## MAIN UPDATE DATA

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INTRODUCTION

This publication provides information, features and instructions for transformation and fitting of the vehicle: considering the type of content, it is meant for qualities and specialised staff.

The Body builder is manager of the project and its execution, and must assure compliance with what is set forth in this publication and in the laws in forth.

Any modification, transformation or fitting not described in this manual and not expressly authorized will relieve IVECO of any liability and the warranty, if present, will immediately be null and void.

The same applies to individual assemblies and components; those described in this manual have been deliberated, approved and tested by IVECO and are part of normal production. The adoption of any type of unit that is not approved (e.g. PTO, tyres, horns, etc.) shall relieve IVECO of any responsibility.

IVECO is available to provide information on the implementation of the interventions and to provide instructions for any cases and situations not covered in this publication.

Before performing any operation, it is necessary to:

- verify that you have the manuals for the vehicle model on which you are about to work;
- ensure that all the safety devices (goggles, helmet, gloves, shoes, etc.), as well as the equipment used for work, lifting and transport, is available and working;
- ensure that the vehicle is placed in safe conditions.

At the end of the operation, the operational, efficiency and safety conditions set by IVECO must be restored. Contact the Service network for vehicle calibration if necessary.

Data and information contained in this publication may be outdated as a result of changes adopted by IVECO, at any time, for technical or commercial reasons or due to the need to adapt the vehicle to new legal requirements.

In the event of discordance between the information herein and the actual vehicle, please contact the Product Manager operating on the market before performing any interventions.

SYMBOLS - WARNINGS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
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<tbody>
<tr>
<td>🚨</td>
<td>Danger for persons&lt;br&gt;Failure to comply with these prescriptions can result in the risk of serious injury.</td>
</tr>
<tr>
<td>⚠️</td>
<td>Risk of serious damage to the vehicle&lt;br&gt;Partial or complete non observance of these prescriptions can lead to serious damages to the vehicle and can sometimes result in the guarantee being voided.</td>
</tr>
<tr>
<td>⚠️</td>
<td>General danger&lt;br&gt;Includes the dangers of both above described signals.</td>
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<tr>
<td>🌲</td>
<td>Environmental protection&lt;br&gt;Indicates correct behaviour in order that vehicle use is as environmentally friendly as possible.</td>
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<td>🔴</td>
<td>NOTE&lt;br&gt;Indicates an additional explanation for a piece of information.</td>
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GENERAL INFORMATION

1.1 SCOPE OF THE GUIDELINES

The scope of this publication is to provide information, features and instructions for fitting and transformation of the original IVECO vehicle in order to ensure its functionality, safety and reliability.

These Guidelines also aim to indicate to bodybuilders:

- the quality level to be obtained;
- obligations regarding the safety of operations;
- obligations regarding the objective responsibility of the product.

It should be noted that the collaboration with IVECO is based on the assumption that the bodybuilder uses the maximum of their technical and organisational skills and that operations are technically and perfectly complete.

As outlined below, the topic is extensive and we can only provide the rules and minimum precautions that can allow development of the technical initiative.

Faults or defects caused by total or partial failure to comply with these Guidelines are not covered by the guarantee on the chassis or relative mechanical units.

1.2 TECHNICAL DOCUMENTATION AVAILABLE ELECTRONICALLY

On the website www.ibb.iveco.com the following technical documentation is available:

- Guidelines for transformation and fitting of vehicles;
- technical specifications;
- truck diagrams;
- chassis diagrams;
- other range-specific data.

Requests to access the site must be made exclusively at www.ibb.iveco.com.

1.3 IVECO AUTHORISATION

Modifications or versions indicated in these Guidelines and carried out in full compliance of the instructions provided, do not require any specific authorisation.

If this is not the case, IVECO authorisation is required to carry out:

- particular changes to the wheelbase;
- work on the braking system;
- modifications to the steering system;
- modifications to the stabilizer bars and suspensions;
- modifications to the cab, cab mounts, locking and tilting devices;
- replacing the engine or the "driveline" with electric motor or hybrid systems;
- modifications to intake, engine exhaust and SCR components;
- applications of retarders;
- power take-off applications;
- tyre size variations;
- any modification not included in these Guidelines.
1.4 AUTHORISATION REQUEST

Authorisation requests, when necessary, must be sent to the responsible IVECO Departments on the market. The bodybuilder must provide vehicle data (cab, wheelbase, overhang, chassis No.) and adequate documentation (drawings, calculations, technical report, etc.) showing the realisation, use and operating conditions of the vehicle. The drawings should evidence everything that differs from these instructions. Upon completion of the interventions the bodybuilder shall be responsible for attainment of definitive approval from the competent authority.

1.5 RESPONSIBILITIES

The authorisations issued by IVECO are exclusively related to the technical/conceptual feasibility of the modification and/or fitting. The bodybuilder is therefore responsible for:

- the design;
- the choice of materials;
- the implementation;
- the compliance of the design and implementation to any specific indications provided by IVECO and the laws in force in the countries where the vehicle is destined;
- effects on functionality, safety, reliability and, in general, good behaviour of the vehicle;
- the supply of spare parts for a minimum period of 10 years starting from the last fitting of an order and for all pieces and components that are installed.

1.6 LEGISLATIVE REQUIREMENTS

The Bodybuilder must verify that the final product is compliant, without exception, to all applicable legal requirements, on the national level of each State in which it is registered and/or will circulate (Highway code, Official Regulations, etc.) and on the international level (European Union Directives, ECE Regulations, etc.). It is also necessary to comply with all requirements for accident prevention, instructions for assistance, the environment, etc.

The regulations on accident prevention or the legal indications cited in these Guidelines may be considered the most important, but are not meant in any way to replace or eliminate the obligation and responsibility of the bodybuilder to stay properly informed.

For this reason, IVECO shall not be held liable for any consequences due to errors caused by insufficient knowledge or incorrect interpretation of the legal provisions in force.

1.7 MULTI STAGE TYPE APPROVAL - COLLABORATION (only for vehicles registered in the EU, Switzerland and Turkey)


This procedure requires that each manufacturer is responsible for the type-approval and compliance of the production of systems, components and "separate technical units" produced by the same or applied to the vehicle.

The manufacturer of the vehicle is defined as 1st stage Manufacturer, while the bodybuilder is defined as the 2nd stage or subsequent Manufacturer.
Based on this Directive, IVECO (main vehicle manufacturer) and a bodybuilder intending to launch the multi-stage approval process must sign a specific Collaboration Contract, called Technical Agreement, which sets out the content and reciprocal obligations in detail.

