated by an authorised workshop.

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

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

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

If it is necessary to disassemble the wheels when fitting out the vehicle, when they are remounted it is necessary to ensure that the contact surface between rim and coupling flange is clean and corrosion-free. Furthermore, the tightening torques according to the in-house IVECO standards must be guaranteed (see next table).

<table>
<thead>
<tr>
<th>N.</th>
<th>Description</th>
<th>Thread</th>
<th>CLASS</th>
<th>Torque [Nm]</th>
<th>SPECIFICATIONS &quot;S&quot; *</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Front and rear wheel fastening (29L-35S)</td>
<td>Stud M14</td>
<td>II</td>
<td>144</td>
<td>176</td>
</tr>
<tr>
<td>2</td>
<td>Front and rear wheel fastening (35C-50C)</td>
<td>Nut M18x1.5</td>
<td>II</td>
<td>290</td>
<td>350</td>
</tr>
<tr>
<td>3</td>
<td>Front and rear wheel fastening (60C-65C-70C)</td>
<td>Nut M18x1.5</td>
<td>II</td>
<td>290</td>
<td>350</td>
</tr>
</tbody>
</table>

* specification "S": safety tightening (see IVECO Standard: 19-0405)

When brackets are used to fasten decorative studs positioned between rim/nut or bolt or if the rims used are thicker than the original rim, the geometric function of the fastening must be ensured with appropriate thread lengths.
2.15 Modifications to the Braking System

2.15.1 General remarks

The braking system and components are very important for driving safety and vehicle use. No changes may be made to the following parts: brake cylinders and callipers, adjustment units and valves, parking brake, brake control and auxiliary systems.

Any modification to the braking system requires authorisation from IVECO.

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

2.15.2 Brake pipes

Pipes must not be welded for any reason whatsoever.

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

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

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

Metal pipes

For the hydraulic system pipes, any additions and replacements must be as follows:
- for materials, dimensions, couplings : ISO 4038 standard
- bending radii (referred to the pipe centre line $\phi = 4.76$ mm) : min. 25 mm
- tightening torque:
  - rigid pipes, M10x1 and M12x1 fittings : $12 \div 16$ Nm
  - flexible pipes, M10x1 male fittings : $17 \div 20$ Nm
Plastic Pipes

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

When replacing pipes, plastic must not be used in the following:

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

During modification the following must be observed:

- material and dimensions Standard DIN 73378 and 74324 (max. operating pressure 11 bars)
- bend Radii min. 6 outer diameter (referred to the pipe centreline)

Preparation and installation

Cut the pipe at right angles (max. permissible variation 15°) using the correct tools to avoid defects that might affect the sealing of the pipe.

To ensure the pipe is correctly fitted into the connector mark the section of the pipe L (see Figure 2.24) that is to be inserted in the connector with indelible ink or adhesive tape. Push the pipe into the connector until the mark is level with the connector to ensure a perfect seal. Mark the pipe in order to avoid assembly mistakes during subsequent operations.

Figure 2.24

<table>
<thead>
<tr>
<th>d mm</th>
<th>L mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>19.5</td>
</tr>
<tr>
<td>6</td>
<td>19.5</td>
</tr>
<tr>
<td>8</td>
<td>20.5</td>
</tr>
</tbody>
</table>
As a rule quick coupling connectors should be used. We recommend that the same makes used on the original vehicle is used. When necessary (e.g. near bends), connectors with metal inserts should be used. Before inserting the pipe into the connector the latter must be screwed into its threaded seat on the component (e.g. pneumatic valve) using the tightening torques shown below.

<table>
<thead>
<tr>
<th>Thread</th>
<th>Tightening torque (Nm ± 10%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 8 x 1 mm</td>
<td>5</td>
</tr>
<tr>
<td>M 12 x 1.5 mm</td>
<td>24</td>
</tr>
<tr>
<td>M 14 x 1.5 mm</td>
<td>28</td>
</tr>
</tbody>
</table>

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

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

In the event that a pipe needs replacing new fittings must be used, fittings must not be reused.

2.15.3 Fitting pipes on the vehicle

New pipes must be thoroughly cleaned inside before use (e.g. by blowing through with compressed air). Pipes shall be secured into their correct positions and the fasteners must fully wrap the pipes: they may be made either of metal, with rubber/plastic protections, or plastic.

Figure 2.25 illustrates two examples of brackets complete with retaining clips, used to secure the brake pipes along the chassis.

![Figure 2.25](image-url)
When a pipe has to pass through the chassis frame (sidemember or cross members), appropriate precautions must be taken to avoid damage.

Observe adequate distances between the various fixing elements. As a rule the maximum distance of 500 mm should be considered. For plastic pipes, in order to prevent distortion and tension on the connectors when fitting them, take the necessary precautions when arranging the pipe runs and fitting the fixing brackets or clips onto the chassis. Correct fitting of the fixing elements will ensure that the pipes do not rub against the fixed parts of the chassis.

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

---

**After completing any work either on the system or on the equipment, the air must be bleed from the system correctly, following the instructions given below. The braking system must then be checked for correct operation and efficiency.**

---

**Manually bleeding air from the hydraulic brake system**

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

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

---

**The fluid discharged from the hydraulic circuit during the bleed operation must not be used again.**

Top up using only new fluid of the prescribed type, contained in original, sealed containers that should only be opened when using the fluid.
Bleed air from the hydraulic braking system using MODUS or E.A.SY. on vehicles with ABS/ABD/EBD

On vehicles equipped with ABS/ABD/EBD systems, the traditional, manual bleeding operation described above may not be sufficient. The presence of air causes the brake pedal stroke to be longer, with possible uncharacteristic operation of the system. Manual operations must be carried out, which will be driven by the program in “MODUS” or “E.A.SY.”. This program makes it possible to perform full drain (primary circuit and secondary circuit of the modulator) under item “System filling / emptying”.

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

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

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

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

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

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

**Warning**

Great care must be taken, when carrying out the work, to make sure the correct connection of the pipes are made to each wheel. After every modification carry out the necessary checks and tests for correct operation at the Authorized Workshops equipped with the specific equipment.
2.15.4 Instructions for adjusting the braking load proportioning valve

Load proportioning valve version

Two types of proportioning valve are used (not fitted on the models with ABS):
- dual circuit (crossed) version for vehicles with single rear wheels (models 29L and 35S);
- single circuit version for vehicles with twin rear wheels.

Load proportioning valve adjustment

This adjustment is made on each vehicle in the factory. It permits loading the vehicle or fitting standard bodies in compliance with the deceleration and road holding characteristic required by the relevant EC Directives. The adjustment and control data are given on the appropriate rating plate, whose location on the vehicle is given in the specific literature. Should it become necessary to adjust the braking load proportioning valve, this can be done following the instructions given below (see Figure 2.26).

NOTE When replacement rear springs have been fitted it is necessary for the rear suspension to settle properly.

To set the valve correctly the suspension must be settled in before making any adjustments to the valve. Load the vehicle partially (approximately 2/3 of its maximum weight) and make a few runs over a rough surface, braking a number of times while travelling forwards and while reversing.

- Connect the pressure gauges 1 and 2 to the pressure test points 3 upstream and downstream of the braking load proportioning valve.
- Loosen the clamping screw 8 of the proportioning valve adjustment lever 7.
- Apply the adjustment load, specific to each model and rear spring, to hole 9, after loading the drive axle in accordance with the prescribed reference value. Check the specific values in the IVECO workshop manuals. A few examples are shown in the following table:

<table>
<thead>
<tr>
<th>Models</th>
<th>Rear leaf spring type (part. no.)</th>
<th>Load on adjustment lever (kg)</th>
<th>Reference ground load on rear axle (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>29L - 35S</td>
<td>single-leaf (504054606 - ...)</td>
<td>1.5</td>
<td>1500</td>
</tr>
<tr>
<td>35C</td>
<td>semi-elliptical (504048792 - ...)</td>
<td>3.5</td>
<td>1500</td>
</tr>
</tbody>
</table>

- Tighten the clamping screw 8 to the prescribed torque of 16 ÷ 19 Nm.
- Press the brake pedal until the control pressure of 100 bar is obtained in the circuit upstream the corrector.
- Verify that the output pressure corresponds to the value shown on the load proportioning valve plate, corresponding to the weight at ground of the rear axle.
Figure 2.26

The example shows the single-circuit braking load apportioning valve of the 35C model

Figure 2.27

An example of a load apportioning plate for a 35C vehicle

 Modifications to the Braking System

Printed 603.95.037 Base – 02/2010
2.15.5 ESP (Electronic Stability Control)

ESP is an electronic function that contributes to vehicle active safety. It controls the lateral dynamics and stability by means of the components indicated in Fig. 2.28 and in particular by means of an electrohydraulic modulator that acts individually on the braking action of each wheel (or wheel pair in the case of paired wheels).

Figure 2.28


The following parameters are important for the correct programming of the control unit governing the ESP function (they are also essential for the product grid).

- wheelbase
- GVW
- suspension type

Any changes in these parameters to switch from one value to another of those present in the product grid does not require approval but will involve reprogramming the control unit by means of Teleservice.

Any change that results in values NOT present in the product grid will lead to a downgrade in the ESP system.

NOTE Reprogramming or downgrading of the ESP system will require adjustment of the electronic management software. This operation must be carried out exclusively by the IVECO assistance service.
Downgrading of the ESP system

Downgrading of the ESP system leads to complete the activation of the vehicle stability control, which means that the driver will no longer receive steering assistance from the system.

Even though the stability control has been deactivated, the following functions will remain active:
- ABS (Antilock Braking System)
- EBD (Electronic Brake Force Distribution)
- ASR (Anti Slip Regulator)
- MSR (Motor Schleppmomenten Regelung)
- HBA (Hydraulic Brake Assist)
- LAC (Adaptive Load Control)
- Hill Holder

2.15.5.1 Converting from truck to tractor unit

Conversion from a truck to the tractor unit must be authorised by IVECO and is not compatible with the presence of the ESP system. If authorisation for the conversion is granted, it is therefore obligatory to downgrade the ESP system.

Downgrading of the ESP system leads to complete the activation of the vehicle stability control, which means that the driver will no longer receive steering assistance from the system.

2.15.5.2 Converting from van to truck

The conversion from van to truck must be authorised by IVECO and is not compatible with the presence of the ESP system. If the authorisation for conversion is granted, it is therefore obligatory to downgrade the ESP system.

Downgrading of the ESP system leads to complete the activation of the vehicle stability control, which means that the driver will no longer receive steering assistance from the system.
2.15.5.3 Change in Gross Vehicle Weight

Changing the vehicle GVW is compatible with the presence of the ESP system only in certain specific cases and must therefore be subject to IVECO authorisation in all cases.

If compatibility is present, it is necessary to update the system management software while downgrading is essential in all other cases. Updating or downgrading are the exclusive responsibility of the IVECO Assistance Service.

2.15.5.4 Wheelbase change

a) Change to values that are not included in the product grid

If the conversion leads to a wheelbase value that does not correspond to any of the values in production for the specific vehicle model, it is essential to downgrade the ESP system management software.

Downgrading of the ESP system leads to complete the activation of the vehicle stability control, which means that the driver will no longer receive steering assistance from the system.

b) Change to values that are included in the product grid

If the conversion leads to a wheelbase value that is included amongst those in production for the specific vehicle model, it is essential to update the ESP system management software.
2.15.5.5 Changing or replacing the suspension system

Total replacement of the suspension assembly is permitted, however, if a replacement unit is chosen that has already been approved by IVECO for the specific vehicle model. It is also possible to replace the air suspension with mechanical suspension units (and vice versa) in this case, provided units that are already type-approved of the specific vehicle model are used. The above operations may be carried out following authorisation by IVECO and require the update of the electronic control units, to be assessed on a case-by-case basis.

2.15.5.6 Changing or replacing the stabiliser bars

Changing or replacement of the stabiliser bars is not compatible with the presence of an ESP system. If the authorisation for conversion is granted, it is therefore obligatory to downgrade the ESP system.

Downgrading of the ESP system leads to complete the activation of the vehicle stability control, which means that the driver will no longer receive steering assistance from the system.

2.15.5.7 Changing tyres

See paragraph 2.14

It is prohibited to change the tyre specifications, unless they have been type-approved by IVECO.
Downgrading of the ESP system leads to complete the activation of the vehicle stability control, which means that the driver will no longer receive steering assistance from the system.

### 2.15.5.8 Installation and removal of retarders

All types of retarders exercise a braking action on the vehicle rear wheels, altering certain parameters controlled by the ESP system.

a) Installation of an electronic retarder is permitted, following authorisation by IVECO, provided it does not interface with the vehicle via the CAN network.

This modification nevertheless requires the ESP system management software to be downgraded.

b) Installation of an electric retarder that interfaces with the vehicle through the CAN network is never permitted under aftermarket circumstances because of its great impact on the operation of the software of the various control units. Technically, this type of retarder may nevertheless be present on the vehicle if it is ordered as original equipment (opt. 8653).

c) Removal of any type of retarder requires an update of the vehicle electronic control unit through the intervention of the IVECO assistance service.

The following conversions are not permitted

- Modification of ESP control unit configuration parameters;
- Change in engine characteristic data;
- Modification in the installation of steering angle, yaw and acceleration sensors;
- Modification and/or application of superstructures that could lead to load distributions not compliant with those specified in Section I - chapter 1.13;
- Modification of steering kinematic ratio.
2.16 Electrical System: Modifications and Drawing-Off Power

General Information

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

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

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

Specific connection points have been provided for additional systems to ensure effective, correct use of the electrical system by Body Builders. This condition is necessary to rule out any adaptions of the basic design in order to ensure operational integrity and thus maintenance of the vehicle warranty.

NOTE For greater details on the vehicle’s electrical system, see the specific Workshop Manual, publication no. 603.95.041 (Daily MY2009).

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

Precautions

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

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 100 mm (reference value = 150 mm) from sources of high heat (turbine, engine, 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 fitting additional equipment, where necessary, diodes must be fitted to provide protection against any induction current peaks.

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

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

Additional equipment should be connected to the system earth with the utmost care (see point 2.16.1). The relative wiring must not be fitted alongside the existing electronic circuits in order to avoid electromagnetic interference.

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

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.

If starting using auxiliary methods, this must be carried out only using an external battery trolley in accordance with 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 2.45 paragraph 2.16.4);
- 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 by 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.
2.16.1 Earth points

Concept of ground

The electric system is traditionally a single-pole system. The body, the frame, the metal container of electromechanical components act as equipotential return conductor to the generator, as any point of their metal structure or any negative terminal not isolated is at the same reference potential or GROUND. This is why the ground has been chosen as reference to the whole system, conventionally giving it the value of zero.

Due to obvious reasons of construction, in the negative network of the system there are various ground points located on the vehicle in relation to the location of the components on the frame, engine and body.

On the other hand, ideally, all the equipment should be connected to only one ground point in order to provide them, particularly for electronic devices, a clearly defined ground reference.

For the above-mentioned reasons it is necessary to distinguish the supply ground or system earth, characterised by strong direct current intensity (> 1 A for electromechanical components), from the analogue ground, characterised by wave shapes at determinate frequencies and very low current intensity (mA, μA) of electronic systems.

The definition of signal ground or analogue ground depends on the sensitivity of the electronic systems to EMC (electromagnetic compatibility), as parasite signals emitted by the systems on board or outside the vehicle, induce failures and/or deterioration of the systems themselves. The best solution for a signal ground is connection with the battery negative terminal.

In order to minimise both continuous and transient disturbance or interference generated by parasite radiation, it is of the utmost importance to always bear in mind that the satisfactory efficiency of the reference plane or system earth depends on the excellent conductivity characteristics (contact resistance tending towards zero) in each of its connection points.

Briefly, we can say that the earth understood as equipotential electrical conductor, i.e. as potential reference for all the electric/electronic components on board, is subdivided into system ground and analogue ground.

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.

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

Figure 2.29

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 2.30

POSITION OF EARTH POINTS ON VEHICLE

Figure 2.31

m = power grounds
ms = signal grounds

m2. Left frame rail engine compartment earth
Figure 2.32

m3 + ms3. Engine compartment earth beneath brake servo

Figure 2.33

m4. Engine compartment earth near right front light
Figure 2.34
m5. Engine compartment earth near left front light

Figure 2.35
m6 + ms6, m7 + ms7. Internal cab earth on dashboard, on central body and under the tachograph
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 2.36**

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

Metal-braid screening of a cable to an electronic component
2.16.2 Electromagnetic compatibility

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

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

- 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 performing main functions (not impacting on direct vehicle control), for frequencies varying from 20 MHz to 2 GHz.

The maximum permitted range for transient voltage with devices powered at 12 V is +60 V measured at the terminals of the artificial network (L.I.S.N.) when tested at the bench. Otherwise, if the test is conducted on the vehicle, the range must be measured at the most accessible point near the interference device.

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

They must operate correctly during voltage lowering phases to 5 V for 40 mS and to 0 V for 2ms. 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>
<thead>
<tr>
<th>Type of emission</th>
<th>Type of transducer</th>
<th>Type of disturbance</th>
<th>Frequency range and limits acceptable by noise in dB_{μ}V/m</th>
<th>Unit of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>radiated</td>
<td>Aerial at a distance of 1 metre</td>
<td>Broadband Nearly peak</td>
<td>63 54 35 35 24 24 24 31 37</td>
<td>dB_{μ}V/m</td>
</tr>
<tr>
<td>radiated</td>
<td>Broadband Peak</td>
<td>76 67 48 48 37 37 37 44 50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>radiated</td>
<td>Narrow-band Peak</td>
<td>41 34 34 34 24 30 24 31 37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>conducted</td>
<td>L.I.S.N. 50 Ω 5 µH 0.11 µF</td>
<td>Broadband Nearly peak</td>
<td>80 66 52 52 36 36</td>
<td>Not applicable</td>
</tr>
<tr>
<td>conducted</td>
<td>Broadband Peak</td>
<td>93 79 65 65 49 49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>conducted</td>
<td>Narrow-band Peak</td>
<td>70 50 45 40 30 36</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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). If in any doubt, call the IVECO Service Network.
The following is an example of the type of marking specified by the current European directive governing electromagnetic compatibility in the automotive industry:

Figure 2.37

If in any doubt, call the IVECO Service Network.

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

In case of systems which use the primary or secondary civil electric network (220 V AC) as a supply source, the relevant characteristics have to comply with the IEC regulations.

**Two-way radio systems**

The most frequent applications include:

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

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

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

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

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

These units must be type-approved according to the applicable legal requirements and must be of the fixed type (non portable) type. The use of non type-approved receiver-transmitter units or supplementary amplifiers might affect the correct operation of standard on-board electrical/electronic devices, with adverse effects on vehicle and/or driver safety.
Amateur equipment for CB and 2 m band.

The installation of CB (27 MHz) and 2m (144 MHz) sets must use the power system provided on the vehicle. The connection is made to terminal 30. Such devices must be legally type-approved and fixed (not portable). Insert the transmitting part in an area separated from the vehicle's electronic components.

The antenna must be installed outside the vehicle, possibly on a large metallic base as vertically as possible with the connection wire leading downwards. Follow the instructions and the manufacturer's warnings for assembly (see Figure 2.38).