Consequently:

1. IVECO has the responsibility of providing, in the agreed form, the approval documents (EC/ECE approvals) and the technical information necessary for the proper implementation of the fitting and/or transformation (manuals, drawings, specifications);

2. the bodybuilder has the following responsibilities:
   - the design and implementation of modifications to the basic vehicle received from IVECO,
   - attainment of approvals of systems already approved in a previous stage when, due to changes on the basic vehicle the approvals need to be updated,
   - compliance with national/international laws and in particular the laws of the destination country, for all changes made,
   - presentation of the changes made to a technical service, for evaluation,
   - appropriate documentation of the changes made, in order to give objective evidence of compliance to the aforementioned provisions of law (e.g. approval documents/test reports).

Before signing the Technical Agreement IVECO reserves the right to visit the bodybuilder, in order to verify qualifications to carry out the fittings and/or processing for which the above collaboration is requested.

The contents of the Technical Agreement can be evaluated in detail upon request to the Manager for relations with the bodybuilder for the single Market.

## 1.8 WARRANTIES

The guarantee that the work has been performed to standard must be given by the bodybuilder who made the superstructure or modifications to the chassis, in full compliance with the instructions in these Guidelines.

IVECO reserves the right to void the warranty on the vehicle, if:

- unauthorised fittings or transformations have been carried out;
- a chassis not suitable for the fitting or intended use has been used;
- the standards, specifications and instructions, provided by IVECO for proper execution of the work, have not been respected;
- original spare parts or equivalent, or components made available by IVECO for specific operations have not been used;
- safety regulations have not been respected;
- the vehicle is used for purposes other than those for which it was designed.
I.9 QUALITY SYSTEM MANAGEMENT

IVECO has always promoted the training and development of a Quality System for bodybuilders. This requirement is not only due to regulations on product liability, but also to the increasingly higher quality level demands, new organizational forms in various sectors and the search for more advanced levels of efficiency. IVECO therefore considers it appropriate for bodybuilders to be equipped with:

- organizational charts for roles and responsibilities;
- quality objectives and indicators;
- design technical documentation;
- process documentation, including controls;
- plan for product improvement, also obtained through corrective actions;
- post-sales assistance;
- training and qualification of staff.

The availability of ISO 9001 certification, even though not mandatory, is considered very important by IVECO.

I.10 ACCIDENT PREVENTION

Do not allow unauthorised personnel to intervene or operate on the vehicle.

▶ It is forbidden to use the vehicle with safety devices that have been tampered with or are damaged.

▶ Structures and devices installed on the vehicles must comply with the applicable regulations for accident prevention, and with safety regulations required in the individual countries where the vehicles are used.

All precautions dictated by technical knowledge must be taken to avoid damage and functional defects. Compliance with these requirements must be overseen by the bodybuilders of the structures and devices.

▶ Seats, coatings, gaskets, protective panels, etc., may pose a fire hazard when exposed to an intense heat source. Remove them before working with welding and with flames.

I.11 ENVIRONMENTAL ASPECTS

In the study and design phase, the choice of materials to be used by be made carefully, even from the ecological and recycling point of view.

To this regard, please note that:

- it is forbidden to use materials that are harmful to health, or at least which may pose a risk, such as those containing asbestos, lead, halogen additives, fluorocarbons, cadmium, mercury, hexavalent chromium, etc.;
- it is advisable to use materials whose processing produces limited waste quantities and allows easy recycling after first use;
- in synthetic materials of the composite type, it is advisable to use components that are compatible with each other, allowing use with the possible addition of other recovery components. Prepare the required markings in accordance with the regulations in force;
• the batteries contain substances that are very dangerous for the environment. To replace the batteries it is possible to go to
the Service Network, equipped for disposal in accordance with the nature and the law.

▶ To comply with Directive 2000/53 EC (ELVs), IVECO prohibits the in-vehicle installation of components that contain lead, mercury, cadmium and hexavalent chromium; exceptions are made in cases allowed by Annex II of the above Directive.

1.12 VEHICLE MANAGEMENT ON THE PART OF BODYBUILDER

1.12.1 Chassis acceptance

The bodybuilder receiving a chassis/vehicle from IVECO or from a Dealership must perform a preliminary check, notifying of any missing accessories or damage attributable to the transporter.

1.12.2 Maintenance

To preserve the chassis/vehicle in its full efficiency, even while parking in the warehouse, maintenance operations may be necessary within a predetermined time.
The costs incurred for these operations are the responsibility of the owner of the vehicle at that moment (bodybuilder, dealer or customer).

▶ In case of long periods of vehicle inactivity, it is advisable to disconnect the negative pole of the battery to maintain optimal charging status.

1.12.3 Delivery of the vehicle to the end customer

Before delivering the vehicle, the bodybuilder must:

• carry out fine tuning operations (vehicle and/or equipment) and verify functionality and safety;
• for items which will be subjected to the intervention, carry out the controls set out in the Pre Delivery Inspection (PDI) list, available from the IVECO network;
• measure battery voltage with a digital multimeter (2 digit decimal) bearing in mind that:
  1. optimal value is equal to 12.5 V,
  2. between 12.1 V and 12.49 V the battery should be put under a slow charge,
  3. with values less than 12.1 V the battery should be replaced.

Note The batteries must be maintained at regular intervals (refer to IVECO Std. 20-1812 and/or IVECO Std. 20-1804) until delivery of the vehicle to avoid problems of insufficient charging, short circuit or corrosion.
IVECO reserves the right to nullify the guarantee on the battery if the prescribed maintenance procedures are not respected.

• carry out a functional road test (in case of vehicle transformation). Any defects or problems should be notified to the IVECO Assistance Service to verify conditions for inclusion in the PDI costs;
• prepare and deliver to the final Customer the necessary instructions for service and maintenance of the fitting and any added units;
• report new data on special labels;
• provide confirmation that the operations carried out comply with the indications of the vehicle Manufacturer and legal requirements;
• draw up a guarantee covering the changes made.
1.13 VEHICLE NAMES

The commercial name of IVECO vehicles (for example EUROCARGO 120-190) does not match the type approval name. A complete example is provided below.

1.13.1 Type approval name

<table>
<thead>
<tr>
<th>EUROCARGO ML 120 EL 21 /P EVI_D</th>
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</thead>
</table>

- **EUROCARGO** – Vehicle name
- **ML** – Medium Light Range
- **120** – Gross mass - Chassis-cab GVW (no/10 = weight in t)

<table>
<thead>
<tr>
<th>75E</th>
<th>7.5 t</th>
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<tbody>
<tr>
<td>100E</td>
<td>10 t</td>
</tr>
<tr>
<td>120EL</td>
<td>12 t</td>
</tr>
<tr>
<td>140E</td>
<td>14 t</td>
</tr>
<tr>
<td>160E</td>
<td>16 t</td>
</tr>
<tr>
<td>180E</td>
<td>18 t</td>
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</tbody>
</table>

- **EL** – Range code

<table>
<thead>
<tr>
<th>E</th>
<th>Standard Eurocargo</th>
</tr>
</thead>
<tbody>
<tr>
<td>EL</td>
<td>Optimised Eurocargo</td>
</tr>
</tbody>
</table>

- **21** – Engine power (no. x 10 = power in HP)

| 16 | 160 HP |
| 19 | 190 HP |
| 21 | 210 HP |
| 22 | 220 HP |
| 25 | 250 HP |
| 28 | 280 HP |
| 32 | 320 HP |

- **/P** – Suspension

| - | Rear mechanical suspension |
| /P | Rear air suspension |
| /FP | Front and rear pneumatic suspensions |

- **EVI_D** – Emissions level

| EVI_D | Euro VI - Step D |
1.14 TRADEMARKS AND SYMBOLS

Logos, identification trade names and nameplates must not be modified, displaced or removed since the original design appearance of the vehicle must be safeguarded.