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

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

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

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

The best position to install the aerial is the centre of the roof because the earth plane is proportional in all directions, while installation on a side or any other part of the vehicle makes the earth plane proportional to the vehicle mass.

Cables involved in the installations should be connected and positioned taking care to:
- use a top-quality, low-loss coaxial antenna cable with the same impedance as the transmitter and the antenna. (see Figure 2.39);
- the coaxial cable run must be at a suitable distance (minimum 50 mm) from pre-existing wiring (TV, radio, telephone, amplifiers and other electronic devices) to prevent interference and malfunctioning. Ensure the minimum distance from the metallic structure of the cab. Cable installation on the left or right-hand side is preferable;
- clean the lower part of the hole made in the body for installing the antenna in fixed position so that the antenna support is perfectly connected to the vehicle earth;
- the coaxial cable connecting the antenna to the radio must be fitted with the utmost care. Avoid curves or bends which can pinch or distort the cable. Avoid tangling. Shorten the wire as much as possible. Remember that any imperfections in the coaxial cable will cause severe interference for the radio transmitter.
- use existing holes for routing the cable. Take all the necessary precautions for protecting the body if additional hole have to be drilled (use anti-rust paint, sheath, etc.);
- ensure a good connection with the vehicle earth both at the base of the antenna and at the device fixing to ensure maximum power transfer.

Radio transmitters are typically fitted on the dashboard in the gear lever area or in the header rail above the driver (see Figure 2.40).

**Figure 2.38**

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

**Figure 2.39**

Two-way systems for Mobile Phones

Cellular telephone systems must be installed using the power system provided in the vehicle. Connect to the Body Builders' connector via a supplementary fuse.

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

- The SWR must be as close as possible to one. The recommended value is 1.5, while the maximum acceptable value must not in any case be greater than 2.

- The AERIAL GAIN values must be as high as possible and ensure sufficient spatial uniformity, normally with deviations from the average value in the order of 1.5 dB in the 870-960 MHz band and 2 dB in the 1710 – 2000 MHz band.

- The RADIATED CAB FIELD value must be as low as possible. We suggest < 1 V/m as a quality target. In any case, the value must not exceed limits imposed by current European guidelines.

- For this reason, the aerial must always be placed on the outside of the vehicle cab, if possible on a broad metal base fitted as upright as possible with the connection lead facing downwards, observing the Manufacturer's installation instructions and warnings.

An optimum aerial position is the front of the cab roof at not less than 30 cm from the other aerials.
Follow the precautions below when connecting and arranging the wires:
- use a top quality cable particularly as concerned to the protective shielding;
- the cable route must be at a suitable distance (minimum 50 mm) from pre-existing wiring. Ensure the minimum distance from the metallic structure of the cab. Avoid excessively pulling or pinching the cable. Installation on the left or right-hand side is preferable;
- never shorten or extend the coaxial antenna cable;
- use existing holes for routing the cable. Take all the necessary precautions for protecting the body if additional hole have to be drilled (use anti-rust paint, sheath, etc.);
- ensure a good connection with the vehicle earth both on the base of the antenna and at the device fixing to ensure maximum power transfer.

Cellular telephones are typically fitted on the dashboard in gear lever area or in the header rail above the driver.

**GPS antenna cable and navigation system installation**

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

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

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

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

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

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

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

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

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

Follow the precautions below when connecting and arranging the wires:
- use a top quality cable particularly concerning the protective shielding;
- the wire course must be at a suitable distance (minimum 50 mm) from pre-existing wiring. Ensure the minimum distance from the metallic structure of the cab. Avoid excessively pulling or pinching the cable. Installation on the left or right-hand side is preferable;
- never shorted or extend the coaxial antenna cable;
- use existing holes for routing the cable. Take all the necessary precautions for protecting the body if additional holes have to be drilled (use anti-rust paint, sheath, etc.);
- ensure a good connection with the vehicle earth both on the base of the antenna and at the device fixing to ensure maximum power transfer.

Navigation systems must be installed using the power system provided in the vehicle. Connect to the Body Builders, connector via a supplementary fuse.

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

The radio comes in two configurations:
- with CD player
- with CD+ MP3 player

The IVECO radio is built into the system on CAN network and allows:
- message repetition to comfort control panel
- volume adjustment according to vehicle speed
- integration with Convergence V2 system
- recognition/antitheft system with body computer

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

Figure 2.41

<table>
<thead>
<tr>
<th>Box pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>CAN-B (CAN-H)</td>
</tr>
<tr>
<td>A2</td>
<td>NC</td>
</tr>
<tr>
<td>A3</td>
<td>CAN-A (CAN-L)</td>
</tr>
<tr>
<td>A4</td>
<td>Permanent 12V (KL 30)</td>
</tr>
<tr>
<td>A5</td>
<td>Automatic Antenna</td>
</tr>
<tr>
<td>A6</td>
<td>NC</td>
</tr>
<tr>
<td>A7</td>
<td>NC</td>
</tr>
<tr>
<td>A8</td>
<td>GND (KL31)</td>
</tr>
<tr>
<td>B1</td>
<td>LS RR +</td>
</tr>
<tr>
<td>B2</td>
<td>LS RR -</td>
</tr>
<tr>
<td>B3</td>
<td>LS RF +</td>
</tr>
<tr>
<td>B4</td>
<td>LS RF -</td>
</tr>
<tr>
<td>B5</td>
<td>LS LF +</td>
</tr>
<tr>
<td>B6</td>
<td>LS LF -</td>
</tr>
<tr>
<td>B7</td>
<td>LS LR +</td>
</tr>
<tr>
<td>B8</td>
<td>LS LR -</td>
</tr>
<tr>
<td>B9</td>
<td>MAUS Bus out</td>
</tr>
<tr>
<td>B10</td>
<td>MAUS Bus in</td>
</tr>
</tbody>
</table>
2.16.3 Additional equipment

Where the set power supply requires a voltage other than the system voltage, this must be obtained by means of an appropriate DC/DC 12-24V converter unless one is already fitted. The power cables for the converter must be as short as possible with no 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 vehicles system is designed to provide the necessary power to all the standard equipment. Each piece of equipment has its own specific protection for its own function and the appropriate dimensions of the wires.

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

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

If batteries of a greater capacity are used, due to the demand of the added loads, it is advisable to 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

Inclusion of a supplementary battery in the vehicle circuit will require a separate recharging system integral with the vehicle system. In this case, provide supplementary batteries with capacities the same as those fitted originally to ensure correct recharging of all batteries.

If the supplementary battery is installed, it is possible to use:

a) recombination batteries (AGM or gel)

b) traditional batteries.

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

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

In the event that type a) batteries are used:

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

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

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

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

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

![Diagram of electrical system modifications](image)

**Figure 2.42**


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**

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

The addition of auxiliary pieces of equipment shall provide for suitable protections and shall not overload the vehicle system. In the event that an extra battery has to be used in parallel to the standard one, it is recommended that a heavy duty alternator is used or an auxiliary alternator is fitted.

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

The auxiliary alternator shall feature the same characteristics as the standard one, and the cables shall be properly dimensioned. In the event that modifications other than the ones described in this manual need be made to the system (e.g, adding several batteries in parallel), the operation shall be carried out together with the IVECO experts.

**Figure 2.43**

 NOTE. THE DIAGRAM IS SHOWN FOR ILLUSTRATIVE PURPOSES ONLY
2.16.4 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 2.44


Drawing current from CBA (on battery)

The battery is fitted with a control unit to deliver the positive (+) and protect the services (CBA).

Figure 2.45

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Function</th>
<th>Fuse range (A)</th>
<th>Sect. (mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Positive +30 for alternator motor</td>
<td>500</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>Positive for engine opening central unit &quot;CVM&quot;</td>
<td>150</td>
<td>35</td>
</tr>
<tr>
<td>3</td>
<td>Positive +30 for CPL - Dashboard control unit secondary loads</td>
<td>70</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Positive +30 for CPL - Dashboard control unit primary loads</td>
<td>70</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Positive +30 for box OPT</td>
<td>50</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Positive +30 - Wiring for Body Builders’ interface</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
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 2.16.5.

And in fitting the CBA it is necessary to:
- avoid removing fuses from their position;
- fit terminals on the studs and secure with nuts (M5 flanged nut, self-locking nut, etc.). Tighten the nuts to torque (4 ÷ 6 Nm);
- then fix the CFO control unit (optional fuse control unit) to the CBA control unit, as in Figure 2.45, fitting the hole of the strip on the stud bolt of the battery terminal (no. 6, incorporated in the CBA of Figure 2.46) and tightening the special nut to the required torque (8.8 ÷ 13.2 Nm).

Figure 2.46
The only points (2) 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 2.47

1. Lever for fast disconnection of battery negative terminal (-) from the electrical system - 2. Only current take-off points

It is absolutely forbidden to draw power from unauthorized points.

RISK OF FIRE.
**Fuse and relay box under the dashboard**

It is located in a special compartment, which can be closed by means of a snap-in drawer.

![Fuse and relay box diagram](image)

Only fuses of the prescribed type and rated current values shall be used - Danger of fire.

The fuses shall be replaced only after the cause of their actuation is eliminated. Cables shall be checked for integrity.

<table>
<thead>
<tr>
<th>Fuse</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-12</td>
<td>Right low-beam headlight</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-13</td>
<td>Left low-beam headlight - headlamp trim corrector</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-31</td>
<td>Window regulator electronics/body computer/unit engine compartment control unit</td>
<td>3 A</td>
</tr>
<tr>
<td>F-32</td>
<td>Out swinging door</td>
<td>15 A</td>
</tr>
<tr>
<td>F-33</td>
<td>Air heater/cigar lighter</td>
<td>15 A</td>
</tr>
<tr>
<td>F-34</td>
<td>Current draw</td>
<td>15 A</td>
</tr>
<tr>
<td>F-35</td>
<td>Debimeter/ESP8 sensors/Retarder/ABS8 electronics</td>
<td>10 A</td>
</tr>
<tr>
<td>F-36</td>
<td>Central locking</td>
<td>20 A</td>
</tr>
<tr>
<td>F-37</td>
<td>Various loads under starter key</td>
<td>5 A</td>
</tr>
<tr>
<td>F-38</td>
<td>Body computer power supply</td>
<td>10 A</td>
</tr>
<tr>
<td>F-39</td>
<td>Air conditioner electronics/back sensor electronics/radio/tachograph/engine compartment control unit</td>
<td>15 A</td>
</tr>
<tr>
<td>F-40</td>
<td>Left heated rear window</td>
<td>10 A</td>
</tr>
<tr>
<td>F-41</td>
<td>Right heated rear window</td>
<td>10 A</td>
</tr>
<tr>
<td>F-42</td>
<td>Reversing lights</td>
<td>5 A</td>
</tr>
<tr>
<td>F-43</td>
<td>Windscreen wiper/headlight washer</td>
<td>20 A</td>
</tr>
<tr>
<td>F-44</td>
<td>Spare</td>
<td>-</td>
</tr>
<tr>
<td>F-45</td>
<td>Window regulator electronics</td>
<td>3 A</td>
</tr>
<tr>
<td>F-46</td>
<td>Spare</td>
<td>-</td>
</tr>
<tr>
<td>F-47</td>
<td>Left window regulator</td>
<td>25 A</td>
</tr>
<tr>
<td>F-48</td>
<td>Right electric window</td>
<td>25 A</td>
</tr>
<tr>
<td>F-49</td>
<td>Radio electronics/C1 or C3 electronics/camera electronics/heated seats/setup socket</td>
<td>15 A</td>
</tr>
<tr>
<td>F-50</td>
<td>Airbag</td>
<td>5 A</td>
</tr>
<tr>
<td>F-51</td>
<td>Tachograph</td>
<td>5 A</td>
</tr>
<tr>
<td>F-52</td>
<td>Spare</td>
<td>-</td>
</tr>
<tr>
<td>F-53</td>
<td>Instrument panel/Rear fog light</td>
<td>7.5 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relay</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>T01</td>
<td>Right and left low-beam headlight</td>
<td>30 A</td>
</tr>
<tr>
<td>T11</td>
<td>Heated rear window</td>
<td>30 A</td>
</tr>
<tr>
<td>T12</td>
<td>Windscreen wiper/windscreen washer</td>
<td>30 A</td>
</tr>
<tr>
<td>T13</td>
<td>Air heater/electric lighter/power socket/window regulator</td>
<td>50 A</td>
</tr>
</tbody>
</table>
Fuse box and relay in engine compartment (Daily MY 2009 EURO V)

Figure 2.49

<table>
<thead>
<tr>
<th>Fuse</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-0</td>
<td>Spark plugs</td>
<td>60 A</td>
</tr>
<tr>
<td>F-1</td>
<td>ABS 8 or EPS 8 or ASR</td>
<td>40 A</td>
</tr>
<tr>
<td>F-2</td>
<td>ABS 8 or EPS 8 or ASR</td>
<td>30 A</td>
</tr>
<tr>
<td>F-3</td>
<td>ECU ESVI (automated gearbox)</td>
<td>30 A</td>
</tr>
<tr>
<td>F-4</td>
<td>ECU ESVI (automated gearbox)</td>
<td>30 A</td>
</tr>
<tr>
<td>F-5</td>
<td>Ignition switch</td>
<td>30 A</td>
</tr>
<tr>
<td>F-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-7</td>
<td>Side marker lights</td>
<td>20 A</td>
</tr>
<tr>
<td>F-8</td>
<td>Heater or climate control fans</td>
<td>40 A</td>
</tr>
<tr>
<td>F-9</td>
<td>Windscreen washer</td>
<td>20 A</td>
</tr>
<tr>
<td>F-10</td>
<td>Horn</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-11</td>
<td>EDC 17 (secondary loads)</td>
<td>15 A</td>
</tr>
<tr>
<td>F-12</td>
<td>Night high beam</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-13</td>
<td>Left high beam</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-16</td>
<td>BLOW BY - trailer intake</td>
<td>5 A</td>
</tr>
<tr>
<td>F-17</td>
<td>EDC 17 (primary loads)</td>
<td>10 A</td>
</tr>
<tr>
<td>F-18</td>
<td>ECU ESVI</td>
<td>10 A</td>
</tr>
<tr>
<td>F-19</td>
<td>Fan electromagnetic coupling</td>
<td>5 A</td>
</tr>
<tr>
<td>F-20</td>
<td>Fuel filter heater</td>
<td>25 A</td>
</tr>
<tr>
<td>F-21</td>
<td>Fuel pump</td>
<td>15 A</td>
</tr>
<tr>
<td>F-22</td>
<td>EDC 17 (primary loads)</td>
<td>25 A</td>
</tr>
<tr>
<td>F-23</td>
<td>Heated mirrors and windscreen - 13-pin trailer socket</td>
<td>15 A</td>
</tr>
<tr>
<td>F-24</td>
<td>ECU ESVI - power takeoff</td>
<td>15 A</td>
</tr>
<tr>
<td>F-30</td>
<td>Left and right foglamp</td>
<td>15 A</td>
</tr>
</tbody>
</table>
### Table 2.26

<table>
<thead>
<tr>
<th>Relay</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>T02</td>
<td>Right and left high beams</td>
<td>20 A</td>
</tr>
<tr>
<td>T03</td>
<td>Horn</td>
<td>20 A</td>
</tr>
<tr>
<td>T05</td>
<td>Fan electromagnetic coupling power supply</td>
<td>20 A</td>
</tr>
<tr>
<td>T06</td>
<td>Fan electromagnetic coupling power supply</td>
<td>20 A</td>
</tr>
<tr>
<td>T07</td>
<td>Side marker lights</td>
<td>50 A</td>
</tr>
<tr>
<td>T08</td>
<td>Heater or climate control fans</td>
<td>30 A</td>
</tr>
<tr>
<td>T09</td>
<td>EDC 17 (main relay)</td>
<td>30 A</td>
</tr>
<tr>
<td>T10</td>
<td>Fuel pump</td>
<td>20 A</td>
</tr>
<tr>
<td>T14</td>
<td>Left and right foglamp</td>
<td>20 A</td>
</tr>
<tr>
<td>T17</td>
<td>Windscreen washer</td>
<td>20 A</td>
</tr>
<tr>
<td>T19</td>
<td>Fuel filter heater</td>
<td>20 A</td>
</tr>
<tr>
<td>T20</td>
<td>MODUS or EASY: diagnosis</td>
<td>20 A</td>
</tr>
</tbody>
</table>

### Table 2.27

<table>
<thead>
<tr>
<th>Off control unit</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-29</td>
<td>Air suspension</td>
<td>40 A</td>
</tr>
<tr>
<td>F-54</td>
<td>Air suspension</td>
<td>40 A</td>
</tr>
<tr>
<td>F-25</td>
<td>Windscreen washer on/off</td>
<td>10/20 A</td>
</tr>
<tr>
<td>F-26</td>
<td>1st/ 2nd windscreen wiper speed</td>
<td>10/20 A</td>
</tr>
<tr>
<td>F-27</td>
<td>Heated rear view mirrors / heated windscreen heating</td>
<td>20 A</td>
</tr>
<tr>
<td>F-30</td>
<td>Activation of brake lights with retarder on</td>
<td>20 A</td>
</tr>
</tbody>
</table>
Fuse and relay box in the engine compartment (Daily MY 2006 EURO 4)

Figure 2.50

![Fuse and relay box diagram](image)

Table 2.28

<table>
<thead>
<tr>
<th>Fuse</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-0</td>
<td>Ignition spark plugs</td>
<td>60 A</td>
</tr>
<tr>
<td>F-1</td>
<td>ABS 8 or EPS 8 or ASR</td>
<td>40 A</td>
</tr>
<tr>
<td>F-2</td>
<td>ABS 8 or EPS 8 or ASR</td>
<td>30 A</td>
</tr>
<tr>
<td>F-3</td>
<td>ECU ESV1 (automated gearbox)</td>
<td>30 A</td>
</tr>
<tr>
<td>F-4</td>
<td>ECU ESV1 (automated gearbox)</td>
<td>30 A</td>
</tr>
<tr>
<td>F-5</td>
<td>Ignition switch</td>
<td>30 A</td>
</tr>
<tr>
<td>F-6</td>
<td>Fan electromagnetic coupling</td>
<td>20 A</td>
</tr>
<tr>
<td>F-7</td>
<td>Side lights</td>
<td>20 A</td>
</tr>
<tr>
<td>F-8</td>
<td>Heater or air conditioner fans</td>
<td>40 A</td>
</tr>
<tr>
<td>F-9</td>
<td>Windscreen washer</td>
<td>20 A</td>
</tr>
<tr>
<td>F-10</td>
<td>Warning horn</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-11</td>
<td>EDC T6 (secondary loads)</td>
<td>15 A</td>
</tr>
<tr>
<td>F-14</td>
<td>Right high-beam headlight</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-15</td>
<td>Left high-beam headlight</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-16</td>
<td>EDC T6, TO2, T14 auxiliary heater</td>
<td>5 A</td>
</tr>
<tr>
<td>F-17</td>
<td>EDC T6 (primary loads)</td>
<td>10 A</td>
</tr>
<tr>
<td>F-18</td>
<td>ESVI ECU - T09</td>
<td>10 A</td>
</tr>
<tr>
<td>F-19</td>
<td>Fan electromagnetic coupling</td>
<td>5 A</td>
</tr>
<tr>
<td>F-20</td>
<td>Fuel filter heater</td>
<td>25 A</td>
</tr>
<tr>
<td>F-21</td>
<td>Fuel pump</td>
<td>15 A</td>
</tr>
<tr>
<td>F-22</td>
<td>EDC T6 (primary loads)</td>
<td>25 A</td>
</tr>
<tr>
<td>F-23</td>
<td>Heated mirrors and windscreen - 13-pin trailer socket</td>
<td>15 A</td>
</tr>
<tr>
<td>F-24</td>
<td>ESVI ECU - power takeoff</td>
<td>15 A</td>
</tr>
<tr>
<td>F-30</td>
<td>Left and right fog light</td>
<td>15 A</td>
</tr>
</tbody>
</table>
### Table 2.29

<table>
<thead>
<tr>
<th>Relay</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>T02</td>
<td>Right and left high-beam headlights</td>
<td>20 A</td>
</tr>
<tr>
<td>T03</td>
<td>Warning horn</td>
<td>20 A</td>
</tr>
<tr>
<td>T05</td>
<td>Fan electromagnetic coupling power supply</td>
<td>20 A</td>
</tr>
<tr>
<td>T06</td>
<td>Fan electromagnetic coupling power supply</td>
<td>20 A</td>
</tr>
<tr>
<td>T07</td>
<td>Side lights</td>
<td>50 A</td>
</tr>
<tr>
<td>T08</td>
<td>Heater or air conditioner fans</td>
<td>30 A</td>
</tr>
<tr>
<td>T09</td>
<td>EDC 16 (main relay)</td>
<td>30 A</td>
</tr>
<tr>
<td>T10</td>
<td>Fuel pump</td>
<td>20 A</td>
</tr>
<tr>
<td>T14</td>
<td>Left and right fog lights</td>
<td>20 A</td>
</tr>
<tr>
<td>T17</td>
<td>Windscreen washer</td>
<td>20 A</td>
</tr>
<tr>
<td>T19</td>
<td>Fuel filter heater</td>
<td>20 A</td>
</tr>
<tr>
<td>T20</td>
<td>MODUS or EASY diagnosis</td>
<td>20 A</td>
</tr>
</tbody>
</table>

### Table 2.30

<table>
<thead>
<tr>
<th>Not incl. in control unit</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>T25</td>
<td>Windscreen wiper switch-on/switch-off</td>
<td>10/20 A</td>
</tr>
<tr>
<td>T26</td>
<td>Windscreen wiper speed 1st &amp; 2nd</td>
<td>10/20 A</td>
</tr>
<tr>
<td>T27</td>
<td>Heated rear view mirrors / heated windscreen heating</td>
<td>20 A</td>
</tr>
<tr>
<td>T30</td>
<td>Activation of brake lights with retarder on</td>
<td>20 A</td>
</tr>
</tbody>
</table>
Fuse and relay box in the engine compartment (Daily MY 2006 EURO 3)

Figure 2.51

Table 2.31

<table>
<thead>
<tr>
<th>Fuse</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-0</td>
<td>Ignition spark plugs</td>
<td>60 A</td>
</tr>
<tr>
<td>F-1</td>
<td>ABS 8 or EPS 8</td>
<td>40 A</td>
</tr>
<tr>
<td>F-2</td>
<td>ABS 8 or EPS 8</td>
<td>30 A</td>
</tr>
<tr>
<td>F-3</td>
<td>Supplementary fuel filter heater</td>
<td></td>
</tr>
<tr>
<td>F-4</td>
<td>Ignition switch</td>
<td>20 A</td>
</tr>
<tr>
<td>F-5</td>
<td>Fan electromagnetic coupling</td>
<td></td>
</tr>
<tr>
<td>F-6</td>
<td>Side lights</td>
<td>20 A</td>
</tr>
<tr>
<td>F-7</td>
<td>Heater or air conditioner fans</td>
<td>40 A</td>
</tr>
<tr>
<td>F-8</td>
<td>Windscreen washer</td>
<td>20 A</td>
</tr>
<tr>
<td>F-9</td>
<td>Warning horn</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-10</td>
<td>EDC T6 (secondary loads)</td>
<td>15 A</td>
</tr>
<tr>
<td>F-14</td>
<td>Right high-beam headlight</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-15</td>
<td>Left high-beam headlight</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-16</td>
<td>EDC T6, T02, T14 auxiliary heater</td>
<td>5 A</td>
</tr>
<tr>
<td>F-17</td>
<td>EDC T6 (primary loads)</td>
<td>10 A</td>
</tr>
<tr>
<td>F-18</td>
<td>T09</td>
<td>10 A</td>
</tr>
<tr>
<td>F-19</td>
<td>Fuel filter heater</td>
<td>25 A</td>
</tr>
<tr>
<td>F-20</td>
<td>Fan electromagnetic coupling</td>
<td></td>
</tr>
<tr>
<td>F-21</td>
<td>Fuel pump</td>
<td>15 A</td>
</tr>
<tr>
<td>F-22</td>
<td>EDC T6 (primary loads)</td>
<td>25 A</td>
</tr>
<tr>
<td>F-23</td>
<td>Heated mirrors and windscreen - 13-pin trailer socket</td>
<td>15 A</td>
</tr>
<tr>
<td>F-24</td>
<td>Power takeoff</td>
<td>15 A</td>
</tr>
<tr>
<td>F-30</td>
<td>Left and right fog light</td>
<td>15 A</td>
</tr>
</tbody>
</table>
### Table 2.32

<table>
<thead>
<tr>
<th>Relay</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>T02</td>
<td>Right and left high-beam headlights</td>
<td>20 A</td>
</tr>
<tr>
<td>T03</td>
<td>Warning horn</td>
<td>20 A</td>
</tr>
<tr>
<td>T05</td>
<td>Fan electromagnetic coupling power supply</td>
<td>20 A</td>
</tr>
<tr>
<td>T06</td>
<td>Fan electromagnetic coupling power supply</td>
<td>20 A</td>
</tr>
<tr>
<td>T07</td>
<td>Side lights</td>
<td>50 A</td>
</tr>
<tr>
<td>T08</td>
<td>Heater or air conditioner fans</td>
<td>30 A</td>
</tr>
<tr>
<td>T09</td>
<td>EDC T6 (main relay)</td>
<td>30 A</td>
</tr>
<tr>
<td>T10</td>
<td>Fuel pump</td>
<td>20 A</td>
</tr>
<tr>
<td>T14</td>
<td>Left and right fog lights</td>
<td>20 A</td>
</tr>
<tr>
<td>T17</td>
<td>Windscreen washer</td>
<td>20 A</td>
</tr>
<tr>
<td>T19</td>
<td>Fuel filter heater</td>
<td>20 A</td>
</tr>
<tr>
<td>T20</td>
<td>MODUS or EASY. diagnosis</td>
<td>20 A</td>
</tr>
</tbody>
</table>

### Table 2.33

<table>
<thead>
<tr>
<th>Not incl. in control unit</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>T25</td>
<td>Windscreen wiper switch-on/switch-off</td>
<td>10/20 A</td>
</tr>
<tr>
<td>T26</td>
<td>Windscreen wiper speed 1st &amp; 2nd</td>
<td>10/20 A</td>
</tr>
<tr>
<td>T27</td>
<td>Heated rear view mirrors / heated windscreen heating</td>
<td>20 A</td>
</tr>
<tr>
<td>T30</td>
<td>Activation of brake lights with retarder on</td>
<td>20 A</td>
</tr>
</tbody>
</table>
Optional fuse box (Daily MY 2006 EURO 3, EURO 4, EURO V)

Figure 2.52

<table>
<thead>
<tr>
<th>Relay</th>
<th>Drawing ref.</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>T04</td>
<td>1</td>
<td>Retarder switch-off with ABS ON</td>
<td>10/20 A</td>
</tr>
<tr>
<td>T16</td>
<td>12</td>
<td>Headlamp washer</td>
<td>30 A</td>
</tr>
<tr>
<td>T15</td>
<td>3</td>
<td>Air heater</td>
<td>30 A</td>
</tr>
<tr>
<td>T22</td>
<td>4</td>
<td>Fan electromagnetic coupling 2nd speed</td>
<td>30 A</td>
</tr>
<tr>
<td>T18</td>
<td>6</td>
<td>Start consent</td>
<td>30 A</td>
</tr>
<tr>
<td>T24</td>
<td>7</td>
<td>Power takeoff actuation enable</td>
<td>30 A</td>
</tr>
<tr>
<td>T23</td>
<td>9</td>
<td>Turning on air conditioning compressor</td>
<td>30 A</td>
</tr>
<tr>
<td>T21</td>
<td>10</td>
<td>Compressor ON signal from EDC T6</td>
<td>20 A</td>
</tr>
</tbody>
</table>

Table 2.35

<table>
<thead>
<tr>
<th>Fuses</th>
<th>Drawing ref.</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-55</td>
<td>2</td>
<td>Auxiliary air conditioner</td>
<td>30 A</td>
</tr>
<tr>
<td>F-25</td>
<td>5</td>
<td>Climate control system</td>
<td>30 A</td>
</tr>
<tr>
<td>F-28</td>
<td>8</td>
<td>Rear differential lock</td>
<td>30 A</td>
</tr>
<tr>
<td>F-27</td>
<td>11</td>
<td>Headlamp washer</td>
<td>20 A</td>
</tr>
</tbody>
</table>
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 2.53

Any damage caused by failure to comply with procedure is not covered by the warranty.
**Maxifuse and megafuse fuses**

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

**Figure 2.54**

<table>
<thead>
<tr>
<th>Capacity</th>
<th>IVECO ref. no.</th>
<th>Cable section</th>
</tr>
</thead>
<tbody>
<tr>
<td>kit 40A</td>
<td>4104 0110 KZ</td>
<td>10 mm²</td>
</tr>
<tr>
<td>kit 60A</td>
<td>4104 0111 KZ</td>
<td>10 mm²</td>
</tr>
</tbody>
</table>

It should be pointed out that the current intensity shall, when grouping several cables, be reduced compared with the rated value of one single cable in order to compensate for smaller heat dispersion.

As regards the vehicles the engines of which are frequently started, in the presence of current drawing and short engine rotation time (e.g. vehicles equipped with refrigerating bodies), the battery shall be recharged at regular intervals in order to ensure efficiency of the same.

The connections with plugs and terminals shall be of the protected, weather-proof type. Components of the same type as the one originally fitted to the vehicle shall be used.

In the event that units and assemblies (various components, etc.) need be relocated due to special body building or vehicle conversion, such relocation shall be permitted providing:

- In the event that a component has be installed just next to the route of a cable belonging to the original system, or a cable route needs be changed, the same can be relocated provided that its integrity is maintained (cuts shall not be made).

**Figure 2.55**

ANY DAMAGE CAUSED BY THE FAILURE TO COMPLY WITH THE PROCEDURE SHALL NOT BE COVERED BY THE WARRANTY.
2.16.5 Additional Circuits

These must be separated and protected by a fuse from the vehicle’s main circuit. The cables utilised must be of a size that is suitable for the relative functions and must be well insulated. They must also be suitable protected in sheaths (not PVC) or routed though flexible conduits in the case of a plurality of functions (we recommended the use of polyamide type 6 plastic for flexible conduits) and they must be correctly installed in a place where they are protected from impact and heat sources. Take care to avoid any chaffing with other components, particularly with live edges of the bodywork. The transit of these cables through structural components (cross members, profiles, etc.) must be executed using suitable cable glands or protections; firstly the cables must be secured separately with insulated cable clamps (e.g. made of nylon) at adequate intervals (approx. 200 mm).

In the case of external panels use a suitable sealant on both the cable and on the panel, to avoid the risk of infiltration of water, dust, or fumes.

Establish suitable distance between electrical wiring harnesses and other components as follows:
- 10 mm from static components;
- 50 mm from moving components (minimum distance = 20 mm);
- 150 mm from components that generate heat (e.g. engine exhaust).

Wherever possible it is good practice to follow a different cable route for signal cables interfering at high absorbed intensity (e.g. electric motors, solenoid valves) and signals that are susceptible to low absorbed intensities such as sensors, maintaining in any event a position as close as possible to the metal structure of the vehicle in both cases.

Plug and terminal connections must be protected, resistant to weathering, and executed using components of the same type as those utilised originally on the vehicle.

Use cables and fuses with the characteristics shown in the following table in accordance with the current draw:

Table 2.36

<table>
<thead>
<tr>
<th>Max. continuous current 1) (A)</th>
<th>Cable cross-section (mm²)</th>
<th>Fuse capacity 2) (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ÷ 4</td>
<td>0.5</td>
<td>5</td>
</tr>
<tr>
<td>4 ÷ 8</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>8 ÷ 16</td>
<td>2.5</td>
<td>20</td>
</tr>
<tr>
<td>16 ÷ 25</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>25 ÷ 33</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>33 ÷ 40</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>40 ÷ 60</td>
<td>16</td>
<td>70</td>
</tr>
<tr>
<td>60 ÷ 80</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>80 ÷ 100</td>
<td>35</td>
<td>125</td>
</tr>
<tr>
<td>100 ÷ 140</td>
<td>50</td>
<td>150</td>
</tr>
</tbody>
</table>

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

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

Precautions

- Incorrect installation of electrical accessories may affect occupant safety and cause severe damage to the vehicle. Contact IVECO if you have any questions.
- Avoid coupling with signal transmission cables (e.g. ABS), for which a preferential path has been defined for electromagnetic requirements (EMI).
  It should be noted that when grouping several cables together, in order to compensate for the lower heat dispersal capacity current intensity must be reduced with respect to the nominal value of a single cable.
- In vehicles subject to frequent engine starts, in the presence of power draws with limited engine running times (e.g. vehicles with refrigerated bodies) periodic battery charges are required to maintain optimal efficiency.
2.16.6 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.

2.16.7 Provision for trailer

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

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

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

a) Trailer connector added by the Body Builder

If the vehicle is not ordered with a trailer point, a set may be ordered from parts. This consists of:

- electronic control unit;
- control unit fastening brackets;
- front bridle for connecting the control unit with the bonnet cable and chassis cable sectioning;
- chassis cable with 13-pole connector.

Installation

To ensure correct installation, the following instructions shall be followed:

- fit the electronic control unit onto the bracket next to the radiator, as illustrated in the pictures.

Figure 2.56
- Disconnect the grey connector between the chassis cable and the cab cable. Connect the interfacing bridle between the electronic control unit and the connections available on the vehicle, as illustrated in the diagram.

Figure 2.57

1. Electronic control unit with bracket - 2. Red taping (connect to the added 13-pole chassis cable) - 3. Yellow taping (connect to the cab/bonnet cable) - 4. Connect to the chassis cable found on the vehicle - 5. Connect to the chassis ground

Figure 2.58

1. To be connected to the chassis cable (from where the reversing gear sensor connection had come off) - 2. To be connected to the reversing gear sensor - 3. Connect to the chassis ground - 4. To be connected to the control unit connector - 5. Cable to be fitted onto the chassis - 6. 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 2.59

NOTE The diagram is shown for illustrative purposes only.

Description of 13-pin interface

<table>
<thead>
<tr>
<th>13-pole connector pin</th>
<th>Cable no.</th>
<th>Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1120</td>
<td>Left rear direction indicator bulb</td>
<td>1 bulb (21 W, 12 V)</td>
</tr>
<tr>
<td>2</td>
<td>2283</td>
<td>Right rear direction indicator bulb</td>
<td>2 bulbs (21 W, 12 V)</td>
</tr>
<tr>
<td>3</td>
<td>0000</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1125</td>
<td>Rear right indicator bulb</td>
<td>1 bulb (21 W, 12 V)</td>
</tr>
<tr>
<td>5</td>
<td>3335</td>
<td>Front left/rear right sidelights;</td>
<td>1 bulb (5 W, 12 V)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>left licence plate light; left clearance light</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1175</td>
<td>Brake light power supply</td>
<td>2 bulbs (21 W, 12 V)</td>
</tr>
<tr>
<td>7</td>
<td>3334</td>
<td>Front right/rear left sidelights;</td>
<td>1 bulb (5 W, 12 V)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>right licence plate light; right clearance light</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>2268</td>
<td>Reversing light power supply</td>
<td>1 bulb (21 W, 12 V)</td>
</tr>
<tr>
<td>9</td>
<td>7777</td>
<td>After fuse F23 on the CVM</td>
<td>Battery positive</td>
</tr>
<tr>
<td>10</td>
<td>8879</td>
<td>After fuse F16 on the CVM</td>
<td>Ignition-operated positive</td>
</tr>
<tr>
<td>11</td>
<td>0000</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>6676</td>
<td>Trailer connection signal (ground)</td>
<td>Signal to be supplied if the parking sensors are available</td>
</tr>
<tr>
<td>13</td>
<td>0000</td>
<td>Ground</td>
<td></td>
</tr>
</tbody>
</table>
2.16.8 Side Marker Lights

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

The Daily range vehicles are equipped with specific terminals to make the electric connection required to power the side marker lights.

The external Body Builders 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 2.60
Table 2.38

<table>
<thead>
<tr>
<th>Connector on the vehicle</th>
<th>IVECO code</th>
<th>Interface to be used</th>
<th>Part number</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male connector</td>
<td>98435341</td>
<td>Female connector</td>
<td>98435344</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Half shell</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cable terminal</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gasket (rubber piece)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cap</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Connector pin-out:

Table 2.39

<table>
<thead>
<tr>
<th>Pin</th>
<th>Cable code</th>
<th>Function</th>
<th>Cable section (mm²)</th>
<th>Max. current (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0000</td>
<td>Ground</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>3390</td>
<td>Vehicle right-side marker lights</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>3390</td>
<td>Vehicle left-side marker lights</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

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.

2.16.9 Operation of emergency control on dashboard (option)

The dashboard Central Emergency Control is used in hazardous situations.

Figure 2.61

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 disconnector 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
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 the disconnector;
- turn the key to STOP;
- re-start the vehicle.

**External hazard control**

Some conversions require the direction indicators to be turned on when the conversion is in operation condition. This function may be managed by supplying a continuous negative signal to pin LN35 of the black body computer connector and then going to an IVECO workshop to make it operational.
2.17 Repositioning Parts and Mounting Auxiliary Assemblies and Equipment

When a need arises to move units (various components, fuel tank, spare wheel etc) to fit equipment, the operation is permitted provided:
- the functionality of the assemblies concerned is not jeopardized;
- the same type of original connection is restored;
- the new weight situation and distribution is compatible with that established for the vehicle originally.

It is forbidden to fit projecting components with a heavy weight (for example batteries); as well as resting on the structural member, the supports must be secured to other elements, such as supporting surfaces or one of the side members.

Wheel holder

On cab versions not supplied with a spare wheel holder, or on vehicles where it is necessary to shift the spare wheel arrangement, a special support must be made which allows rapid extraction and respects a minimum entry angle of 7°, or larger depending on the service that the vehicle can provide.

Figures 2.64 and 2.65 show two possible solutions.

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

Figure 2.64

To keep down twisting stress on the vehicle frame, we recommend applying a crossmember in the area, particularly in the case of heavy units.