The application of trademarks relating to the transformation or outfitting must be authorised. They must not be applied near to the IVECO trade names or logos.

IVECO reserves the right to withdraw its trade names and logos if the above requirements are not met.

1.15 DIMENSIONS AND GROUND

1.15.1 General information

The dimensions and masses of vehicles allowed on the axles are shown in the drawings, the technical descriptions and, more generally, on the documents on the official IVECO website. Defects refer to vehicles in their standard versions; the use of special equipment may lead to changes on the masses and their distribution on the axles.

1.15.2 Vehicle adaptability

The vehicle adaptability limits for each model are mainly defined as:

- distribution of mass on the axles;
- width of mirrors adopted;
- rear under-run protection device position.

The positioning of lights and mirrors, normally set for widths of 2550 mm, is also suitable for special superstructures 2600 mm wide (e.g. refrigerated vans).

1.15.3 Determination of the centre of gravity of the superstructure and the payload

The specific technical documentation for each model (chassis cab layout) illustrates the positions allowed with the standard version vehicle. The masses and the positioning of the individual components of the vehicle are shown on the chassis and weight allocation diagram.

To determine the position of the centre of gravity of the superstructure and the payload, proceed according to the examples given in Figure 2 and the subsequent Note.
2-axle vehicles and 3-axle vehicles with equal loads on the two rear axles

\[ W = \text{Payload plus superstructure} \]
\[ W_1 = \text{Measurement of payload on front axle} \]
\[ W_2 = \text{Measurement of payload on rear axle (or tandem)} \]

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

Note For vehicles with three or more axles, if the load distribution ratio of the masses on the two rear axles based on the load is variable, the "virtual" values of the wheelbase and the centreline between the axles must be determined for the respective load condition, using the indications provided on the chassis cab vehicle screen.

This way, in particular version outfits (e.g. cranes on the rear overhang), the correct positioning can be determined for the centre of gravity of the equipment and the payload, depending on the load carried (see Chapter 3.8).

For the purposes of breakdown of the payload on the axes, it should be considered that this is evenly distributed, except in cases in which the shape of the load surface leads to a different load distribution.

For equipment, the centre of gravity is obvious considered for its actual position.

In the realisation of the superstructure or containers, automatic loading and unloading of the goods transported must be provided to avoid excessive variations of the distribution and/or excessive loads on the axles, providing information for users if necessary.

The Bodybuilder should also provide a suitable anchoring systems for the load on the superstructure, so that transport can occur in maximum security.
1.15.4 **Height of centre of gravity**

For the cab version and no-load vehicle, the value of the height of the centre of gravity is shown on the specific technical documentation for each model (cab version diagram).

For the vehicle complete with super structure and full load, this height must comply with the maximum values allowed by national or international standards, in particular, Directives ECE 13 on longitudinal stability and ECE 111 on lateral stability while driving.

The following cases should be distinguished:

a) fixed loads;

b) mobile loads;

c) loads that result in increased aerodynamic actions.

**a) Fixed loads**

\[
H_t = \frac{W_v \cdot H_v}{W_v + W_s} + H_s
\]

\[
H_s = \frac{(W_v + W_s) \cdot H_t - W_v \cdot H_v}{W_s}
\]

**Control at full load**

- **Hv** = Vehicle centre of gravity height (loaded)
- **Ws** = Height of payload centre of gravity from the ground
- **Ht** = Complete full-load vehicle centre of gravity height
- **Wv** = Vehicle tare weight
- **Ws** = Payload
- **Wt** = Complete vehicle ground at full load
For any inspections with the vehicle set up without payload you can proceed similarly, assuming Ws is only the tare weight of the superstructure (considering for Hs a value appropriate for the load and between the no-load cab version trim and the full-load trim).

b) Mobile loads

In the versions where the load can be moved laterally while cornering (e.g.: suspended loads, liquid transport, animal transport, etc.) high lateral dynamic forces may be generated which may jeopardise the stability of the vehicle.

With reference to the indications of the regulation ECE R11, special attention should therefore be paid to:

- defining the height of the fitted vehicle's centre of gravity and at full load;
- assessing the dynamic forces and the lateral displacement of the centre of gravity;
- considering (for liquids) the density;
- prescribing the implementation of adequate precautions for driving.

Any cases where evaluation is difficult should be submitted to IVECO for approval.

c) Loads that result in increased aerodynamic actions

In outfits characterised by high vertical and surface development (e.g.: advertising panelling), the height of the centre of thrust, determined in the case of cross-wind, must be evaluated very carefully.

> Even with the low centre of gravity, a vehicle fitting that has a high surface area may not provide sufficient lateral stability and may be exposed to the danger of tilting.

Special attention must therefore be paid:

- in defining the height of the fitted vehicle's centre of gravity and at full load,
- in assessing the aerodynamic forces,
- prescribing the implementation of adequate precautions for driving.

Any cases where evaluation is difficult should be submitted to IVECO for approval.

1.15.5 Adoption of stabilizer bars

The application of additional or reinforced stabiliser bars, reinforcing the springs or rubber elastic elements (in accordance with the procedure outlined in Section 2.7 - Paragraph "suspension" (➡ Page 35)) helps to compensate for any high values of the centre of gravity of the payload.

In this case, the operation must be carried out on the rear axle, since acting on the front may give rise to an incorrect sensation of higher vehicle stability and higher safety limits. Interventions on the front axle can be carried out in the presence of concentrated loads behind the cab (for example, cranes) or of superstructures with high rigidity (for example, vans).

1.15.6 Observance of the permitted masses

All the limits shown on IVECO documentation must be respected.

The assessment of the maximum mass on the front axle in any load condition is particularly important, in order to ensure the necessary steering characteristics in all road conditions. Special attention must therefore be paid to vehicles with concentrated load on the rear overhang (e.g.: cranes, tail lifts, trailers with central axle) and vehicles with a short wheelbase and high centre of gravity (for example, silo vehicles, cement mixers).
Note  In the positioning of the auxiliary bodies and superstructure, a proper load distribution in the transverse direction must be ensured. For each wheel, a variation in the nominal load (50% of the load on the corresponding axis) of ±4% can be allowed (for example, load allowed on the axle 10,000 kg; permit load for each side of the wheel from 4800 to 5200 kg) in compliance with what is permitted by the tyres, without affecting the braking characteristics and the driving stability of the vehicle.

Unless otherwise specified individual vehicles, the minimum values of the mass on the front axle must be:

- 20% of the actual mass of the vehicle, if the load is evenly distributed,
- 25% of the actual mass of the vehicle, if the load is concentrated on the rear overhang.

Actual mass is meant to include any vertical load resulting from the trailer.

The rear overhang of the superstructure must be implemented in full compliance with the permitted axle loads, the minimum load required on the front axle, length limits, the position of the tow hook and the under-run protection as envisaged by various standards and regulations.

1.15.7 Variations on the permitted masses

Special exemptions from the maximum permissible masses may be granted for specific uses, for which, however, there are precise limits for use and reinforcements to be made to parts of the vehicle. These exceptions, if they exceed the limits of the law, must be authorised by the Administrative Authority.

In the authorisation request, you must indicate:

- type of vehicle, wheelbase, chassis number, intended use;
- division of the tare weight on the axles (in fitted vehicles, e.g.: crane with flatbed), with the position of the payload centre of gravity;
- any proposals for strengthening the parts of the vehicle.

Reduction of the permitted mass on the vehicles (downgrading) can lead to interventions on the suspensions and brakes; In these cases IVECO can provide the necessary indications.

1.16 CORRECT OPERATION OF THE VEHICLE UNITS AND ACCESSIBILITY

In carrying out the transformations and applying any type of equipment, there should be no alteration to what enables the proper functioning of the vehicle units and parts under various working conditions.

For example:

- free access must be guaranteed to the places requiring inspection, or periodic controls (e.g. battery, access to the air suspension compressor assembly) and, in the case of enclosed superstructures (e.g. camper, vans), special compartments and doors should be provided;
- it must be guaranteed the free tipping of the cab and the possibility of operating the relevant pump; Figure 6 shows the longitudinal dimensions and the rotation radius of the available cabs, as well as the angle that the bar inserted in the pump must have without obstacles in relation to the upper limit of the subframe;
1. **Possible fitting size limit**

- it must still be possible to disassemble the assemblies for maintenance interventions or assistance (e.g. battery replacement; removing muffler see Figure 8);
- in outfilings which include the tipping of the side boards, consider the size of the parts which protrude most from the vehicle, in order to avoid limitations to tipping or damage to the parts. These dimensions are shown on the diagrams for Bodybuilders available on the website [www.ibb.iveco.com](http://www.ibb.iveco.com);
- conditions should not be affected regarding cooling (front grille, radiator, air passages, cooling etc.), fuel supply (pump positioning, filters, pipe diameter, etc.) and engine air intake;
- in the case of closed outfilings (campers, mobile shops, vans) sufficient ventilation of the brakes and sufficient aeration of the battery case and muffler unit must be guaranteed by means of openings or windows in the paneling in front;
- the soundproofing panels must not be altered or moved so as not to affect the approved sound emission limits. If any openings need to be made (e.g. for the passage of pipes or added sections), they must be thoroughly closed, using fireproof and soundproofing materials equivalent to the original materials used;
- in the placement of fenders and wheel arches, free shaking of the rear wheels must be guaranteed, even under the conditions of use with chains. It must also be guaranteed enough space for the lifting axle tyres;
- for any elements supplied loose (e.g. spare wheel, chocks), the bodybuilder must position and fasten them in an accessible and secure way, in compliance to any national regulations.
1.16.1 Exhaust system accessibility (only diesel versions)

In any outfitting, but with particular emphasis for full bodies (e.g. bus, mobile shops, campers and motorhomes) access to the exhaust system (muffler) for its maintenance or replacement must be ensured.

A = 275 mm
B = 335 mm
C = 435 mm

Openings, hatches or doors must be made allowing for the removal/refitting of the muffler screw cap for access to the compartment where the particulate ceramic filter is fitted (see Figure 7).

Above and around the muffler, the outfitting must be kept at a minimum distance of 80 mm to allow any vertical and transversal movements which may be required when removing the silencer.

- Remember that the weight of the muffler is approximately 120 kg and also that the temperature of its surface can reach 250 °C in certain cases.

**Note** To make the indications described easier to carry out, the two heat guards which were originally positioned on the muffler, can be removed providing that the outfitting of the muffler is still guaranteed.
1.16.2 Distances of components from the muffler

Assemblies or parts made using flammable material must never be fitted near the vehicle’s exhaust system.

Take into consideration that:

- synthetic materials must never be exposed to temperatures exceeding 70 °C; adequate protections must be implemented if higher temperatures are expected (thermal shielding);
  - The factory mounted fuel tank is made from materials belonging to this class and therefore, if fitting in a position that is not original, particular attention must be exercised.
- the minimum distance between the muffler and the cab rear wall, gearbox and braking system components must be at least 50 mm.
- the minimum distance between the exhaust pipe and brake pipes, wiring, spare wheel must be at least 200 mm; this value may drop to 80 mm if using protections.

1.17 PREVENTION OF FIRE RISK

Particular attention must be paid to prevent the spillage of hydraulic fluids or inflammable liquids above components which may become hot or overheated. Therefore:

Note: When pipes have to be installed near the engine, exhaust system, catalytic converter or turbocharger, suitable insulating shields or protective plates must be used.

1.18 CONVENTIONS

The following conventions are adopted in these Guidelines:

- **Wheelbase**: distance between the centre lines of the first steering axle and the first rear axle (engine or not).
- **Rear overhang**: distance between the centre line of the last axle and the rear extremity of the chassis side members.
- **Dimensions A, B and t** of the chassis section: see the picture on the side.
SECTION 2

CHASSIS

INTERVENTIONS
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CHASSIS INTERVENTIONS

2.1 CHASSIS MODIFICATION STANDARDS

2.1.1 General precautions

Keep in mind that:

- **weldings on the supporting structures of the chassis are absolutely forbidden** (except as prescribed in Paragraph "Weldings" (⇒ Page 9) and in Chapters 2.4 (⇒ Page 15), and 2.5 (⇒ Page 18));
- **no holes may be drilled into the side members** (with exception to indications provided in Paragraphs "Weldings" (⇒ Page 9) and "3.3 Choosing the type of connection" (⇒ Page 12));
- for cases where modifications to nailed unions are allowed, the nails may be replaced with flanged head screws or with hex head screws classed 8.8 with the next higher class diameter and nuts fitted with an anti-unscrewing system. Screws larger than M14 may not be used (maximum hole diameter of 15 mm), unless otherwise specified;
- for cases where unions that require screws are restored, the suitability of these screws must be checked before being reused, and they must be tightened to the appropriate torque;

>> As regards remounting safety components, it is prohibited to re-use the same screws and tightening must be done at the specified torque (contact the Service Network for the value).