A similar procedure should be adopted when fitting additional units such as tanks, compressors etc. When positioning them, due consideration must be given to the distribution of the weights (see point 1.13). Adequate ground clearance must be ensured with due consideration given to the operation of the vehicle.
Any new holes that are necessary for the relocation must be made in the web of the sidemember in accordance with the specifications given in point 2.3 taking care to use existing holes as much as possible.

**Figure 2.65**

**Clutch control tank**

This is on the front of the chassis, the tank cover must not be removed, the assembly needs no maintenance.

**Figure 2.66**
Fuel tank

If the fuel tank capacity is insufficient or if the tank is not suitable for the needs of the bodybuilder, it is possible to install a larger capacity or different shaped tank. Before replacement, it is advisable to check that the new tank is compatible with the vehicle’s original configuration. The following table shows the different types of IVECO Tanks available as an alternative to the original tank.

Table 2.40 - Fuel tanks available

<table>
<thead>
<tr>
<th>Shaped tank (100 l.)</th>
<th>Shaped tank (70 l.)</th>
<th>Trapezoidal tank (90 l.) LF</th>
<th>Trapezoidal tank (90 l.) RH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangular tank (70 l.)</td>
<td>Rectangular tank (90 l.)</td>
<td>Rectangular tank (120 l.)</td>
<td></td>
</tr>
</tbody>
</table>

Note that replacing the tank with another of a different type requires update of the body computer. Because the body computer processes level gauge signals and associates them with the emptying rule for the specific tank design, the use of tanks of different types means that the settings for fuel consumption, residual range etc must be reset.

NOTE  Fuel tanks are subjected to homologation.
2.18 Retarder Installation

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

Installation on some vehicles can be carried out at our plants (as optional item). Later installation on these vehicles must correspond with the original installation (refer to retarder manufacturer for instructions).

In the remaining cases, the retarder manufacturer’s workshops must carry out the installation in compliance with points 2.3, 2.8 and 2.16 of these instructions. The firm authorized to carry out the installation is responsible for correct operation, installation and good workmanship.

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

### Table 2.41

<table>
<thead>
<tr>
<th>Model</th>
<th>Permitted application</th>
</tr>
</thead>
<tbody>
<tr>
<td>29L, 35S, 35C</td>
<td>no</td>
</tr>
<tr>
<td>40C, 45C, 50C, 60C, 65C, 70C</td>
<td>yes</td>
</tr>
</tbody>
</table>

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

\[
\frac{i_p \cdot C_f}{R' \cdot PTT} = 1
\]

- \(i_p\) = rear axle ratio
- \(C_f\) = maximum braking torque (Nm)
- \(R'\) = loaded radius of the tyre used (m)
- \(GVW\) = Gross Vehicle Weight (Kg)

#### Example of calculation the maximum braking torque of a retarder for Daily

Let us consider a 50C15V/P vehicle with 3.15 rear axle ratio and 195/75R16 tyres.

1. \(i_p = 3.15\)
2. \(R' = 0.317\) m
3. \(GVW = 5200\) kg

We obtain:

\[
C_f = \frac{(5200 \cdot 0.317)}{3.15} = 520 \text{ Nm}
\]

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

#### NOTE

For vehicles with ESP system, see point 2.15.5.
2.19 Modifications to the Rear Underrun

Our vehicles are fitted with a rear underrun bar in accordance with EC Directives. The maximum permitted distance from the bar to the rearmost part of the body is 400 mm, deducting the distortion found during approval tests (10 mm on average).

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

When modifying the vehicles or installing special equipment (e.g. tail lifts) it may be necessary to modify the structure of the underrun bar. Such modifications must not change the original resistance and stiffness specifications (so as to comply with local government regulations, if any). The company carrying out the modification / installation must where required, submit the necessary document demonstrating compliance with legislation in force at the time.

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

Chassis cab vehicles provided without wings must be completed by the bodybuilder using solutions equivalent to those adopted by IVECO for similar vehicles. In making the mudguards, wheel arches, as well as the shape of the body, bear in mind:

- that free wag of the wheels under the conditions of use with chains must be ensured, respecting the limits given in the documentation supplied by IVECO;
- the maximum tyre width must comply with the legal limits specified for the vehicle;
- the supporting structure adequately sturdy, avoiding sharp changes in the sections and vibrations;
- the connection can be made to the vertical web of the vehicle's side members or to the longitudinal sections of the subframe. In the first case, the connection must be made solely with screws, or directly under the superstructure (e.g., body, van, etc.), (refer to Figure 2.67).

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

Figure 2.67

2.21 Mudflaps

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

In some countries national or EC regulations require that the vehicle is fitted with side guards. The Bodybuilder who finishes off the vehicle must ensure compliance with the required regulations.

On permanently fitted structures such as fixed platform or box bodies etc, side guards can be fitted directly to their basic structure (floor frame, crossmembers). Whereas on mobile structures (such as tippers, demount bodies, removable containers) the side guards will be connected to the subframe by way of suitable brackets or installed directly to the chassis. In the latter case, we the Bodybuilder should, as far as possible, makes use of any holes already existing in the sidemembers vertical web in compliance with point 2.3.

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

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

Operation of and access to the following parts must be ensured.
- brake system equipment;
- fuel supply;
- suspension;
- spare wheel;
- engine exhaust.

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

Particular care must be taken with the installation to ensure that the various requirements of the regulations are complied with (e.g. ground and body dimensions).

2.23 Chocks

The Body Builder must take care when preparing and fitting the side guards which will depend on the type of body built, as it is not possible to give specific instructions that would apply to all body versions built.

Usually these are fitted directly at the factory. Should this not be the case, or if it is necessary to change their original position, the Bodybuilder must work out a new arrangement in compliance with local regulations. The new position must ensure reliability and safety as well as easy access for operation by the user.
SECTION 3

Fitting supersstructures

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<th>Description</th>
<th>Page</th>
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<td>Municipal, Fire-fighting and Special Services</td>
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<td>3.12</td>
<td>Installation of front snowploughs</td>
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<td>3.13</td>
<td>Winch Installation</td>
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<td>Chassis-cowls</td>
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<td>3.14.2</td>
<td>Motor Homes</td>
<td>3-36</td>
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<td>3.14.3</td>
<td>Installing an aerial platform</td>
<td>3-37</td>
</tr>
</tbody>
</table>
NOTE The following general instructions complement the general instructions given in the general regulations in Chapter 1.

### 3.1 Construction of the Subframe

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

#### 3.1.1 Material

Usually, provided the subframe is not to undergo great stress, the material used for its construction may be of a lower grade than that used for the vehicle chassis. It shall have good weldability characteristics and limits not lower than values (1) shown in Table 3.1.

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

The properties of certain materials that are considered in some of the applications indicated below are as follows.

<table>
<thead>
<tr>
<th>Steel name</th>
<th>Breaking load (N/mm²)</th>
<th>Yield point (N/mm²)</th>
<th>Elongation A5</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVECO FE360D</td>
<td>360 (1)</td>
<td>235 (1)</td>
<td>25% (1)</td>
</tr>
<tr>
<td>EUROPE S235JR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GERMANY S235JR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK 37/23CR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IVECO FE420</td>
<td>530</td>
<td>420</td>
<td>21%</td>
</tr>
<tr>
<td>EUROPE S420MC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GERMANY S420MC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK S420MC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IVECO FES 10D</td>
<td>520</td>
<td>360</td>
<td>22%</td>
</tr>
<tr>
<td>EUROPE S355J2G3F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GERMANY S355J2G3F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK 50D</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Construction of the Subframe*
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 feature smaller values.

Table 3.2 - Section bar dimensions

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

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

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

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

It should be remembered that, when stating the minimum dimensions for the reinforcement runners, besides the admitted limit of stress for the aluminium, the different elastic modulus compared to steel (approx. 7,000 kg/mm² as against 21,000 kg/mm² for steel) will also have to be considered. This will result in larger dimensions for the runners.

Similarly, when the connection between frame and counterframe guarantees the transmission of shearing forces (connection via plates), a new neutral axis must be defined for the section based on the different elastic coefficients of both materials when checking the stresses at both ends of the single section.

The cooperation request for aluminium definitely means dimensions that are too large and not good value.
3.2 Elements making up the subframe

3.2.1 Longitudinal Runner Profiles

The side member of the added structure must be continuous, extending as far as possible forward to the front of the vehicle to include, if possible, the area of the rear support of the front spring, and rest on the chassis of the vehicle but not on the brackets. In order to achieve a gradual reduction in the resistant section, the front ends of the longitudinal runner must be tapered upwards at an angle of no more than 30°, or tapered in some other equivalent way (see Figure 3.1), ensuring that the front end in contact with the chassis is suitably connected, min radius 5 mm.

Figure 3.1

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

Figure 3.2
The shape of the section of the runner is determined with due consideration to the function of the subframe and to the type of structure that is above it. It is advisable to use open C-sections if the subframe is supposed to adapt itself elastically to the chassis of the vehicle, and to use box-type sections when added rigidity is called for.

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

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

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

In all cases, it is possible to use similar sections whose moments of inertia and resistance are no lower. Such dimensions can be obtained from the technical literature supplied by the manufacturer of the runner profiles. It should be borne in mind that the moment of inertia, apart from being an important factor for the calculation of the share of bending moment to be applied, also represents the most adequate response to the degree of torsional stress required for the specific type of connecting section in use. Therefore, the moment of resistance is a determining factor as regards the stress exerted on the material.
### 3.2.2 Cross Members

An adequate number of cross members, which should be positioned if possible adjacent to the fastenings, are required to brace the two runners of the subframe. The cross members may be of the open type (e.g. C-type) or, if greater rigidity is desired, of the closed type. Suitable gusset plates must be employed at the points of the connection to confer sufficient strength to the connection (see Figure 3.4). In those cases, when greater rigidity is required for the connection, the work procedure may be carried out as illustrated in Figure 3.5.

**Figure 3.4**

![Figure 3.4](image1.png)

**Figure 3.5**

![Figure 3.5](image2.png)

### Stiffening the Subframe

In the case of certain bodies, such as tippers, cement mixers, crane on rear overhang or bodies with a high centre of gravity, the subframe must be additionally stiffened at the rear end. Depending on the degree of torsional stress, this must be done in one of the following manners:
- joining the rear section of the longitudinal member by a box-frame construction;
- box-frame construction, closed-section cross members (see Figure 3.6);
- box-frame construction, crossties (see Figure 3.7).

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

**Figure 3.6**

![Figure 3.6](image3.png)
Self-supporting Bodies as Subframes

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

3.3.1 Choosing the Type of Body Mounting

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

The subframe connection may be flexible (brackets or clamps) or it may be rigid, resistant to shearing stress (longitudinal or transverse plates); the choice must be made based on the type of body that is to be mounted (see points 3.4 to 3.9) analysing the stress forces which the additional equipment that is added transmits to the chassis both under static and dynamic conditions. The number, size and type of securing devices properly subdivided over the length of the subframe, must be such as to ensure a good connection between the chassis of the vehicle and the subframe.

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

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

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

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

![Warning]

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

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

In all other cases, holes on the frame flanges must not be drilled.

3.3.2 Body Mounting Characteristics

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

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

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

- lower height of the subframe profile under the same bending moment acting on the section;
- higher bending moment under the same subframe profile dimensions;
- further increase in the strength capacity, when the subframe is made up of high mechanical characteristic materials.
### 3.3.3 Connection with Brackets (flexible joint)

A few examples of this type of connection (flexibility mounting), are shown in Figure 3.8 and 3.9.

Figure 3.8

![Diagram showing connection with brackets](image)


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

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

In order to guide and better contain the loads transversally, a slight protrusion of the brackets above the chassis is recommended. When the brackets are fitted flush with the upper flange of the side member, the lateral movement of the body structure must be secured by other means (e.g. using guide plates the chassis connected - see Figure 3.10). When the front connection is of the elastic type (Figure 3.9), lengthwise securing must be ensured even in the conditions of maximum twisting of the chassis (e.g. off-road).

When the chassis already has factory fitted brackets for the installation of a box-type body, these brackets must be used for the installation of the structure. The brackets fitted to the subframe or to the body must have characteristics of strength not lower than those of the original brackets fitted to the vehicle (see Table 2.8 and Table 3.1).
3.3.4 Elastic connections

In the event that greater flexibility is required from a connection (e.g. vehicles with very rigid superstructures such as van body versions, tanks, etc. used on rough or winding roads, special vehicles, off-road vehicles, etc.), in the area behind the driver’s cab, fastenings of the type indicated in Figure 3.9 must be adopted.

In other words, it is necessary to use brackets equipped with rubber blocks (1), Belleville washers (2) fitted in line and parallel or coil springs (3).

Figure 3.9

The characteristics of the elastic element must be adequate to the superstructure stiffness, wheelbase and use intended for the vehicle (rough road conditions).

Furthermore:
- stiffness must increase progressively for fastenings closest to the rear part of the frame;
- the overall connection capacity must also include shear-resistant fastenings, to be positioned near the rear suspension.

As a result, the first fastening behind the cab will always be constructed using one of the solutions in Figure 3.9. The solution must also be replicated for subsequent fastenings, changing only the stiffness, particularly when the vehicle wheelbase is long.

For example, in the case of brackets with rubber blocks, care must be taken to use elements of the same hardness (sh=83) and assembled double in the first bracket and single in the next, with M10 bolts and 15-18 Nm tightening torques.

The following must be observed for all types of fastening:
- use materials that ensure good long-term flexible properties;
- provide appropriate instructions for periodic checking;
- restore the tightening torque.

Also note:

a) with superstructures that generate bending and twisting moments (e.g. crane behind cab), the subframe must be big enough to support them;

b) in conversions where the vehicle is lifted by means of hydraulic stabilisers (e.g. crane, overhead platforms), it will be necessary to limit the yield of the flexible element to ensure an adequate contribution by the sub-frame and prevent excessive bending moments on the original frame.
3.3.5 **Connection with U-bolts (clamps)**

The most important mounting of this type is illustrated in Figure 3.10. In this type of construction the Bodybuilder must place a spacing piece, preferably made of metal, between the flanges of the two side members at the point where the U-bolts are located, in order to prevent the bending of the frames when the U-bolts are tightened.

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

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

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

**Figure 3.10**

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

This type of fixing shown in Figure 3.11 is achieved by means of a plate that is welded or bolted to the subframe and is secured to the chassis by means of bolts or rivets. This ensures good reaction to longitudinal and transverse thrust and provides maximum rigidity between the vehicle chassis and the subframe.

For their use, bear in mind that:
- the plate must be attached to the vertical web of the main sidemembers. Before fixing ensure that the subframe is mounted correctly on the top flange with no gaps between the two mating surfaces;
- the use of cleat plates must only be fitted to the central and rear sections of the frame;
- the number of plates, thickness and number of securing bolts must be adequate to transmit the sections shear and bending moments between the chassis and the subframe.

When all the necessary elements are available these values can be determined accurately by calculation.

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

<table>
<thead>
<tr>
<th>Chassis / subframe section height ratio</th>
<th>Max. distance between the centre line of the shear-resistant plate (mm)</th>
<th>Models</th>
<th>Min. plate characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thickness (mm)</td>
</tr>
<tr>
<td>&gt;1.0</td>
<td>700</td>
<td>35C, 40C</td>
<td>4</td>
</tr>
<tr>
<td>≤1.0</td>
<td>500</td>
<td>45C, 50C</td>
<td>4</td>
</tr>
<tr>
<td>≤1.0</td>
<td>500</td>
<td>60C, 65C, 70C</td>
<td>5</td>
</tr>
</tbody>
</table>

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

On the basis of the instructions given for the construction of the subframe (point 3.1) and instructions given in the general section of point 3.3., the mounting between the vehicle frame and subframe can be of a mixed type, i.e. it may be made through a rational use of flexible connections (brackets) and rigid connections (shear-resistant plates for longitudinal and transversal fixing).

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

For this purpose it is also possible to use bolt-type connections at the rear end of the chassis as illustrated in Figure 3.12.

Figure 3.12

3.4 Fitting Box Bodies

Dimensions and centres of gravity

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

3.4.1 Fixed boxes

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

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

Table 3.4

<table>
<thead>
<tr>
<th>Models</th>
<th>Minimum reinforcement sectional longitudinal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wheelbase (mm)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>29L, 35S</td>
<td>All (1)</td>
</tr>
<tr>
<td>35C, 40C, 45C, 50C</td>
<td>All</td>
</tr>
<tr>
<td>60C, 65C, 70C</td>
<td>Up to 3750</td>
</tr>
<tr>
<td></td>
<td>Above 3750</td>
</tr>
</tbody>
</table>

1) The body structure with its base should be made so that it can make an adequate torsion contribution to the chassis frame of the vehicle.

The attachment is carried out using the brackets arranged on the vertical web of the side members. If IVECO have not provided the brackets they must be installed according to the specifications given in point 3.3. In order to provide adequate longitudinal restraint when brackets or clamps are used, it is recommended that a rigid connection both sides on the rear overhang is made using either cleat plates or bolts through the upper flange of the side members (see Figures. 3.11 and 3.12).

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

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

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

Figure 3.13

![Figure 3.13](image-url)
Building Vans

For the connection of the body to the vehicle chassis, it is possible to make a framework composed of longitudinals and crossmembers, the minimum dimensions for the longitudinal sections are given in Table 3.4. Figure 3.14 shows an example of a construction, where crossmembers and brackets have been added along the length of the longitudinal sections to keep down the height of the superstructure.

In this case, rear wheel boxes may have to be fitted in the floor of the van to allow the correct wheel movement.

Figure 3.14
If the floor is constructed using crossmembers arranged at a distance of less than 700 mm from one another and properly connected so as to provide a rigid self-supporting structure, the use of longitudinal runners may not be required (refer to Figure 3.15).

To ensure the crossmembers have the necessary stability and to prevent vehicle chassis from becoming stiff towards the front, the instructions given in point 3.4.1 should be followed.