- for cases involving remounting of safety components where nails are replaced by screws, the union must be checked again after about 500 - 1000 km of travel.

2.1.2 Special precautions

>> During operations involving welding, drilling, grinding or cutting carried out near brake pipes or electric cables, the battery must always be disconnected to prevent any damage to the electronic control units. Furthermore, all precautions must be taken to protect the aforementioned pipes and cables, removing them if necessary (observe the indications provided in Chapters 2.15 and 5.7).
Precautions for alternators and electric/electronic components

In order to avoid damage to the rectifier diode, the battery must never be disconnected (or the isolator switch opened) while the engine is running.

In cases where the vehicle must be started by towing (strongly discouraged), make sure that the battery is charged and connected so as to ensure minimum supply voltage to the engine ECU.

Recharge the battery only after disconnecting it from the vehicle circuit. In cases where the engine must be started-up with external charging equipment, be sure to avoid using the "start" function (if these devices feature this function) in order to avoid peak currents that may damage electric and electronic components.

Start-up must be performed only via an external battery trolley, making sure that polarity is respected.

Earth connection

For further details on the connections to ground, see the Chapter 5.7 (☞ Page 38).

Braking and electrical systems

For additional details on the braking and electrical systems see Chapters 2.15 (☞ Page 50) and 5.7 .

2.1.3 Characteristics of the material used in chassis modifications

For modifications on the vehicle chassis (all models and wheelbases) and for applications of reinforcements on the side members, the material used must correspond to the original chassis material in terms of quality and thickness (see Tables 2.1 and 2.2).

If it is not possible to procure materials of the thickness indicated, materials having immediately higher standard thickness may be employed.

<table>
<thead>
<tr>
<th>Table 2.1 - Material to be used in chassis modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of steel</td>
</tr>
<tr>
<td>IVECO</td>
</tr>
<tr>
<td>Europe</td>
</tr>
<tr>
<td>Germany</td>
</tr>
<tr>
<td>IVECO</td>
</tr>
<tr>
<td>Europe</td>
</tr>
<tr>
<td>Germany</td>
</tr>
<tr>
<td>U.K.</td>
</tr>
</tbody>
</table>

(1) Side members, stiffeners and cross members (and everything relating to parts with Fe E420 material).
(2) For parts with Fe 360 material or with materials with characteristics lower than Fe 360.
(3) Alternatively, only by lengthening the rear overhang.

<table>
<thead>
<tr>
<th>Table 2.2 - Chassis side members sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>60E, 65E, 75E, 80EL</td>
</tr>
<tr>
<td>80E, 90E, 100E</td>
</tr>
</tbody>
</table>
2.1.4 **Stresses on the chassis**

The following stress value in static conditions cannot be exceeded for any reason whatsoever:

<table>
<thead>
<tr>
<th>Model</th>
<th>A x B [mm]</th>
<th>Wheelbase [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2790 3105 3330 3690 4185 4455 4590 4815 5175 5670 6210 6570</td>
</tr>
<tr>
<td>110EL, 120EL</td>
<td>195.5x65</td>
<td>5 5 5 5 6 6 - 6 6 6 - 6</td>
</tr>
<tr>
<td>120E, 140E</td>
<td>240x70</td>
<td>- 5 - 5 6 6 - 6 6.7 6.7 - 6.7</td>
</tr>
<tr>
<td>150E, 160E</td>
<td>240x70</td>
<td>- 5 - 6 6 6 - 6.7 6.7 7.7 - 7.7</td>
</tr>
<tr>
<td>180E, 190EL</td>
<td>262.5x80</td>
<td>- - 6 7.7 - 7.7 7.7 7.7 7.7 7.7 7.7 7.7</td>
</tr>
</tbody>
</table>

**Note** static stress on the chassis: **120 N/mm²**

In any case, respect any more restrictive limits placed by national standards.

Welding causes material property deterioration; therefore, when checking stresses in thermally altered zones, a resistance reduction of 15% must be accounted for.

### 2.2 DRILLS ON THE CHASSIS

Installation of auxiliary equipment onto the chassis must be done using the factory drilled holes whenever possible.

> **It is strictly forbidden to drill holes into the side member flaps, with exception to what is indicated in Chapter 3.3 - Paragraph "Choosing the type of connection".**

When new holes must be made for specific applications (installation of shelves, corner shelves, etc.), these must be drilled into the upright rib of the side member and must be thoroughly de-burred and bored.
2.2.1 Positioning and dimensions of the holes

The new holes must not be drilled into the areas subjected to greater stresses (such as spring supports) or where the side member section varies.

Hole diameter must be suited to sheet metal thickness but cannot exceed 15 mm (unless otherwise stated). The distance of the axis of the holes from the internal edge of the side member must not be less than 30 mm; in the same way, the axes of holes must not be less than 45 mm from each other or from other existing holes.

The holes must be offset as in Figure 2.

The original hole layout must be maintained when moving spring supports or crossbars.

![Figure 2](image)

2.2.2 Screws and nuts

We generally recommend the use of the same type and class of screws and nuts as those employed for similar anchorages on the original vehicle (see Table 2.3).

<table>
<thead>
<tr>
<th>Resistance class</th>
<th>Use</th>
<th>Breaking strength [N/mm²]</th>
<th>Yield stress [N/mm²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.8</td>
<td>Intermediate resistance screws (crossbars, shear resistant plates, brackets)</td>
<td>800</td>
<td>640</td>
</tr>
<tr>
<td>10.9</td>
<td>High resistance screws (springs supports, stabiliser bars and shock absorbers)</td>
<td>1000</td>
<td>900</td>
</tr>
</tbody>
</table>

The screws belonging to classes 8.8 and 10.9 must be well cleaned and, for applications with diameter ≤ 6 mm, protection FeZnNi 7 IV S is recommended; for diameters > 6 mm, protection GEO-8 is recommended.

Screw treatment allowed is Geomet or zinc coating. Geomet treated screws are discouraged when using them in welding operations.

Use flange headed screws and nuts if there is sufficient space.

Use nuts with an anti-unscrewing system and keep in mind that the tightening torque must be applied to the nut.
2.2.3 Welding

> When welding, drilling, milling and cutting near brake hoses and electrical wires, be sure to adopt appropriate precautions for their protection; disconnect these parts if necessary (respect the prescriptions in Chapters 2.15 and 5.7).

Welds are allowed:

- in side member unions for elongations or trimming;
- in the application of corner reinforcements in the area regarding side member modification, as hereafter specified (see Figure 3).

![Figure 3](image)

The following instructions must be respected when performing electric arc welding and in order to protect electrical components and ECUs:

- before disconnecting the power cables ensure there are no active electric users;
- if an electric circuit breaker (main switch) is present, wait for it to complete the cycle;
- disconnect the negative pole from the battery;
- disconnect the positive pole of the battery without connecting it to ground; do NOT short-circuit the negative pole;
- disconnect all ECU connectors, proceed with caution and do not touch the ECU connector pins;
- disconnect the ECU from the vehicle for welds close to the ECU;
- connect the welder ground directly to the weld piece;
- protect the plastic pipes from heat and disconnect them if necessary;
- protect the surfaces of the leaf and air springs against any weld splashes when welds are performed nearby;
- avoid touching the spring leafs with the electrodes or pliers.
Weld operations

- Thoroughly remove paint and rust from the chassis where welds will be made, as well as all parts that will be covered by reinforcements.
- Cut the side members with a skewed or vertical cut. The side members must not be cut at the points where the chassis contour and width changes or where stress is greater (e.g. spring mounts). The cutting line must not go through the holes on the side member (see Figure 4).

![Figure 4](image)

- Make a 60 degree bevel cut on the internal part of the side member of the parts to be joined, along the entire length of the weld area (see Figure 5).

![Figure 5](image)

- Arc weld the area with multiple steps and use base electrodes that are thoroughly dried.
- Avoid power overloads; the welds must be free of marginal incisions and slag.
- Start from the opposite end and weld as in the previous item.
- Let the side members cool slowly and in a uniform fashion. No cooling with air jets, water or other means is allowed.
- Grind off the excess material.
- Mount steel corner reinforcements that have the same characteristics as the chassis; the minimum indicative sizes are shown in Figure 3. Reinforcement anchorage must regard only the vertical rib of the side member and can be realised with a weld bead, staples, bolts or nails (even Huck nails). Area and length of the weld bead, number and distribution of staples, number of nails of bolts must be adequate to transmit the bending and shearing moments.
- Once work is complete, use anti-rust protection (see Paragraph "Added or Modified Parts" ( Page 13)).
2.2.4 Closing holes by welding

If new holes are located near old holes, (see Figure 2), these last can be welded shut.

Good results are obtained by:

- chamfering the outer edge of the hole;
- applying a copper plate on the inner edge of the side member to hold the welding material;
- welding the side member on both sides with elimination of all residual material.

Holes of 20 mm diameter can be sealed off by using chamfered washers welded on both sides.

2.3 RUST AND PAINT PROTECTION

Note: All components mounted on the chassis must be painted in compliance with IVECO Standard 18-1600 Colour IC444 RAL 7021 - 70/80 gloss.

2.3.1 Original vehicle components

The following tables show, respectively, the classes of coating and protection required for the original vehicle components, the protections required for the parts not painted or in aluminium and treatments required for the painted parts.

| Table 2.4 - Class of protection - IVECO Standard 18 - 1600 (Prospectus I) |
|---|---|---|
| Class | Part requirements | Examples of parts involved |
| A | Parts in direct contact with atmospheric agents | Bodywork - Rear-view mirrors - Windscreen wipers - Metallic structured sun visors - Metallic bumpers - Cab hook lock - Door stop device - Bodywork fastening elements (screws, bolts, nuts, washers), etc. |
| B B2 | Parts in direct contact with atmospheric agents that mainly have structural characteristics, in clear sight | Chassis and relative parts, including its fasteners Parts below the radiator grille (class B) External cab ramps |
| B1 | | Only for rear axles and front axles |
| C | Parts in direct contact with atmospheric agents, not in clear view | Engine and relative parts |
| D | Parts not in direct contact with atmospheric agents | Pedals - Seat covering - Fastening elements - etc., mounted inside the cab |

Table 2.5 - Unpainted aluminium parts - IVECO Standard 18 - 1600 (Table 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 (1)</td>
<td>18-0506</td>
<td>–</td>
</tr>
<tr>
<td>Geomet (2)</td>
<td>18-1101</td>
<td>–</td>
</tr>
</tbody>
</table>

---

(1) IVECO standard 18-0506

(2) IVECO standard 18-1101
### Table 2.6 - Painted parts - IVECO Standard 18 - 1600 (Prospectus III)

<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>Geomet 2</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>Zinc coating 2</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>Alloy Zn-Ni</td>
<td>Fe/Zn Ni 7 VII S</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Fe/Zn Ni 7 IV</td>
<td>–</td>
</tr>
<tr>
<td>Aluminium</td>
<td>Anode oxidation</td>
<td>1B-1148</td>
</tr>
<tr>
<td></td>
<td>Painting</td>
<td>See Table III</td>
</tr>
</tbody>
</table>

(1) Coupling with other materials must not cause the "battery effect".
(2) Coatings free from chromium salts.
(3) Coatings free of hexavalent chromium.

### Table 2.7 - Painted parts - IVECO Standard 18 - 1600 (Prospectus III)

<table>
<thead>
<tr>
<th>Cycle phase description</th>
<th>Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>MECHANICAL SURFACE CLEANING (1)</td>
<td>Sandshot blasting</td>
</tr>
<tr>
<td></td>
<td>Brushing</td>
</tr>
<tr>
<td></td>
<td>Sandpapering</td>
</tr>
<tr>
<td>PRE-TREATMENT</td>
<td>Iron phosphating (only for non-precoated ferrous materials)</td>
</tr>
<tr>
<td></td>
<td>Zinc phosphating (1)</td>
</tr>
<tr>
<td>CATAPHORETIC PAINTING</td>
<td>High thickness (30-40 μm)</td>
</tr>
<tr>
<td></td>
<td>Medium thickness (20-30 μm)</td>
</tr>
<tr>
<td></td>
<td>Acrylic finishing (&gt;35 μm)</td>
</tr>
<tr>
<td>RUST PREVENTER</td>
<td>Bi-component (30-40 μm)</td>
</tr>
<tr>
<td></td>
<td>Single-component (30-40 μm)</td>
</tr>
<tr>
<td>ANTIROCK PRIMER</td>
<td>Single (130 °C) or bicomponent (30-40 μm)</td>
</tr>
<tr>
<td>VARNISH</td>
<td>Single (130 °C) or bicomponent (30-40 μm)</td>
</tr>
<tr>
<td></td>
<td>Powders (40-110 μm)</td>
</tr>
<tr>
<td></td>
<td>Low temperature single-component (30-40 μm)</td>
</tr>
</tbody>
</table>

(1) This operation must be performed when dealing with cutting burr, oxidation, weld slag, or laser-cut surfaces.
(2) Two-layer bodywork cycle.
(3) Three-layer bodywork cycle.
(4) In alternative to single and bi-component paint only for particular bodywork (windscreen wipers, rear-view mirrors, etc.).
(5) Only rear/front axles.
(6) Excluding parts that cannot be immersed in pre-treatment baths or undergo painting because of compromised functionality (e.g.: mechanical parts).
(7) Only if the colour is defined in a drawing according to I.C.
(8) For fuel tanks in ferrous or pre-coated sheets.
(9) Only parts to mount on the engine.
(10) Alternative products and cycles for the same phase under the condition of comparability with the part to treat.
(11) Specific phosphates must be used for zinc coated or aluminium sheets.