**Figure 3.15**

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

**Front bulk-head**

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

**Bodies integrated with the cab**

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

Connecting the body to the cab:
- the structure must not be welded to the cab, only mechanical fixings must be used;
- the body structure must be self-supporting and must not be supported by the cab;
- all parts of the cab that have been modified in any way must be protected against oxidation and corrosion (see point 2.2).
3.4.2 Tipper boxes

The use of tilting platforms at the rear and on all three sides generally subjects the frame to considerable stress. The following instructions must therefore be observed.

a) It is advisable to use a stabiliser on models where IVECO offers the feature as an option.

b) The subframe 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)
   - and be stiffened at the rear by box-type construction and crossbraces (see Figure 3.6 and 3.7). Connections for fastening to the vehicle frame must be flexible (brackets or straps) at the front while at the rear they must be rigid (plates) (v. Figure 3.11) to allow the additional structure to contribute extra stiffness. It is possible to use omega brackets on vehicles originally equipped with such brackets.

c) Rear pivot for the body must be arranged on the subframe and it must be positioned as close as possible to the rear suspension rear mount. In order not to affect vehicle stability during the flatbed tilting stage and not to increase stress on the frame excessively, it is advisable to respect the distance between the rear spring hinge and mount and the tandem centre line. When this is not possible, the subframe sections fitted must be larger than usual and must offer extra stiffness at the rear. In specific cases where long flatbeds are required for higher volumes, it is advisable to adopt bigger wheelbases instead of creating longer overhangs.

d) Particular care must be taken when positioning the lift device in terms of ensuring that the supports are strong enough and setting up an accurate and convenient attachment position: in any case, with the aim of reducing localised load size, it is advisable to position the load in front of the overall assembly created by the flatbed plus payload.

e) For both under floor and front end tipping gear installations it is recommended that appropriate stabiliser acting as a guide for the stroke of the tipping body, are fitted.

f) The hinge of the lifting unit must be mounted on the subframe.
   The useful volume on the body must conform - with the consideration of the maximum permissable mass on the axles - to the density of the material that is to be transported (a density mass of approx. 1600 kg/m³ is to be used for excavated material). When freight having a low density is transported, the useful volume may be increased within the limits established for the maximum height of the centre of gravity of the payload plus the fixtures.

g) The Bodybuilders must see to it that the functioning and safety of all parts of the vehicle (for instance, the positioning of lights, tow hook etc.) is safeguarded, in full compliance with the current safety regulations it must also be ensured that vehicle stability is guaranteed during tilting operations once the structure has been added.
Figure 3.16


Table 3.5

<table>
<thead>
<tr>
<th>Models</th>
<th>Minimum reinforcing longitudinal</th>
<th>Modulus of resistance Wx (cm³)</th>
<th>Dimensions (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35C, 40C</td>
<td></td>
<td>19</td>
<td>80x50x5</td>
</tr>
<tr>
<td>45C, 50C, 60C, 65C, 70C</td>
<td></td>
<td>36</td>
<td>100x60x6</td>
</tr>
</tbody>
</table>
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 Fitter must follow, the allowed masses and the prescriptions for use. Below are some general instructions.

**Fifth wheel mounting**

The purpose of installing a suitable structure such as a subframe (see Figure 3.17) is not only to distribute the load bearing on the fifth wheel, but also to ensure the chassis receives appropriate support for torsion and bending. Table 3.6 gives the minimum dimensions to use for the longitudinal runner sections.

Moreover, for its execution bear in mind that:
- the structure must be adequately dimensioned to handle the vertical and horizontal loads transmitted to it by the fifth wheel;
- reference should be made to what is set forth under point 3.1 for the characteristics of the structure material;
- the upper and lower surfaces of the structure must be flat to provide a good support on the vehicle frame and the base of the fifth wheel;
- The component parts of the structure, particularly in cases where it consists of several parts, must be joined to one another by welding and/or rivets so as to form a single unit;
- The mounting of the structure to the tractor must be made with brackets at the front and shear resistant plates in the central area and at the rear of the chassis. The fixing of the structure must be made with grade 8.8 bolts fitted with self-locking nuts in sufficient number and diameter to withstand the longitudinal and transverse forces.

<table>
<thead>
<tr>
<th>Models</th>
<th>Wheelbase (mm)</th>
<th>Minimum reinforcing section</th>
</tr>
</thead>
<tbody>
<tr>
<td>35C, 50C</td>
<td>3450</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modulus of resistance Wx (cm³)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24</td>
</tr>
</tbody>
</table>
Figure 3.17

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 the fifth wheels featuring the loading capacity, dimensions and performance levels as declared to be suitable for the intended purpose by the respective manufacturers may be used on IVECO vehicles.

In accordance with the national and/or international standards and regulations, fifth wheels must comply with the requirements and shall be of the approved types. Regarding fifth wheel fixing to the supporting structure, the number of screws to be used, dimensions, longitudinal and transverse retainer positions, the instructions given by the fifth wheel manufacturer must be adhered to.

The fifth wheel must not be modified in any way whatsoever, since it is an essential component to the vehicle and public safety.

**Braking system**

The Body Builder must provide the specific braking system for the semi-trailer.

---

The braking system shall be designed and executed with the greatest care, due to its being of critical importance for the vehicle’s and public’s active safety.

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

The braking system performance (service, emergency and parking brakes) shall comply with the national standards and regulations or EC Directives, depending on the total weights achieved, in terms of deceleration, behaviour when hot, response time, etc.

The technical documents for the adherence and compatibility curves must also be prepared for the authorities that require them (unless otherwise provided for).

IVECO, on request, can provide the technical documentation giving the specifications of the system and braking capacity of the original vehicle.
Air compressors suitable for semi-trailer braking are available from the manufacturers who supply the vehicle’s original components and parts.

**Electric system**

The electric system must be fitted in accordance with the general instructions given in point 2.16.

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For vehicles with ESP system, see point 2.15.5.

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**Combining the tractor with the semi-trailer**

The semi-trailers must not feature such construction characteristics as excessively flexible chassis, unsuitable braking capacity, etc. that may badly affect the operational conditions of the complete articulated truck on the road. When combining the tractor with the semi-trailer all the respective movements must be checked under the various operating conditions. All the necessary safety requirements must be met in compliance with national and EC regulations applying to the vehicles on-road use.
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 used to support the load on the tractor unit must be in the form of the subframe. Other limits may be specified from time to time.
### 3.7 Installation of Tanks and Containers for Bulk Materials

As a general rule, the installation of tanks and containers on our vehicles requires the use of an appropriate auxiliary frame. Table 3.7 contains the guidelines for the dimensions of the longitudinal runners to be used for the auxiliary frame.

#### Table 3.7 - Installing a tank

<table>
<thead>
<tr>
<th>Models</th>
<th>Wheelbase (mm)</th>
<th>Minimum reinforcing longitudinals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Modulus of resistance Wx (cm²)</td>
</tr>
<tr>
<td>35C, 40C, 45C, 50C</td>
<td>All</td>
<td>16</td>
</tr>
<tr>
<td>60C, 65C, 70C</td>
<td>Up to 3750</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Above 3750</td>
<td>26</td>
</tr>
</tbody>
</table>

Tankers, or more generally, structures which are torsionally very rigid, must be fitted so that the vehicle chassis retains sufficient and gradual torsional flexibility, by avoiding areas of high stress.
In order to define the elastic connection, the rigidity characteristics of the vehicle chassis as well as the area where the connections are to be installed and the operation for which it is intended must be taken into account.

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

Tanks may be mounted directly onto the vehicle chassis without fitting a subframe providing the following conditions are observed:
- the distance between saddles must be determined depending on the load to be transmitted and must not exceed 800 mm;
- saddles must be fitted so as to allow an even distribution of the load over a suitable large surface. Suitable brackets must be provided between the saddles to limit the longitudinal and transverse forces;
- other anchoring solutions shall be approved by IVECO;
- self-bearing tanks may be positioned directly on the chassis by means of suitable mountings located immediately behind the cab and in the area of the rear axle. The number and distribution depends on the wheelbase a minimum of 2 mountings each side are to be used on vehicles with a short wheelbase;
- the mounting brackets must be long enough to spread the load over the top flange 400 mm minimum and be positioned next to the suspension mountings.
  To permit the necessary torsional movements of the chassis, elastic front mountings should be used.

The installation of two or more separate containers or tanks on the vehicle requires the use of a subframe that permits good distribution of the load and an adequate torsional rigidity for the chassis/subframe using shear resistant connections. A good solution is to use a rigid connection which joins the containers to one another. So shall the minimum ratio of the front axle weight and the vehicle’s overall weight when the vehicle is fully loaded (see point 1.13).

In consideration of the nature of this equipment, special attention must be paid to limiting the height of the centre of gravity as much as possible so as to ensure good handling (see point 1.13). It is recommend that if not already fitted stabilising bars must be used.

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

When building containers for flammable liquids all the installation must comply with all safety requirements required for the safe operation of the vehicle as well as all current National / EC regulations.
3.8 Installation of cranes

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

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

Stabilisers must be used while the crane is operating. As a general rule, the installation of a crane requires the use of a suitable subframe, whose construction must take into account all general specifications relating to it (see point 3.1). For the dimensions of the longitudinal runners required for the subframe refer to 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 for instance a crane is to be fitted to a tipper which has its own subframe which has a greater section modulus (Wx) than that required for the crane then the tipper subframe should be used. In all applications the structure or ancillary requiring the greater section modulus (Wx) must be used.

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

Figure 3.19

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

- \(g\) = gravity acceleration, equal to 9.81 m/s².
- \(W_L\) = 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 Body Builder must verify each time the vehicle's stability and take all the necessary precautions to ensure correct operation. Both the crane manufacturer and the Body Builder are to define the type and number of stabilizers and make the subframe depending on the maximum static moment and the crane position.
3.8.1 **Crane Behind the Driver's Cab**

The mounting of the subframe onto the chassis frame will as a rule, be performed by using the standard brackets (see Figure 3.20) to which are added, if necessary, other flexible anchorages (brackets or clamps) so that the flexibility and torsional characteristics of the chassis frame remain unchanged.

The dimensions and the subframe to be used for this type of installation are specified in Table 3.6.

For on-road vehicles only if the height of the subframe runner profile has to be reduced (e.g. to lower the total height of the vehicle) the mounting of the subframe may be carried out with shear resisting connections. For these applications, the minimum dimensions of the reinforcing runner are specified in Table 3.9.

The use of runners with a constant cross-section is recommended over the entire useful length of the vehicle. Any possible gradual reduction of the cross-section of the runners is permissible in those areas in which the flexional moment induced by the crane assumes values that correspond for those of boxes marked “A” in Tables 3.8 and 3.9.

The subframe for the crane may be integrated with the body longitudinal runner as shown in Figure 3.20 Length “Lv” must not be less than 35% of the wheelbase for vehicles with forward-control cab when the body runner has a smaller cross-section.

**Figure 3.20**
When installing cranes on crew cab vehicles (e.g., 6+1), extend the subframe appropriately under the cab (see Figure 3.2), otherwise it may be necessary to limit crane rotation, depending on its capacity, so as not to exceed the bending moment allowed for the chassis.

The installation of cranes on vehicles used on rough roads may involve making elastic connections between the chassis and the frame in the front and central parts, so as not to excessively restrain the chassis torsion movement (refer to Figure 3.8). Since the crane is, in such cases, virtually connected only to the frame, the longitudinal runner dimensions must be suited to withstand the moments generated by the cranes operation.

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

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

**NOTE** Tables 3.8 and 3.9 show that the subframe material yield limit is 360 N/mm².

---

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

<table>
<thead>
<tr>
<th>Models</th>
<th>Chassis section at the centre line (mm)</th>
<th>Crane capacity ( \mathbf{M}_{\mathbf{G}} ) max (kNm)</th>
<th>0-20</th>
<th>20-30</th>
<th>30-40</th>
<th>40-50</th>
<th>50-60</th>
<th>60-70</th>
<th>70-80</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min. value of subframe section modulus ( W_x ) (cm³)¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35C, 40C</td>
<td>182x70x4</td>
<td>21</td>
<td>36</td>
<td>57</td>
<td>89</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45C, 50C</td>
<td>182x70x4</td>
<td>21</td>
<td>36</td>
<td>57</td>
<td>89</td>
<td>105</td>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60C, 65C, 70C</td>
<td>184x69x5</td>
<td>19</td>
<td>21</td>
<td>46</td>
<td>57</td>
<td>89</td>
<td>105</td>
<td>E</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Models</th>
<th>Chassis section at the centre line (mm)</th>
<th>Crane capacity ( \mathbf{M}_{\mathbf{G}} ) max (kNm)</th>
<th>0-20</th>
<th>20-30</th>
<th>30-40</th>
<th>40-50</th>
<th>50-60</th>
<th>60-70</th>
<th>70-80</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min. value of subframe section modulus ( W_x ) (cm³)¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35C, 40C</td>
<td>182x70x4</td>
<td>19</td>
<td>21</td>
<td>31</td>
<td>57</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45C, 50C</td>
<td>182x70x4</td>
<td>19</td>
<td>21</td>
<td>31</td>
<td>57</td>
<td>89</td>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60C, 65C, 70C</td>
<td>184x70x5</td>
<td>19</td>
<td>19</td>
<td>21</td>
<td>46</td>
<td>57</td>
<td>89</td>
<td>E</td>
<td></td>
</tr>
</tbody>
</table>

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.
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.

In consideration of the particular distribution of the weight on the vehicle, wherein the load is concentrated on the rear overhang, and in order to ensure the rigidity that is necessary for good performance on the road and when the crane is in operation, the subframe must be strengthened and stiffened in relation to the capacity of the crane. Box-type construction sections (see point 3.1) and brackets are to be used in the area of the rear suspension and rear overhang - length Lv shown on Figure 3.21 Care must also be taken to ensure that the transition from box-type to open section is a gradual process as illustrated in Figure 3.3.

In the area that is affected by the box-type section, the subframe must be secured to the chassis of the vehicle by means of shear-resistant joints (i.e. an adequate number of plates spaced at most 400 mm from each other), whereas elastic mountings are to be used in the front part. Due care must be taken to ensure that under any load conditions, the ratio of the weight on the front axle to the rear axle or axles, do not exceed the limits set for the vehicle (see point 1.13).

As the required stiffness of the subframe depends on various factors (i.e. crane capacity, size of the supporting subframe, vehicle weight, chassis overhang) we cannot give information for all possible conditions. For this reason, if required, the Bodybuilder will have carry out vehicle stability tests. If, as a consequence of such tests, the subframe stiffness proves insufficient the bodybuilder will have to achieve this objective by means of alternative methods.

The rear overhang of the crane (length Lv, see Figure 3.21) must be limited as much as possible in order to ensure good driving characteristics of the vehicle and acceptable stress conditions. This value must not exceed 40% of the wheelbase.

NOTE Table 3.10 shows that the subframe material yield limit is 360 N/mm².

<table>
<thead>
<tr>
<th>Models</th>
<th>Total torque Mg max (kNm)</th>
<th>0-20</th>
<th>20-30</th>
<th>30-40</th>
<th>40-50</th>
<th>50-60</th>
<th>60-70</th>
<th>70-80</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min. value for the subframe section modulus Wx (cm³)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35C, 40C</td>
<td>122x70x4</td>
<td>32</td>
<td>57</td>
<td>71</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45C, 50C</td>
<td>122x70x4</td>
<td>32</td>
<td>57</td>
<td>71</td>
<td>110</td>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60C, 65C, 70C</td>
<td>184x69x5</td>
<td>23</td>
<td>23</td>
<td>32</td>
<td>42</td>
<td>71</td>
<td>E</td>
<td></td>
</tr>
</tbody>
</table>

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

The installation of removable cranes on the rear overhang may be carried out according to the specifications of the preceding paragraph provided that the type of anchorage used between the crane and the subframe does not cause additional stress to the vehicle’s chassis.

In consideration of the fact that the vehicle may be used with or without the crane, we recommend recording on the body the position of the useful load consistent for the two types of operating condition.

If the vehicle retains its ability to tow a trailer, all regulation concerning the proper coupling of the vehicle must be observed.
3.9 Installation of Tail Lifts

The dimensions of the longitudinal runners to be used when installing tail lifts can be assessed as follows:
- by means of Table 3.11, with the standard rear overhangs and mean bending moments induced by tail lifts; depending on their capacity. In the table, the minimum capacity values are specified above which suitable stabilisers must be used;
- with different lengths of the rear overhang and with special tail lifts (e.g., of aluminium), the bending moments induced on the chassis frame can be defined with the information in Figure 3.22;

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

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

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

![Figure 3.22](image)

\[ M [N\text{m}] = W_L \times A + W_{TL} \times B \text{ for tail lifts without stabilizers} \]
\[ M [N\text{m}] = W_L \times C + W_{TL} \times D \text{ for tail lifts with stabilizers} \]
The Bodybuilder must consider each time the necessity of using stabilisers even in those cases where merely in terms of stress of the chassis their use may not appear to be necessary. When evaluating the need for stabilisers in relation to the capacity of the platform, the stability and attitude of the vehicle resulting from the deflection of the suspension during loading operations must also be considered.

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

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

To compensate for the elastic movement of the chassis, which is inevitable when the tail lift is in operation, the Bodybuilder may make use of longitudinal runner profiles of larger size in comparison to the one indicated in Table 3.11.

The dimensions of the sections shown in Table 3.11 are for standard rear overhangs. For longer overhangs you need to check whether it is necessary to fit larger sections or stabilizers (see Figure 3.22).

NOTE The installation of tail lifts must be carried out with due regard for the maximum permissible weights on the rear axle or axles and of the minimum load established for the front axle (see point 1.13). if this should not be the case the rear overhang will have to be reduced.

When electro-hydraulic tail lifts are installed, it is necessary to check that the capacity of the batteries and the alternator is adequate (see point 2.16).

IVECO recommends fitting a switch to disconnect the electric circuit of the tail lift from the vehicle electric circuit when the tail lift is not working.

The Bodybuilder is responsible for any modification to the rear underrun guard or for installing a different type (see point 2.19) and for maintaining the visibility of the rear lights. For the departure angles, for the installation of any tow hook and full compliance with all relevant National and EC regulations.

<table>
<thead>
<tr>
<th>Models</th>
<th>Wheelbase (mm)</th>
<th>Tail lift capacity, kN (kg)</th>
<th>Minimum value subframe section modulus Wx (cm³)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3 (300)</td>
<td>5 (500)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.5 (750)</td>
<td>10 (1000)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.5 (1250)</td>
<td>15 (1500)</td>
<td></td>
</tr>
<tr>
<td>29L, 35 S</td>
<td>-</td>
<td>16</td>
<td>21</td>
<td>E</td>
</tr>
<tr>
<td>35C, 40C, 45C, 50C</td>
<td>3000 + 3450</td>
<td>21</td>
<td>26 + S</td>
<td></td>
</tr>
<tr>
<td>35C, 40C, 45C, 50C</td>
<td>3750 + 4100</td>
<td>21 + S</td>
<td>26 + S</td>
<td></td>
</tr>
<tr>
<td>45C, 50C</td>
<td>4350 + 4750</td>
<td>26</td>
<td>26 + S</td>
<td></td>
</tr>
<tr>
<td>60C, 65C, 70C</td>
<td>3450 + 3750</td>
<td>26</td>
<td>26 + S</td>
<td></td>
</tr>
</tbody>
</table>

1) Material yield limit = 360 N/mm²

Notes.

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

S = Stabilizers must be fitted.

As far as the van versions are concerned, tail lifts with capacity of up to 3kN (300 kg) may be fitted, provided local reinforcements are fitted to the chassis frame. For higher capacities, the installation must be examined each time.
3.10 Recovery Vehicles

Installing breakdown equipment is generally done after choosing a specific subframe to ensure even load distribution and correct connections with the chassis of the component parts and assemblies to handle the vehicle to be recovered. If the vehicle to be recovered has to be lifted and towed, the towing weights, vertical loads at the hook and the minimum ratio between the weights on the front and rear axle must be observed. (These are defined in the specific authorizations issued by IVECO). The Bodybuilders must use special plates / stickers to indicate the specific conditions for which transport is authorized (towing weight, load at hook, maximum speed, etc.).

3.11 Municipal, Fire-fighting and Special Services

Preparing municipal vehicles such as compactors, compressors or road sprinklers in many cases requires:
- building a subframe which is particularly strong at the rear or elastic mountings at the front of the vehicle;
- shortening the rear overhang of the chassis. When very short overhangs are required, the chassis may be shortened immediately behind the rear spring hanger (or after the anti-roll bar connection in the case of pneumatic suspension), keeping the cross member connection to the chassis intact;
- fitting a vertical exhaust behind the cab;
- using rear suspensions that are more rigid or with asymmetrical springs;
- rearranging the rear lights.

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

The installation of snow removal equipment on the front of the vehicle, such as blades or plows, requires the use of suitable supporting structures and entails observance of the specifications contained in point 2.3 concerning the connection to the chassis. Furthermore, all government requirements and regulations governing the application of this type of equipment must be observed. The functional characters and possible use of the original items located at the vehicle front (e.g., towing hook) must not be affected. Otherwise the Body Builder must provide for similar items in accordance with the safety standards and regulations.

An increase of the maximum load permitted on the front axle may, on request, be approved for most of the IVECO models, when the latter are used as snowploughs and driven at moderate speed. Compliance with the requested load must be documented and guaranteed by the bodybuilder that carries out the installation.

3.13 Winch Installation

The winch installation on the vehicle should be positioned on one of the following points:
- on the front of the frame (front installation);
- on vehicle chassis behind the cab;
- between vehicle side members, centre or displace on one side;
- on the end of the frame.

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

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

When specific requests are made for commercially available types of winch, we suggest choosing those equipped with hydraulic systems that can be operated through the hydraulic pumps already used for equipment previously installed on the vehicle (tipping bodies, crane etc.).

Should mechanical winches be used the drive transmission must conform to the instructions given at points 4.1 and 4.2.

For worm screw type winches the power take-off system arrangement should take into account the low performance of such a drive system.

Electrical winches should be used for low power requirements and for short periods of use because of the limited capacities of the battery and alternator.

All safety requirements, national and EC regulations must be complied with.
3.14 Special body conversions

When the special body conversions (some examples listed below) are carried out, the general operating criteria previously detailed must be followed.

As referred to in paragraph 1.8, the vehicles manufactured by IVECO conform to the requirements set by the standards and regulations in force. The Body Builder must ensure and comply with these requirements as regards the operations carried out, especially in cases of body conversions that involve carrying people.

3.14.1 Chassis-cowls

They are prepared especially for the installation of bodies or special body versions, such as mobile shops, motor homes, etc. Comply with the instructions and precautions specified in the technical documents (chassis diagram) that IVECO provide.

3.14.2 Motor Homes

Particular attention must be given to ensure the total weight of the vehicle is observed and the individual axles are not over or under loaded. A sufficient load margin should be left to allow for the total number of people to be carried with essential items, such as:
- luggage, curtains, sports equipment;
- water tank capacity, toilet facilities food;
- gas bottles, etc.

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

For any work to be carried out on the rear overhang, see the instructions given in point 2.5.

Special attention must be paid when making compartments for installing gas bottles. This must be done in compliance with all current regulations, taking all the necessary safety precautions.
3.14.3 Installing an aerial platform

The choice of aerial platform is determined by taking into account the specifications of the platform required to allow for vehicle performance.

The aerial basket and its payload must be positioned in accordance with permitted load limits.

When applying the aerial basket, it will be necessary to comply with specific legal requirements, national regulations (e.g. CUNA, DIN) and international regulations (e.g. ISO, CEN), after checking which are required for the specific vehicle type.

Stabilisers must be used during working stages. The aerial basket must be fitted to the vehicle on a suitable subframe. To construct the subframe, comply with general requirements (see point 3.3), and also refer to tables 3.2 and 3.3 for section dimensions.

The Bodybuilder must also:

- be careful to construct the subframe in such a way as to avoid abrupt changes in cross-section, safeguard the frame against stress concentration points and minimise front overhang (see attached photo);

adjust vehicle lift/lower speed by modifying the hydraulic system to include flow modulating valves;

minimise lifting of the front axle off the ground in relation to the vehicle’s horizontal attitude.

- Specific cases must be checked each time. Request specific authorisation from IVECO.

Figure 3.23

DETAIL OF FIRST SUBFRAME FASTENING

- adjust vehicle lift/lower speed by modifying the hydraulic system to include flow modulating valves;
- minimise lifting of the front axle off the ground in relation to the vehicle’s horizontal attitude.

Specific cases must be checked each time. Request specific authorisation from IVECO.

The Bodybuilder must check vehicle stability each time and take all the necessary precautions for correct use. The crane manufacturer and the Body Builder are responsible for determining the type and number of stabilisers and for constructing a subframe suited to the maximum static moment and crane position.
Overhead platforms on 29L - 35S vehicles

The installation of this conversion on 29L-35S (single wheeled) vehicles is possible after fitting special reinforcement straps (which may be ordered by quoting specification CCM N° 14205).

Figure 3.24

The minimum thickness of the straps must be 4 mm and they must be long enough to cover the frame longitudinal members in front of the cab block areas and to the rear of the subframe first fastening (see Figure 3.24); the total length must be at least 1050 mm.

Additional straps must be fastened to the lower frame wing using rivets spaced no more than 110 mm apart and they must be made out of high-strength steel.
### SECTION 4

**Power take-offs**

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</tr>
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</tr>
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</tr>
<tr>
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<td>4.6.2.3 Engine speed control for power take-off</td>
<td>4-14</td>
</tr>
</tbody>
</table>
4.1 General Specifications

Different types of power takeoffs (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.

\[
P(CV) = \frac{M \cdot n \cdot i}{7023} \quad P(kW) = \frac{M \cdot n \cdot i}{9550}
\]

- \( P \) = 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.

Continuous applications are those envisaging long power take-off durations. If the application is comparable to that of a stationary motor, the possibility of reducing specified values to allow for application conditions (engine cooling, transmission, etc.) should be considered.

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

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

To respect the instructions of the transmission manufacturer, particular care will be taken in the design stage with the mechanism (angles, n° of revs, moment) from the power take-off to the using appliance and with the dynamic behaviour in the realisation stage. This means that:

- the dimensions should take into consideration the forces which might occur under maximum power and torque conditions
- to obtain good homokinetic results angles must be made with the same value at the ends of the shafts (see Figure 4.1) and the max value can be 7°
- the Z solution will be preferable to W, as smaller loads are exerted on the bearings of the power take-off and of the unit to be controlled. In particular, when it is necessary to create a transmission line with the sections inclined in space at an angle $\phi$ (as shown for example in figure 5.1), it must be remembered that the homokinetic result of the whole can be guaranteed only if the intermediate section is equipped with forks offset at the same angle $\phi$ and if the condition of equality is respected between the end angles $\chi_1$ and $\chi_2$. For transmissions employing multiple sections, the instructions given at point 2.8.2 should be followed.

**Solution Z**

![Figure 4.1 Solution Z](image)

**Solution W**

![Figure 4.1 Solution W](image)

**Figure 4.2**

![Figure 4.2](image)
4.2 Power Take-off from Gearbox

It is possible to take drive off the gearbox lay shaft by means of flanges or fastenings located in the side part to the left of the gearbox.

The technical characteristics necessary are given in the documentation supplied upon request for the various gearboxes. Table 4.1 shows available torque levels for the different types of power take-off with ratios between output rpm and engine rpm.

The values refer to the conditions indicated in the table.

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

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

The power take-off applied to the gearbox must only be used when the vehicle is stationary and must be engaged and disengaged when the clutch is disengaged to avoid excessive stress on the synchronisers during gear change. For special situations when the power take-off is used and the vehicle is moving the gear must not be changed.

For gearboxes equipped with a torque converter, the same power take-offs used for normal gearboxes are, as a rule, used. It should be carefully noted that, when the engine r.p.m. is below 60% of the max. value the converter will be in the phase of hydraulic r.p.m.; in this phase, depending on the absorbed power, the r.p.m. of the power take-off is subject to oscillation despite the fact that the engine r.p.m. is constant.

Figure 4.3

![Image of power take-off from gearbox]

1. 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

The transmission ECU and the Body Computer (BC) will need to be reprogrammed when a PTO is applied after-market. Interventions on the electrical and pneumatic system are required. Read paragraph 4.6 “PTO management” carefully before applying a PTO.

Electronic control unit reprogramming operations must be carried out in accordance with the instructions given in IVECO manuals using the appropriate diagnostic tool (available from IVECO dealerships and IVECO authorised workshops) and providing information on the PTO used.

<table>
<thead>
<tr>
<th>Gearbox</th>
<th>PTO opt</th>
<th>PTO</th>
<th>Assembling position</th>
<th>Output</th>
<th>Direction of rotation (1)</th>
<th>Flange</th>
<th>Max. torque Cmax (Nm) (2)</th>
<th>Total PTO ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>55300</td>
<td>06364</td>
<td>20Z1</td>
<td>Sideways</td>
<td>Rear</td>
<td>Clockwise</td>
<td>Pump</td>
<td>120</td>
<td>1.00</td>
</tr>
<tr>
<td>65400</td>
<td>06365</td>
<td>23Z2</td>
<td>Sideways</td>
<td>Rear</td>
<td>Clockwise</td>
<td>Pump</td>
<td>180</td>
<td>1.04</td>
</tr>
</tbody>
</table>

(1) When viewing the PTO output from the front.
(2) 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 to declare the warranty on the gearbox null and void if the causes of any malfunctions can be traced back to the PTO and, in that case, if the PTO installed by the Body Builder is not the same type as those indicated in Table 4.1.

NOTE A power take-off other than the one provided for by IVECO cannot be used on vehicles equipped with automatic transmission (6AS400) since manual clutch control is not available.

Figure 4.4

Direction of running

PTO TYPE 20Z1
Direct Application of Pumps

When the application of pumps of other equipment (e.g. for the control of tipping apparatus or cranes) is carried out directly from the power take-off, without the use of intermediate shafts and after checking that the size of the pump permits margins of safety with chassis and engine unit (cross member, transmission shaft etc.), the static and dynamic torques exerted by the mass of the pump and by the power take-off should be checked for compatibility with the resistance of the walls of the gearbox.

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

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 are equipped with a flange for the direct installation of pumps with 4-hole UNI attachment. 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 Euro 4.

4.4 Power Take-off from Drive line

Authorisation to apply a power take-off on the transmission after the gearbox is issued following examination of the full documentation, which must be submitted to IVECO.

The various power and torque values will be evaluated as each occasion arises on the basis of the conditions of use.

As a general rule, bear in mind that:
- the drive take-off may be operated only when the vehicle is stationary;
- the power take-off r.p.m. is dependent on the gear selected;
- the power take-off must be located immediately downstream of the gearbox. For vehicles with the drive line in two or more sections, the power take-off may also be fitted at the flexible support included between the first and second sections (respect the indications given in point 2.8.2);
- the angles of the drive line on the horizontal plane and vertical plane must be kept as close as possible to the original values;
- masses and rigidity added to the drive line must not provoke a loss of balance or abnormal vibrations or damage the transmission drive line (from engine to axle) either during vehicle movement or during operation with the motor running;
- the power take-off must be fixed to the chassis with its own suspension.

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

In general the use of these power take-offs is planned for apparatus requiring a continuous power supply.

4.5.1 Torque drawing from engine front end

Power is taken from the front part of the crankshaft via belt-driven transmissions where the torque requirement is limited (e.g. air conditioning unit drives).

The data shown in the table refer to a drawing made with a special pulley made according to the construction examples shown in Figure 4.5.

Table 4.2 - Power take-off from the front of the engine

<table>
<thead>
<tr>
<th>Engine</th>
<th>Engine code (1)</th>
<th>( n_{\text{max}} ) (rpm) (2)</th>
<th>Max. no-load speed (r.p.m.)</th>
<th>Max. torque that can be taken (Nm)</th>
<th>Max. inertia moment (kgm²)</th>
<th>Max. bending moment (Nm) (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1A Series</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.10</td>
<td>FIAE0481F*A</td>
<td>3900</td>
<td>4500</td>
<td>35</td>
<td>0.005</td>
<td>42</td>
</tr>
<tr>
<td>.10</td>
<td>FIAE0481F*B</td>
<td>3900</td>
<td>4500</td>
<td>35</td>
<td>0.005</td>
<td>42</td>
</tr>
<tr>
<td>.11</td>
<td>FIAE0481U*A</td>
<td>3900</td>
<td>4500</td>
<td>35</td>
<td>0.005</td>
<td>42</td>
</tr>
<tr>
<td>.11</td>
<td>FIAE0481U*B</td>
<td>3900</td>
<td>4500</td>
<td>35</td>
<td>0.005</td>
<td>42</td>
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<td>4500</td>
<td>35</td>
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<td>42</td>
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<td>3900</td>
<td>4500</td>
<td>35</td>
<td>0.005</td>
<td>42</td>
</tr>
<tr>
<td>.14</td>
<td>FIAE0481H*B</td>
<td>3900</td>
<td>4500</td>
<td>35</td>
<td>0.005</td>
<td>42</td>
</tr>
<tr>
<td>FIC Series</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.14</td>
<td>FICE3481L*C</td>
<td>3500</td>
<td>4200</td>
<td>35</td>
<td>0.005</td>
<td>42</td>
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<td>.15</td>
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<td>3900</td>
<td>4500</td>
<td>35</td>
<td>0.005</td>
<td>42</td>
</tr>
<tr>
<td>.15</td>
<td>FICE0481F*B</td>
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<td>4500</td>
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<td>0.005</td>
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<td>4600</td>
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<td>0.005</td>
<td>42</td>
</tr>
<tr>
<td>.18</td>
<td>FICE0481H*B</td>
<td>3900</td>
<td>4600</td>
<td>35</td>
<td>0.005</td>
<td>42</td>
</tr>
<tr>
<td>.18</td>
<td>FICE3481C*C</td>
<td>3500</td>
<td>4200</td>
<td>35</td>
<td>0.005</td>
<td>42</td>
</tr>
</tbody>
</table>

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

Figure 4.5
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. 6364/6365);
b) PTO (opt. 6364/6365) 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).

For a description of specifications and procedures for use, see the specific Guidelines issued on 12/2008.

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 Body builder is left free to decide where to position the PTO controls.
**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.
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;
   - release the handbrake and 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 PTO is engaged
   - gear changes (involving automatic disengagement) are not possible
   - the vehicle must not exceed 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.
4.6.2.2 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 PTO is engaged**
- gear changes (involving automatic disengagement)
- are not possible- the vehicle must not exceed 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 4.7).

Figure 4.7

In addition, the control unit is able to check the set speed and keep or restore the balance according to the applied load.

**NOTE** Engine speed may be adjusted only with the vehicle stationary, gearbox in neutral, handbrake on and brake pedal not depressed.

After setting the selector in Figure 4.7 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.

In each position set on the PTO multiple switch and if the RES key is held down for at least 5 seconds, it is possible to store a new rpm number (with the PTO active).

This function is active by default for ‘position 0’ (multiple switch not connected) and requires specific activation by the IVECO service network if it is to be used for the other PTO modes (multiple switch positions 1, 2 and 3).

**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 4.7 OFF or by pressing the brake or clutch pedal (if applicable).
## SECTION 5

**Special instructions for electronic subsystems**

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<td>Disconnecting ECUs</td>
<td>5-19</td>
</tr>
</tbody>
</table>
## 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**

5.2 Bodybuilder connectors

To use these connectors, a set of connectors, terminal and protective rubber caps must be ordered from Parts.

- Any interface between the body building and the vehicle shall take place through diodes and relays (clean contacts), unless otherwise specified in the manual.

- DIRECT CONNECTION TO THE BODY BUILDER CONNECTOR IS STRICTLY PROHIBITED. FAILURE TO COMPLY WITH THIS PRESCRIPTION WILL CAUSE THE WARRANTY TO IMMEDIATELY BECOME NULL AND VOID.

5.2.1 Inside the cab

Two connectors (61071 and 72068) are envisaged in the new Daily. Their purpose is to interface the Fitters with the vehicle electric system.

Figure 5.2

The connectors are located behind the passenger side compartment in an easily accessible area.
5.2.2 20 pin Bodybuilders connector (61071)

For effective and correct interfacing by Body Builders with the vehicle electrical system, IVECO has prepared specific connection points to use for additional systems. Such provision is necessary to avoid tampering with and interfering in the basic system, in order to guarantee functional intactness and, therefore, the validity of the contractual warranty itself.

20-way connector

Figure 5.3

<table>
<thead>
<tr>
<th>Code number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>500314817</td>
<td>20-way male holder joint</td>
</tr>
<tr>
<td>500314820</td>
<td>Male contact for 0.3 to 0.5 mm² cable</td>
</tr>
<tr>
<td>500314821</td>
<td>Male contact for 1 to 1.5 mm² cable</td>
</tr>
</tbody>
</table>
### Table 5.2 - Basic functions of 20 pin connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Signal</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Engine start-up</td>
<td>Input max 20 A</td>
<td>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.</td>
</tr>
<tr>
<td>2</td>
<td>Engine shut-down</td>
<td>Input max 10 mA</td>
<td>When a positive signal is supplied, the vehicle engine is shut down.</td>
</tr>
<tr>
<td>3</td>
<td>Service braking</td>
<td>Output max 500 mA (interface with uncoupling diode)</td>
<td>When the brake pedal is pressed, a positive signal is generated.</td>
</tr>
<tr>
<td>4</td>
<td>Vehicle stationary</td>
<td>Output max 500 mA</td>
<td>When the vehicle is stationary, a positive signal is obtained</td>
</tr>
<tr>
<td>5</td>
<td>Parking brake</td>
<td>Output max 500 mA (interface with uncoupling diode)</td>
<td>When the handbrake is operated, an earth signal is generated.</td>
</tr>
<tr>
<td>6</td>
<td>Battery positive</td>
<td>Output max 15 A</td>
<td>Positive protected by fuse present on dashboard node F49.</td>
</tr>
<tr>
<td>7</td>
<td>Exterior light activation</td>
<td>Output max 500 mA</td>
<td>When the sidelights are on, a positive signal is obtained</td>
</tr>
<tr>
<td>8</td>
<td>Alternator operation</td>
<td>Output max 500 mA (interface with uncoupling diode)</td>
<td>When the vehicle alternator is cranked, a positive signal is obtained.</td>
</tr>
<tr>
<td>9</td>
<td>Clutch engagement</td>
<td>Output max 500 mA (interface with uncoupling diode)</td>
<td>When the clutch pedal is pressed, the circuit is open.</td>
</tr>
</tbody>
</table>
### Table 5.2 - (continues) Basic functions of 20 pin connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Signal</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Cruise Control SET +</td>
<td>max 10 mA</td>
<td>With the vehicle stationary, the engine rpm number is increased at each pulse (50 engine rpm per pulse). When the vehicle is travelling faster than 30 km/h, the vehicle speed can be adjusted. +12 V = Set+ active. Open circuit = Set+ not activated.</td>
</tr>
<tr>
<td>13</td>
<td>Cruise Control SET -</td>
<td>max 10 mA</td>
<td>With the vehicle stationary, the engine rpm number is decreased at each pulse (50 engine rpm per pulse). When the vehicle is travelling faster than 30 km/h, the vehicle speed can be adjusted. +12 V = Set- active. Open circuit = Set- not activated.</td>
</tr>
<tr>
<td>14</td>
<td>Cruise Control OFF</td>
<td></td>
<td>I no r d e t o a c t i v a t e C r u i s e C o n t r o l a n d e b l e t o u s e t h e +/ - / Resume commands, a positive signal must be applied as soon as the key is turned to the first click. When the positive signal is turned off, the Cruise Control is turned OFF again. +12 V = Cruise Control active. Open circuit = Cruise control inactive.</td>
</tr>
<tr>
<td>15</td>
<td>Cruise control RESUME</td>
<td></td>
<td>With the vehicle stationary, when a positive signal is issued, the Resume command adjusts the rpm back to a stored value. When the vehicle is travelling faster than 30 km/h, the vehicle speed is adjusted to the stored speed. +12 V = Resume active. Open circuit = Resume not activated.</td>
</tr>
<tr>
<td>16</td>
<td>Not connected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Earth</td>
<td>max 15 A</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Not connected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Not connected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Not connected</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.2.3 12 pin bodybuilders connector (72068)