### 2.3.2 Added or modified parts

All vehicle parts (body, chassis, equipment, etc.) that are add-ons or subjected to modifications must be protected against oxidation and corrosion.

Areas free of protection on ferrous materials are not accepted.

Tables 2.7 and 2.8 indicate the minimal treatment that modified or added components must receive when it is not possible to have protection that is similar to that of original components. Different treatment is allowed if it ensures similar oxidation and corrosion protection.

Do not use powder varnish directly after degreasing has been performed.

Lightweight alloy, copper and brass parts must be protected.

#### Table 2.7 - Painted modified parts or add-ons

<table>
<thead>
<tr>
<th>Cycle phase description</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical surface cleaning (including elimination of burrs/oxidation and cleaning of cut parts)</td>
<td>Brushing/sandpapering/sand blasting</td>
</tr>
<tr>
<td>Pre-treatment</td>
<td>Degreasing</td>
</tr>
<tr>
<td>Rust preventer</td>
<td>Bi-component (30-40 μm) (1)</td>
</tr>
<tr>
<td>Varnish</td>
<td>Bi-component (30-40 μm) (2)</td>
</tr>
</tbody>
</table>

(1) Modifications on rear axles, from axles and engine (classes B1 and C) not allowed

(2) Preferably epoxy

(3) Preferably polyurethane

#### Table 2.8 - Unpainted or aluminium modified parts or add-ons

<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>yes</td>
</tr>
<tr>
<td>Zinc coating (2)</td>
<td>–</td>
</tr>
</tbody>
</table>

(1) Free from hexavalent chromium
2.3.3 Precautions

a) On the vehicle

Appropriate precautions must be taken to protect parts on which paint could be harmful to the conservation and operation thereof:

- hoses for pneumatic and hydraulic systems in rubber or plastic, with particular reference to the braking system;
- gaskets, rubber or plastic parts;
- propeller shaft and PTO flanges;
- radiators;
- suspension, hydraulic/pneumatic cylinder stems;
- air vent valve (mechanical assembly, air tank, thermostarter preheat tanks, etc.);
- fuel sediment filter (only diesel versions);
- plates, codes.

If painting is required after wheels are removed, it is necessary to:

- Protect the wheel rim mounting surfaces on the hubs and the contact areas of the locking lugs/wheel studs;
- ensure adequate protection of brake discs.

The electronic components and modules must be removed.

b) On engines and their electric and electronic components

Appropriate precautions must be taken to protect:

- engine wiring and ground contacts;
- the sensor/actuator side connectors and wiring side;
- the sensors/actuators on the flywheel and on the flywheel rpm sensor mounting bracket;
- pipes (plastic and metal) of the fuel circuit;
- diesel filter base assembly (only diesel versions);
- the ECU and its base;
- the entire internal part of the sound-proof cover (injectors, rails, pipes);
- the common rail pump and its control valve;
- the vehicle electric pump;
- tank containers;
- the front V-belts and relative pulleys;
- the power steering pump and relative pipes.

**Note**  When the painting operation has been completed, and prior to oven drying (max. temperature. 80 °C), all parts which may be damaged by exposure to heat, must be removed or protected.
2.4 WHEELBASE MODIFICATION

2.4.1 General information

**Note** Any wheelbase modifications that regard the electric circuits and/or relocation of the electric/electronic components requires IVECO approval and must be carried out in compliance with chapter 5.7 instructions.

Usually, wheelbase modification must be performed on the standard wheelbase that is closest to the target value.

If the dimensions of the superstructure are suitable, it is best to use wheelbases in standard production; this allows the use of original propeller shafts and pre-defined cross member positions and existing datasets for ESP and ABS systems.

Nevertheless, IVECO must issue its authorisation for wheelbases below the minimum or maximum approved standard sizes on the market.

2.4.2 Authorisation

Wheelbase modification is allowed without IVECO authorisation only when:

- another length included in production for the vehicle model is to be made;
- number, type and position of the cross members, the existing circuits and systems on the standard chassis are replicated taken as reference.

**Note** For the 4x4 versions, a variation of the wheelbase is only permitted with specific approval.

The workshop that performs the transformation must provide sufficient guarantees in terms of technology and inspections (qualified personnel, appropriate operational processes, etc.).

**Note** The operations must be performed in compliance with these Guidelines, taking into account the suitable adjustments and adaptations (for example, the need for re-parametrization of the control units), as well as all necessary precautions (arranging the exhaust pipe, observance of minimum tare weight on the rear axle, etc.) provided for on the corresponding original wheelbases.

2.4.3 Impact on steering

Table 2.9 lists the maximum values of the wheelbase approved by IVECO.

> **Extending the wheelbase will have a negative effect on steering.**

<table>
<thead>
<tr>
<th>Model</th>
<th>Maximum load on front axle [kg]</th>
<th>Maximum wheelbase [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>60E, 65E, 75E, 80E, 80E, 90E, 100E</td>
<td>3600</td>
<td>4815</td>
</tr>
<tr>
<td>110EL, 120EL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>120E, 140E</td>
<td>5100</td>
<td></td>
</tr>
<tr>
<td>150E, 160E</td>
<td>6100</td>
<td></td>
</tr>
<tr>
<td>180E, 190EL</td>
<td>7500</td>
<td></td>
</tr>
<tr>
<td>110EW, 150EW</td>
<td>5700</td>
<td>4150</td>
</tr>
</tbody>
</table>
If the wheelbase is to be lengthened beyond the maximum value approved, these steering solutions must be authorised by IVECO. Any type approval tests are charged fully to the Bodybuilder.

2.4.4 Impact on braking

Generally speaking, shortening the wheelbase will have a negative effect on braking.

Contact the IVECO Department - TECH PE T&H - BODY BUILDER SUPPORT to find out the conditions (brake cylinders, minimum tare, theoretically admissible loads, tyres, height of centre of gravity) with which transformation can be allowed.

Modifications to the wheelbase on vehicles equipped with electronic control systems for braking, and where present, grip and stability, require the mandatory updating of the setting parameters (datasets) of the relevant control units via IVECO teleservices.

The possible wheelbases are between 2790 mm and 6570 mm; shorter or greater lengths are not covered by the necessary datasets and are therefore cannot be authorised.

Table 2.10 lists the minimum values of the wheelbase approved by IVECO.