12-way connector

Figure 5.4

Counterpart to be coupled onto the vehicle

Table 5.3

<table>
<thead>
<tr>
<th>Code number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>500314815</td>
<td>12-way male holder joint</td>
</tr>
<tr>
<td>500314820</td>
<td>Male contact for 0.3 to 0.5 mm² cable</td>
</tr>
<tr>
<td>500314821</td>
<td>Male contact for 1 to 1.5 mm² cable</td>
</tr>
</tbody>
</table>
### Table 5.4 - Basic functions of 12 pin connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Signal</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed limiter</td>
<td>Input max. 10 mA</td>
<td>When an earth signal is supplied, vehicle speed is limited to 30 km/h</td>
</tr>
<tr>
<td>2</td>
<td>Programmable speed limiter</td>
<td>Input max. 10 mA</td>
<td>When earth is connected, limitation is activated/deactivated at the current speed</td>
</tr>
<tr>
<td>3</td>
<td>Multiple switch</td>
<td></td>
<td>Available for power take-offs</td>
</tr>
<tr>
<td>4</td>
<td>Speed signal (B7)</td>
<td></td>
<td>See Specification 1</td>
</tr>
<tr>
<td>5</td>
<td>Automatic key</td>
<td>Input max 500 mA</td>
<td>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:</td>
</tr>
<tr>
<td>6</td>
<td>Power take-off activation</td>
<td>Output max 500 mA</td>
<td>When the power take-off is engaged, an earth signal is present</td>
</tr>
<tr>
<td>7</td>
<td>Horn</td>
<td>Output max 10 mA</td>
<td>Additional horns (interface with relays)</td>
</tr>
<tr>
<td>8</td>
<td>Multiple switch</td>
<td></td>
<td>Available for power take-offs</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Engine revs (r.p.m.)</td>
<td></td>
<td>See Specification 2</td>
</tr>
<tr>
<td>11</td>
<td>Not connected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Not connected</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Specification 1**

**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**

Below are the electric features of the signal:

- Minimum voltage level $< 1.5 \text{ V}$
- Maximum voltage level $> 5.5 \text{ V}$
- Max. frequency 1.5 kHz
- Pulse duration (TH) $0.67 \div 6.7 \text{ ms}$
- Pulse duration tolerance 1%
- Load impedance minimum value $5.5 \text{ k}\Omega$
- Load impedance typical value $15 \text{ k}\Omega$
The body builder 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>
<thead>
<tr>
<th>Features</th>
<th>Condition</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-IO</td>
<td>To container / VBat-</td>
<td>1.2</td>
<td>1.85</td>
<td></td>
<td>nF</td>
</tr>
<tr>
<td>R-IO</td>
<td>To VBat+</td>
<td>2.57</td>
<td>2.65</td>
<td></td>
<td>kΩ</td>
</tr>
<tr>
<td>I-Out</td>
<td></td>
<td></td>
<td></td>
<td>50</td>
<td>mA</td>
</tr>
<tr>
<td>t-Rise</td>
<td>Signal output time from 10% to 90%</td>
<td></td>
<td></td>
<td>10.5</td>
<td>μs</td>
</tr>
<tr>
<td>R-ON</td>
<td>Output current &lt; 0.05 A</td>
<td></td>
<td></td>
<td>33.8</td>
<td>Ω</td>
</tr>
<tr>
<td>V-I</td>
<td></td>
<td>5.4</td>
<td>13.5</td>
<td>15.7</td>
<td>V</td>
</tr>
<tr>
<td>Pulses per rev</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.7

The body builder 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 $V_{dc}$ 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.
Provision for a rear additional centralized door locking

Opt 5864 "central locking + predisposition for an additional central rear locking system" makes available an output on the central pillar. The body builder may fit a remote controlled door on the body in combination with the remote-controlled central door locking system (lock/release).
Opt 5865 "anti-theft system + predisposition for an additional central rear locking system" offers the anti-theft system in combination with RCL (Remote Control Lock) + predisposition for rear door.
Opt 5864 or opt 5865 offers, on van versions, a key with three-button remote-control (one button is for the rear door) to control the additional rear door in addition to a button (lock/unlock all doors) on the dashboard.
The connector is located beneath the plastic pillar trim behind the passenger seat (see Figure 5.8).

Figure 5.8

The Diagram below shows the connection between to rear door plug and the Bodybuilder’s Actuator/close door switch (Figure 5.9).

Figure 5.9

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**(1)

**Figure 5.10**

![Diagram of door connections](image)

- Pin1: Driver/Passenger Door actuator
- Pin3: Driver/Passenger Door actuator
- Pin2: Closed door Signal
- Pin4: Closed door Signal

Bodybuilder's Actuator

Bodybuilder's Switch Button

Open circuit → when door is closed
Closed circuit → when door is opened

---

(1) Only for Stripped Camper Cowl, Chassis cowl and Stripped Chassis Cowl version.
5.2.4 Daily Antitheft System

The antitheft system is controlled by the body computer and is only perimeter type. It is composed of the following elements:
- a key with remote control, buttons for remote locking/unlocking;
- motors for closing driver’s and passenger’s doors, side sliding doors and rear door (when presents);
- door opening sensors (Perimetric) and engine bonnet opening sensor (Perimetric);
- alarm siren (12 V).

Current absorption of the antitheft device is 30-40 mA.
The body builder must include a 'door closed' signal to ensure that the anti-theft system monitors for any theft attempts, including in the engine compartment.

**Engine bonnet button connecting diagram**(2)

![Diagram showing engine bonnet button connections]

Pin1: Closed door Signal
Pin2: Closed door Signal

Open circuit → when door is closed
Closed circuit → when door is opened

(2) Only for Stripped Camper, Chassis cowl and Stripped Chassis Cowl version with opt 5865
Function

When locking is requested from the remote control, the Body-Computer checks the antitheft system closing the doors and activating the perimetric sensors controlled by the antitheft system.

When enablement is issued to the antitheft system, the direction indicators flash once per second.

Once the antitheft system is ON it activates the siren in the following conditions:
- vehicle's door opening (driver, passenger). In case of Stripped Camper, Chassis Cowl and Stripped Chassis Cowl, the doors and sensors must be correctly mounted by the bodybuilder;
- lateral or rear door opening (in VAN models) or rear door opening (if requested Rear Door Provision and door correctly mounted by bodybuilder);
- engine bonnet opening (in case of Stripped Camper, Chassis Cowl and Stripped Chassis Cowl, the sensor must be installed by the bodybuilder if function wanted);
- cut off the wires of the siren;
- vehicle battery wires disconnected.

The alarm siren cycle is composed (default configuration) of 26 seconds of sound and a break of 6 seconds. This cycle is repeated for a maximum of 10 times (320 seconds). Each 3 cycles the system analyses the status of the conditions to turn off the alarm siren if no required.

Antitheft deactivation

If order to deactivate the antitheft system do as follows:

a) push on the remote opening pushbutton on the key;

b) insert a correct key and turn it on to the ignition position in order to let the immobilizer recognize the key.

In both cases:
- body-Computer ECU will switch OFF the alarm;
- turn indicators will flash twice.
5.3 Electronic control units

5.3.1 Precautions to be taken with the installed electronic control units

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

• in case of actions to the taken on the chassis, which require electric arc welding, the following shall be done:
  - disconnect the cable from the positive terminal of the battery and connect the same to the chassis ground
  - remove the connector form the control units
  - remove the control unit form the chassis (in case of welds made quite near the control unit)
  - make the welds by using direct current
  - ground the welding machine as near the welding point as possible
  - do not lay the battery cables parallel to the vehicle’s electric cables;
• do not remove and/or connect the connectors from the control units when the engine is running or the control units are powered;
• remove ECUs whenever special operations are to be performed at temperatures exceeding 80 ºC;
• 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;
• connect and disconnect the battery terminals with caution because they generate voltages that adversely affect vehicle electronic systems and ECUs. Before carrying out any operation on the electrical system, it is always necessary to disconnect the battery, first removing the negative terminal and then the CBA;
• do not power the components interlocked with electronic modules with the vehicle's nominal voltage via movable cables;
• connect control units equipped with metal casings to the system earth by means of screws or bolts unless otherwise specified.

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.

When operations are completed, if work has being carried out on the electrical system, restore the wiring to its original condition (routing, protections, strapping), preventing the cable from coming into contact with metal surfaces of the structure that could affect its integrity under all circumstances.
**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 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.

5.3.3 Disconnecting ECUs

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

Follow the instructions below carefully before disconnecting an ECU:

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

### Daily PASSENGER TRANSPORT

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<td>A-14</td>
</tr>
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<td>A.8</td>
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<td>A-16</td>
</tr>
</tbody>
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**NOTE** Keep to what is prescribed in the previous sections for everything not specified in this appendix.
A.1 Specific instructions for the chassis

A.1.1 Transport of the chassis/vehicle

The non-bodied chassis does not run and must therefore always be transported on a two-tier car carrier.

A.1.1.1 Lifting the chassis for transporting it on ships, trains etc.

To load the chassis on ships, train, cars, etc., it must be hoisted only by the axles or wheels. Fixing the crane cables to the cross-pieces and chassis members is strictly forbidden. The chassis must be secured on the transportation vehicle only by the axles. The wheels must support the chassis weight.

A.1.2 Chassis delivery and storage

A.1.2.1 Delivery

Before delivery by IVECO, the chassis undergoes stringent quality controls.

For chassis delivery, refer to paragraph 1.11.1 of these Directives.

When the Fitter receives it, he must inspect it to detect any faults that may have occurred during transport; IVECO will not accept claims for missing material or faults occurred during transport, after delivery and not recorded in the specific forms, bearing the carrier’s signature.

When making a claim, mention the vehicle identification number: this number is located on the core of the right rail in the wheel arch near the suspension.
A.1.2.2 Storage

After carrying out the delivery inspection, if the vehicle must stay in storage, it must be protected properly, taking into consideration the storage time and the area's environmental conditions. The Fitter is responsible for the protection of delicate components, such as the instrument panel, the batteries, the fuse box and relays, etc., to avoid jeopardising their long life and reliability.

A.1.3 Indications and data on weights and weighing

The bodywork design and the positions of the seats and baggage compartment must be implemented without exceeding the given overall weight. Weighing must be carried out per axle and with the total weight. To take the manufacturing tolerances into consideration, the weight related data will have a tolerance of ± 3% for models 40C, 50C and 65C. Consequently before fitting-out the weight of the finished, cowled vehicle and its weight distribution on the axles must be determined;

A.2 General rules for fixing the bodywork to the chassis

Particular care must be taken when joining the chassis elements to the bodywork side elements: these joins must be made so as to guarantee perfect strain transmission. These unions are specially critical at the front and rear elements of the wheelhouses, since stress transmission to the rest of the structure happens mainly through these points. Excessive pressure at the body union points should be avoided. Body structure should be so conceived that it forms a bearing unit together with the chassis; bending, torsion and thrust stresses should be absorbed by the whole unit. This is necessary due to the relative flexibility of the chassis. For further information, contact IVECO Quality Department. Bodywork can be welded or screwed to the structure. Mixed jointing is not recommended. Bodywork elements shall be fixed by means of intermediate plates.
A.3 Building the bodywork

A.3.1 Introduction

This chapter provides instructions for assembling the bodywork, with the main technical aspects and regulations. The definition of the bodywork is left to the Fitter’s decisions, according to requirements.

A.3.2 Bodywork configuration

A.3.2.1 Main dimensions

For all vehicles the entry and exit angles must be 7° or larger.
The construction of the bodywork must allow the steering radii established by Rule 107/ECE or by the equivalent regulation in the country in which the registered vehicle will be driven.
The vehicles must be equipped with mudflaps behind each wheel, up to a height above the ground of 75 mm.
The bodywork configuration must allow inspection of the vehicle identification number.

A.3.3 Vehicle interior configuration and capacity

For all classes of vehicles, the area available for the ducting and the number of seats will comply with the provisions of Rule 107/ECE or the regulations in the country where the vehicle is sold.

A.3.4 Driver station - characteristics

Heating system:

it is mandatory to have hot air outlets for the windscreen demister.

Sun visor:

a sun visor must protect the driver; it should be foldable and adjustable in height while the vehicle is running. A sun screen or a tinted glass can be fitted, total or partial.

Driver’s seat:

it will be adjustable in height, inclination and longitudinal distance to the steering wheel. Each one of these adjustments will be independent. The seat should have the suitable suspension and will be upholstered with perspirable material.

Driver station - ergonomics:

the instrument panel supplied with the unit may be incorporated in the dashboard or the instruments may be dismantled and fitted on a panel produced by the Fitter; in this case it is advisable to maintain the relative position of the instruments/controls to obtain optimum ergonomics. The panel supplied as standard complies with the Directive on “Indicators, controls and telltale lights”. If a modification is introduced, this aspect should be checked and type-approved, if required.
When the bodybuilder fits the floor and upholsters the driver’s seat, care must be taken not to limit the pedal travel.
A.3.5 Requirements concerning the fire-proofing materials

The coating materials used inside the engine bay must be non-inflammable and not liable to become impregnated with fuel or lubricant, unless the material is coated with a waterproof layer.

The rest of the materials used on the bodywork must be flame retardant or self-extinguishing, depending on the number of passengers that can be carried and/or on the regulations in force in the country for which the vehicle is intended.

The polyamide piping and electrical wiring harnesses laid next to an engine hot zone, like the manifold or exhaust pipe, turbocharger, etc., must be protected by a metal screen made of aluminium or stainless steel, covered with insulating material.

A.4 Noise levels and heat insulation

The bodybuilder is obliged to ensure that the completed vehicle complies with acoustic level requirements, specific for each case. The body builder will also be obliged to type approve the vehicle, if necessary.

A.4.1 External noise

Standards require a maximum level of 78 dBA and add a limit to the acoustic level generated by the outlet of air-driven components.

A.4.2 Interior noise: measurement method

The measurements are carried out according to the Regulation ISO 5128, and at a stabilised speed:

- with manual gearbox:
  - 60, 80 and 100 km/h in the second-last gear
  - 80 and 100 km/h in top gear.

- with automatic gearbox:
  - 40, 60, 80 and 100 km/h, with button D.

Regarding the position we must 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.

In these conditions, the results obtained must never exceed the following values:

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Without air conditioning at maximum power</th>
<th>With air conditioning at maximum power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front area</td>
<td>72 dBA</td>
<td>74 dBA</td>
</tr>
<tr>
<td>Rear area</td>
<td>74 dBA</td>
<td>76 dBA</td>
</tr>
</tbody>
</table>
A.4.3 Soundproofing coating

During execution of the insulation, ensure that the installation is as continuous as possible, avoiding interruptions; it is very important for the communicating hatches between the passenger area and the areas of the engine, gearbox, axle, etc. to have a good seal.

For the covering of the floor, door bays and steps, it is recommended to use a panel with a minimum thickness of 15 mm with an interposed layer of Septum.

The fixtures of the bays for the steps must not have any cracks or interruptions that let noise reach the inside. The same applies to the part under the doors.

To respect the rule that establishes 80+1 dBA of external noise, it may be necessary to cover the bottom of the engine bay.

Below is a list of materials with sound deadening characteristics that have been checked in the IVECO laboratories, the use of which guarantees the specified results.

All the materials used must comply with fire prevention regulations. Ensure that the fixing of the insulating and sound-deadening materials is sufficiently long-lasting to prevent them becoming detached and coming in contact with hot parts or moving parts. It is recommended to use good quality adhesives or metal links or other fastening devices.

<table>
<thead>
<tr>
<th>Octave band</th>
<th>Absorption coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>0.18</td>
</tr>
<tr>
<td>250</td>
<td>0.3</td>
</tr>
<tr>
<td>500</td>
<td>0.7</td>
</tr>
<tr>
<td>1000</td>
<td>0.9</td>
</tr>
<tr>
<td>2000</td>
<td>0.95</td>
</tr>
<tr>
<td>4000</td>
<td>0.98</td>
</tr>
</tbody>
</table>

A.4.4 Thermal insulation

The most critical points from the point of view of thermal insulation are the points where operating temperature is higher: turbo, manifold and exhaust pipes, silencer and the electrical retarder rotors.

When a part of the bodywork made of non-metal material is close enough to one of the critical points to be able to reach a higher temperature than the admissible level, it must be protected by a layer of insulating felt coated with aluminium sheeting able to support a stabilised temperature of 250°C and a maximum conductivity coefficient of 0.1 W/mK.

In any case, the minimum distance between a critical point and the insulation will be 80 mm at least.

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.
To maintain a comfortable temperature inside the vehicle, the insulation in the engine bay and gearbox must have a minimum conductivity coefficient of 0.08 W/mK and a minimum temperature of 85 ºC. The correct arrangement of the soundproofing-thermal insulating material must cover all the distance surface between the engine compartment and the interior, also covering steps, walls and any other surface which may let heat in.

In areas that do not require sound insulation, such as the area close to the electrical retarder, insulation with polyurethane foam with similar characteristics to the ones described before is allowed.

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 of the vehicle for cold climates must ensure that the temperature of the engine cooling water never falls below 80 ºC during stabilized operation.

The thermostat fitted in the circuit ensures correct engine operation if the opening temperature is 68 ± 2 ºC.

If despite the insulation the engine runs at less than 80 ºC or not enough hot water arrives at the heater, it is necessary to install a pre-heater which in any case is obligatory when the vehicle normally works at temperatures lower than 0 ºC.

The minimum power supplied by the pre-heater must be 25000 kcal/hour.

Once the engine insulation has been determined, its efficiency must be measured by carrying out 2 tests on the cooling system capacity and on the heating system capacity respectively.

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 to inform IVECO of the results obtained and to ask for advice about any changes in preparation.
A.5 TRANSPORT OF PEOPLE version specifications

A.5.1 Seat supporting structures and how to fix them

It is not allowed to anchor the seats directly to the floor or on the wheelhouse arches. A structure must be used that is suited to distribute the stress on the whole internal surface of the floor in the passenger area. This structure must be made of sections of galvanised plate of 2 mm with plates of suitable thickness for the thread. The following figures show examples of structures and methods of anchoring the fixed seats and the seats on guides (IVECO Drawings n° 504156623, 504208108 and 504208109).

Figure A.1

Floor frame for fixing seats
Diagram for installing fixed seat
Diagram for installing seats on guides
A.5.2 Cutting and assembly of the rear baggage compartment

The volume of the baggage compartment is conditioned by the technically admissible maximum weight of the vehicle and by the weight on the axles; the size and position must be decided by structural tests and calculation.

A.5.3 Cutting and assembly of the entrance door

The execution of the door bay must guarantee the non deformability of the structure in the area of the bay itself.

**NOTE** Modification (cutting) of the door bay is allowed only on the top or on the bottom, never on both parts.

European Directive 2001/85/EC or ECE107 must also be respected with regard to the access bay and steps.

Figure A.4

A.5.4 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.5.5 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. If the rear door is used, reference must be made to the methods for fixing the loading bay as described in paragraph 3.9 of these Directives.
A.6 Electrical power draw-off

A.6.1 People Transport version CBA

The CBA distribution and protection control unit for passenger transport versions is fitted with a disconnector to turn off loads in emergencies.

Figure A.5

1) Starter motor power supply
2) Engine compartment control unit power supply
3) Dashboard control unit secondary load power supply
4) Dashboard control unit primary load power supply
5) Optional box power supply
6) Wiring for Body Builders’ interface
7) Disconnector
8) Disconnector status indicator (red = open; off = closed)
9) Yellow button for resetting disconnector

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 disconnector;
- turn the key to STOP;
- re-start the vehicle.
A.7  Bodybuilder connectors

NOTE For information about Bodybuilder connector 20 PIN (61071), refer to Section 5.

A.7.1  Bodybuilder connector (72068) 12 PIN for Transporting People

Figure A.6

Counterpart to be coupled onto the vehicle

Table A.3

<table>
<thead>
<tr>
<th>Code number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>500314815</td>
<td>12-way male holder joint</td>
</tr>
<tr>
<td>500314820</td>
<td>Male contact for 0.3 to 0.5 mm² cable</td>
</tr>
<tr>
<td>500314821</td>
<td>Male contact for 1 to 1.5 mm² cable</td>
</tr>
<tr>
<td>Pin</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Hazard warning light repetition</td>
</tr>
<tr>
<td>2</td>
<td>Speed limiter programming</td>
</tr>
<tr>
<td>3</td>
<td>Turn and slide door status</td>
</tr>
<tr>
<td>4</td>
<td>Speed signal (B7)</td>
</tr>
<tr>
<td>5</td>
<td>Door status</td>
</tr>
<tr>
<td>6</td>
<td>Not connected</td>
</tr>
<tr>
<td>7</td>
<td>Supplementary acoustic signal control</td>
</tr>
<tr>
<td>8</td>
<td>Emergency handle lock</td>
</tr>
<tr>
<td>9</td>
<td>Turn and slide door operation</td>
</tr>
<tr>
<td>10</td>
<td>Engine revs (r.p.m.)</td>
</tr>
<tr>
<td>11</td>
<td>Not used</td>
</tr>
<tr>
<td>12</td>
<td>Not used</td>
</tr>
</tbody>
</table>

See specification 1 - Section 5

See specification 2 - Section 5
A.8 Road tests

a) Before starting the road test, check the following with the vehicle stationary:
   - 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) During a journey of 50 km on various roads (flat, curves, climbing, descent and irregular asphalt), the following parameters must be checked:
   - 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.

As regards the operation of the "systems", it must be checked 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.

As regards economics, the following must be checked:
   - 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) At the end of the journey, it is necessary to:
   - check for any leaks of water, oil, fuel and brake, steering and clutch fluid;
   - Check and retighten the wheel nuts to 290-350 Nm.
APPENDIX B

Daily CNG and CNG with Recovery Mode

B.1 General Information
B.2 Safety Rules
  B.2.1 During refuelling
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B.6 Bodybuilder connectors
B.7 Power takeoff

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 odorising 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 currently in force.

Operations on the engine fuel system using components other than those type-approved by IVECO (even if type-approved as an Independent Technical Unit) require the vehicle to repeat the type approval process.

The financial costs of repeating the type approval are payable by the bodybuilder.

Operations on the engine fuel system that modify the original architecture (for example: removal or addition of cylinders, cylinder fastening type) are subject to IVECO approval.
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.3.4)

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

<table>
<thead>
<tr>
<th>PART</th>
<th>TORQUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Methane gas system</strong></td>
<td></td>
</tr>
<tr>
<td>High-pressure hose connection (M12 x 1) to refuelling filler (Italy) - Figure B.2</td>
<td>24 ÷ 26</td>
</tr>
<tr>
<td>High-pressure hose connection (M12 x 1) to refuelling filler (CEE) - Figure B.2</td>
<td>33 ÷ 37</td>
</tr>
<tr>
<td>High-pressure hose connection (M12 x 1) to VBE 498 solenoid check valve - Figure B.2</td>
<td>33 ÷ 37</td>
</tr>
<tr>
<td>High-pressure hose fittings - Figure B.3</td>
<td>38 ÷ 42</td>
</tr>
<tr>
<td>Medium-pressure hose connection (M18 x 1.5) to pressure reducer Figure B.1</td>
<td>67 ÷ 73</td>
</tr>
<tr>
<td>Medium-pressure hose connection (M18 x 1.5) to fitting on cylinder head Figure B.1</td>
<td>67 ÷ 73</td>
</tr>
<tr>
<td>Stainless steel stiff pipe connection (M12 x 1) to pressure reducer</td>
<td>33 ÷ 37</td>
</tr>
<tr>
<td>Stainless steel stiff pipe connection (M12 x 1) to VBE solenoid valve (side opposite check valve)</td>
<td>24 ÷ 26</td>
</tr>
<tr>
<td>Stainless steel stiff pipe connection (M12 x 1) to VBE solenoid valves</td>
<td>24 ÷ 26</td>
</tr>
<tr>
<td>Blank plug (M12 x 1) on solenoid valve</td>
<td>33 ÷ 37</td>
</tr>
<tr>
<td>Fittings (M14 x 1.5) connecting pipe to T fittings and cross-fittings - Figures: B.4 - B.5 - B.6</td>
<td>74 ÷ 82</td>
</tr>
<tr>
<td>Fittings (M 14 x 1.5) fastening cross fitting to chassis</td>
<td>67 ÷ 70</td>
</tr>
<tr>
<td>Refuelling filler fastening to support (M24 x 1)</td>
<td>60 ÷ 70</td>
</tr>
<tr>
<td>Solenoid valve fastening to cylinders (W28.8 x 1/14&quot;)</td>
<td>260 ÷ 280</td>
</tr>
<tr>
<td>Cylinder support bracket and rear crossmember fastening (M14 x 2)</td>
<td>151 ÷ 184</td>
</tr>
<tr>
<td>Cylinder support strip fastening (M10 x 1.5)</td>
<td>33 ÷ 35</td>
</tr>
<tr>
<td>Bracket fastening to cylinder support rear crossmember (M12 x 1.75)</td>
<td>74 ÷ 90</td>
</tr>
<tr>
<td>Cylinder support rear crossmember fastening (M10 x 1.5)</td>
<td>42 ÷ 51</td>
</tr>
<tr>
<td>Cylinder shelf fastening (M8 x 1.25)</td>
<td>21 ÷ 26</td>
</tr>
</tbody>
</table>

**NOTE** The tightening torques indicated only refer to special original equipment components.
B.3.4 Parts list

Medium-pressure gas line

Figure B.1

![Diagram of medium-pressure gas line](image)


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 an 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

![Diagram of high-pressure gas lines](image)

1. 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 6.4x1.8 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

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

ADJUSTABLE "T"-FITTING

Front tipped, AISI 316 TJ stainless steel

Figure B.5

INTERMEDIATE "T"-FITTING

AISI 316 TJ stainless steel front tipped fitting.

Figure B.6

STaight 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

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 the battery wires and connect them together.
- 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

- Disconnect the electrical connection from the coil.
- Unscrew the outer nut of coil (1) with its O-Ring (2).

Figure B.9

- 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

- 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).
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

- 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

- Fasten the coil holder sleeve ring nut and tighten at a torque of 28 Nm.
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.

**WARNING** Before disconnecting the solenoid valves, empty the system completely following the procedure described in the "Emptying the gas system" chapter.

- 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.

- Remove the screws (2) and remove the cover (1).
Figure B.16

- 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

- Use tool 99355018 (1) to loosen 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.
- tighten the valve by hand through a few turns. Then use specific wrench 99355018 (1) with a torque wrench to tighten to a torque of 270 ±10 Nm.

NOTE In this operation, make sure that tool 99355018 (1), does not damage the VBE valve thermal fuse device.
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 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.

**NOTE** In case of subsequent disassembly, replace the seals with new parts.
B.4 Cylinders

Figure B.19


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) = 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

01/1234/123 = FABER serial numbers
B.4.1 Cylinder scheduled overhauling according to ECE/ONU R 110 standards

Methane gas cylinders for road vehicles must be inspected **EVERY FOUR YEARS** by competent authorities responsible for certifying their validity.

**NOTE** The due date is shown on the cylinders and in the documents supplied with the vehicle.

ECE/ONU R 110 specify the following procedure to be followed in the event of an accident:

- cylinders that have been involved in a vehicle collision (frame) must be inspected by an agency authorised by the manufacturer unless the competent authorities decide otherwise. A cylinder that has not suffered any damage following the collision impact can be returned to service; otherwise the cylinder must be sent back to the manufacturer for examination;
- cylinders that have been subject to the effects of a fire must be inspected by an agency authorised by the manufacturer or scrapped and removed 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

- Remove the screws (2) and remove the cover (1).

Figure B.21

- 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**

This is located in a specific compartment, closed by a built-in cassette.

*Figure B.22*

Use only fuses of the specified type and with the specified current rating; otherwise there is a fire risk. Replace the fuses only after having eliminated the cause of the problem and check the wiring is intact.

<table>
<thead>
<tr>
<th>Fuse</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-12</td>
<td>Right low-beam headlight</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-13</td>
<td>Left low-beam headlight - headlamp trim corrector</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-31</td>
<td>Window regulator electronics/body computer/unit engine compartment control unit</td>
<td>3 A</td>
</tr>
<tr>
<td>F-32</td>
<td>Out swinging door</td>
<td>15 A</td>
</tr>
<tr>
<td>F-33</td>
<td>Air heater/cigar lighter</td>
<td>15 A</td>
</tr>
<tr>
<td>F-34</td>
<td>Current draw</td>
<td>15 A</td>
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<tr>
<td>F-35</td>
<td>Debimeter/ESP8 sensors/Telma/ABS8 electronics</td>
<td>10 A</td>
</tr>
<tr>
<td>F-36</td>
<td>Central locking</td>
<td>20 A</td>
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<tr>
<td>F-37</td>
<td>Various loads under starter key</td>
<td>5 A</td>
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<tr>
<td>F-38</td>
<td>Body computer power supply</td>
<td>10 A</td>
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<tr>
<td>F-39</td>
<td>Air conditioner electronics/back sensor electronics/radio/tachograph/engine compartment control unit</td>
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<td>F-40</td>
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<td>10 A</td>
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<td>F-41</td>
<td>Right heated rear window</td>
<td>10 A</td>
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<td>F-42</td>
<td>ABS8 electronics/camera electronics /NI1 electronics /reversing lights setup socket</td>
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<td>F-43</td>
<td>Windscreen wiper/headlight washer</td>
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<td>F-44</td>
<td>Spare</td>
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<td>F-45</td>
<td>Window regulator electronics</td>
<td>3 A</td>
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<td>Left window regulator</td>
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<td>F-48</td>
<td>Passenger window regulator</td>
<td>25 A</td>
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<td>F-49</td>
<td>Radio electronics/CF or C.S electronics/camera electronics /back sensor electronics/heated seats/setup socket</td>
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<td>F-50</td>
<td>Airbag</td>
<td>5 A</td>
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<td>F-51</td>
<td>Tachograph</td>
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<td>Body computer</td>
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**Table B.2**

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<td>T11</td>
<td>Heated rear window</td>
<td>30 A</td>
</tr>
<tr>
<td>T12</td>
<td>Windscreen wiper/windscreen washer</td>
<td>30 A</td>
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<tr>
<td>T13</td>
<td>Air heater/electric lighter/power socket/window regulator electronics/window regulator</td>
<td>50 A</td>
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B.5.2 Fuse and relay box in the engine compartment (Daily MY 2009 CNG)

Table B.3

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<td>F-1</td>
<td>ABS 8 or EPS 8 or ASR</td>
<td>40 A</td>
</tr>
<tr>
<td>F-2</td>
<td>ABS 8 or EPS 8 or ASR</td>
<td>30 A</td>
</tr>
<tr>
<td>F-3</td>
<td>ECU ESV1 (automated gearbox)</td>
<td>30 A</td>
</tr>
<tr>
<td>F-4</td>
<td>ECU ESV1 (automated gearbox)</td>
<td>30 A</td>
</tr>
<tr>
<td>F-5</td>
<td>Ignition switch</td>
<td>30 A</td>
</tr>
<tr>
<td>F-6</td>
<td>Fan electromagnetic coupling</td>
<td>20 A</td>
</tr>
<tr>
<td>F-7</td>
<td>Side lights</td>
<td>20 A</td>
</tr>
<tr>
<td>F-8</td>
<td>Heater or air conditioner fans</td>
<td>40 A</td>
</tr>
<tr>
<td>F-9</td>
<td>Windscreen washer</td>
<td>20 A</td>
</tr>
<tr>
<td>F-10</td>
<td>Warning horn</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-11</td>
<td>SDU (Injector interface)</td>
<td>15 A</td>
</tr>
<tr>
<td>F-14</td>
<td>Right high-beam headlight</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-15</td>
<td>Left high-beam headlight</td>
<td>7.5 A</td>
</tr>
<tr>
<td>F-16</td>
<td>IAW - Trailer output</td>
<td>5 A</td>
</tr>
<tr>
<td>F-17</td>
<td>Injectors</td>
<td>15 A</td>
</tr>
<tr>
<td>F-18</td>
<td>IAWV 5SF ECU</td>
<td>5 A</td>
</tr>
<tr>
<td>F-19</td>
<td>ELTV</td>
<td>15 A</td>
</tr>
<tr>
<td>F-20</td>
<td>Fuel pump</td>
<td>10 A</td>
</tr>
<tr>
<td>F-21</td>
<td>Fan electromagnetic coupling power supply</td>
<td>5 A</td>
</tr>
<tr>
<td>F-22</td>
<td>Wastegate - Lambda sensor</td>
<td>10 A</td>
</tr>
<tr>
<td>F-23</td>
<td>Heated mirrors and windscreen - 13-pin trailer socket</td>
<td>15 A</td>
</tr>
<tr>
<td>F-24</td>
<td>ECU ESVI - power takeoff</td>
<td>15 A</td>
</tr>
<tr>
<td>F-30</td>
<td>Left and right fog light</td>
<td>15 A</td>
</tr>
</tbody>
</table>
### Table B.4

<table>
<thead>
<tr>
<th>Relay</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>T02</td>
<td>Right and left high-beam headlights</td>
<td>20 A</td>
</tr>
<tr>
<td>T03</td>
<td>Warning horn</td>
<td>20 A</td>
</tr>
<tr>
<td>T05</td>
<td>Power supply to solenoids on cylinders and pressure reduction solenoid</td>
<td>20 A</td>
</tr>
<tr>
<td>T06</td>
<td>Fan electromagnetic coupling power supply</td>
<td>20 A</td>
</tr>
<tr>
<td>T07</td>
<td>Side lights</td>
<td>50 A</td>
</tr>
<tr>
<td>T08</td>
<td>Heater or air conditioner fans</td>
<td>30 A</td>
</tr>
<tr>
<td>T09</td>
<td>ECU IAW-SSF (main relay)</td>
<td>30 A</td>
</tr>
<tr>
<td>T10</td>
<td>Fan electromagnetic coupling power supply</td>
<td>20 A</td>
</tr>
<tr>
<td>T14</td>
<td>Left and right fog lights</td>
<td>20 A</td>
</tr>
<tr>
<td>T17</td>
<td>Windscreen washer</td>
<td>20 A</td>
</tr>
<tr>
<td>T19</td>
<td>Fuel pump</td>
<td>20 A</td>
</tr>
<tr>
<td>T20</td>
<td>MODUS or E.A.SY. diagnosis</td>
<td>20 A</td>
</tr>
</tbody>
</table>

### Table B.5

<table>
<thead>
<tr>
<th>Fuse</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-29</td>
<td>Air suspension</td>
<td>40 A</td>
</tr>
<tr>
<td>F-54</td>
<td>Right low-beam headlight</td>
<td>40 A</td>
</tr>
<tr>
<td>T25</td>
<td>Windscreen wipers on/off</td>
<td>10/20 A</td>
</tr>
<tr>
<td>T26</td>
<td>1st and 2nd windscreen wiper speed</td>
<td>10/20 A</td>
</tr>
<tr>
<td>T27</td>
<td>Heated for rear view mirrors / heated windscreen</td>
<td>20 A</td>
</tr>
<tr>
<td>T30(*)</td>
<td>Activation of brake lights with retarder on</td>
<td>20 A</td>
</tr>
</tbody>
</table>

(*) Present only on Daily “People carrier” with electromagnetic retarder
B.5.3 CNG optional fuse-relay box

Figure B.24

Table B.6

<table>
<thead>
<tr>
<th>Relay</th>
<th>Drawing ref.</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>T04</td>
<td>1</td>
<td>Spare</td>
<td></td>
</tr>
<tr>
<td>T16</td>
<td>12</td>
<td>Headlamp washer</td>
<td>30 A</td>
</tr>
<tr>
<td>T15</td>
<td>3</td>
<td>Air heater</td>
<td>30 A</td>
</tr>
<tr>
<td>T22</td>
<td>4</td>
<td>Air conditioner relay</td>
<td>30 A</td>
</tr>
<tr>
<td>T18</td>
<td>6</td>
<td>Start consent</td>
<td>30 A</td>
</tr>
<tr>
<td>T24</td>
<td>7</td>
<td>Spare</td>
<td></td>
</tr>
<tr>
<td>T23</td>
<td>9</td>
<td>Turning on air conditioning compressor</td>
<td>30 A</td>
</tr>
<tr>
<td>T21</td>
<td>10</td>
<td>Spare</td>
<td></td>
</tr>
</tbody>
</table>

Table B.7

<table>
<thead>
<tr>
<th>Fuses</th>
<th>Drawing ref.</th>
<th>Utilization</th>
<th>Rated capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-55</td>
<td>2</td>
<td>Auxiliary air conditioner</td>
<td>30 A</td>
</tr>
<tr>
<td>F-25</td>
<td>5</td>
<td>Climate control system</td>
<td>30 A</td>
</tr>
<tr>
<td>F-28</td>
<td>8</td>
<td>Rear differential lock</td>
<td>30 A</td>
</tr>
<tr>
<td>F-27</td>
<td>11</td>
<td>Headlamp washer</td>
<td>20 A</td>
</tr>
</tbody>
</table>
B.6 Bodybuilder connectors

NOTE For information on body builders’ connectors, see Section 5 - Paragraph 5.2.
B.7 Power takeoff

The PTO (power takeoff) engagement/disengagement procedures are the same as those described in Section 4 for vehicles with Diesel engine, except for the need (during engagement) to bring the engine speed to 1200 rpm before pressing the PTO dashboard pushbutton (see Figure 4.6).