<table>
<thead>
<tr>
<th>Model</th>
<th>Maximum load on front axle [kg]</th>
<th>Minimum wheelbase [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>60E, 65E, 75E, 80EL, 80E, 90E, 100E</td>
<td>3600</td>
<td>3105</td>
</tr>
<tr>
<td>110EL, 120EL</td>
<td>4600</td>
<td>2790</td>
</tr>
<tr>
<td>120E, 140E</td>
<td>5100</td>
<td>3105</td>
</tr>
<tr>
<td>150E, 160E</td>
<td>6100</td>
<td>3690</td>
</tr>
<tr>
<td>180E, 190EL</td>
<td>7500</td>
<td>3360</td>
</tr>
<tr>
<td>110EW, 150EW</td>
<td>3240</td>
<td>4150</td>
</tr>
</tbody>
</table>

2.4.5 Intervention procedure

Proceed as follows to obtain good results:

- position the vehicle so that the chassis is perfectly horizontal, use appropriate trestles;
- detach the propeller shafts, braking system hoses, cables and all other equipment that may interfere with proper work execution;
- identify the reference points on the frame (e.g. guide holes, suspension supports);
- mark the reference points with a slight punch mark on the top flaps on both side members, after having verified that the conjunction line is at a perfect right angle with the longitudinal axle of the vehicle;
- if moving the suspension supports, identify the new position using the previously determined references;
- make sure that the new measurements are identical on both the right and left sides; the diagonal check, for lengths of at least 1500 mm must not yield deviations of over 2 mm;
- make the new holes using as jig - if any other tools are unavailable - the supports and gusset plates of the crossbars;
- secure the supports and crossbars using nails or screws; if using screws, bore the holes and use calibrated screws class 10.9 with anti-unscrewing nuts; if size allows, flanged head screws may be employed;
- if cutting the frame (to be carried out according to indications of the second item in "Welding Operations" - Paragraph "Welding" (☞ Page 9)) mark a second line of reference points so that the work area is set between the two lines (plan for a distance of at least 1500 mm upon work completed). Carry over the points relative to the cutting area between the two lines; proceed as instructed in Paragraph "Welding" (☞ Page 9);
before welding, check that the side members and any added parts are perfectly aligned and perform the check measurements on both sides and along the diagonal line, as previously indicated. Apply the reinforcements as in Paragraph "Welding" (Page 9).

Additional information

- Protect the surfaces against oxidation as in Paragraph "Added or modified parts" (Page 13).
- Restore the braking and electrical systems as according to Chapters 2.15 (Page 50) and 5.7.
- Follow the instructions in Chapter 2.8 (Page 37) for interventions on the driveline.

2.4.6 Verification of the chassis stresses

With regard to wheelbase elongation, aside from local reinforcement in the joint area of the side members, the Bodybuilder must also account for reinforcements - along the entire contour of the wheelbase - until achieving area strength modulus equal to IVECO values for the same wheelbase or for the next admissible greater length. In alternative, for cases allowed by local standards, larger subframe profiles can be adopted.

The Bodybuilder must make sure that the stress limits prescribed by national standards are respected. These stresses must not be greater than those of the original wheelbase frame, assuming an evenly distributed load and considering the frame as a beam positioned in place of the suspension supports.

When an elongation is performed starting from the longest original wheelbase, the reinforcements adopted must account for wheelbase elongation, type of chassis produced and vehicle use.

2.4.7 Cross members

The need to apply one or more cross members is dependant on the elongation, the positioning of the transmission mount, the welding area, the points of application of forces arising from the superstructure, and the conditions of use of the vehicle.

Any additional cross members must have the same characteristics of those already mounted on the frame (bending and torsion strength, material quality, connection to side members, etc.). Figure 6 shows an example. In any case an additional crossbar must be installed for elongations exceeding 600 mm.

The distance between the two cross members must generally be within 1000–1200 mm.

The minimum distance between the cross members, especially for "heavy duty use" must not be less than 600 mm; this restriction excluded "lightweight" cross member that acts as transmission and suspension supports.

Figure 6
2.4.8 Modifications to the transmissions
See Chapter 2.8 (⇒ Page 37) for checks of modifications allowed.

2.5 REAR OVERHANG MODIFICATION

2.5.1 General information
When modifying the rear overhang, the limits set by national standards must be respected. This is also the case for the maximum distances from the rear structural edge and distance from the ground, defined for the tow hook and under-run protection. The distance from the tip of the frame to the rear edge of the superstructure must, as a rule, not exceed 350–400 mm.
If it is necessary to move the rear crossbar fixed using screws, it is necessary to maintain the same type of union as in the series (number of screws, dimensions, strength class).
If a tow hook shall be attached, it is necessary to leave sufficient space (approx. 350 mm) between the rear crossbar and that nearest, for any tow hook assembly/disassembly operations.
If all works are performed in a professional manner and according to the instructions contained herein, the original towing capacity may remain the same.
In all cases, the parties performing the work shall be liable thereof.

2.5.2 Authorisation
Rear frame elongation as well as shortening to the smallest value for each model of the series do not require authorisation if performed in compliance with the instructions provided herein.

**Note** If you need to adjust the length of the electrical circuits, see Chapter 5, “Special instructions for electronic subsystems”.

2.5.3 Shortening
The last crossbar must be moved forward when shortening the rear overhang of the frame.
When the rear crossbar is too close to another crossbar, the latter can be eliminated if it plays no role in suspension support.

2.5.4 Lengthening
Possible solutions concerning elongations are shown in Figures 7 and 8.
Cuts can be of straight type. The minimum dimensions of the reinforcements to apply in the area of modification are shown in Figure 3.
The solution for elongations greater than 300–350 mm is shown in Figure 7. In this case, the corner reinforcements, which also serve as junction between cross member and frame, must have the same width and thickness of the original gusset plate. The union between the cross member and plate, originally performed using nails, can be done with screws class 8.8 having the next largest scale diameter and anti-unscrewing nuts.
When the connection between the cross member and gusset plate is made by welding, the gusset plate can be connected to the reinforcement by welding (see Figure 7).
The solution for elongations exceeding 350 mm is shown in Figure 8.
When the elongation is rather large, the need of an additional crossbar must be evaluated on a case to case basis in order to ensure proper torsional strength of the frame. The insertion of an extra crossbar having characteristics similar to the series is necessary, however, when two cross members are spaced more than 1200 mm apart.
2.6 INSTALLING THE TOW HOOK

2.6.1 General information

The application of a tow hook is possible without authorization:

- on vehicles with the specified cross members (opt. 6153) for inertia trailers;
- on vehicles originally equipped with opt. 430 for adaptation to towing a trailer.

Authorisation is required for installation on vehicles where the tow hook was not originally envisaged.

For trailers with one or more close axles (central axle trailers) and in consideration of the stresses to which the rear crossbar is subjected, particularly due to the dynamic vertical loads, observe the indications provided in the Paragraph "Tow hook for trailers with central axle" (→ Page 22).

2.6.2 Precautions for installation

The towing hook must be suited for the loads allowed and must be of a type approved by national standards.

⚠️ Given their importance related to safety, the drawbar couplings must not undergo modifications.

In addition to the requirements of the hook manufacturer, it is necessary to respect the limitations imposed by the Regulations on:

- clearances required for the coupling of the brakes and electrical system;
- distance between the hook pin axis and the rear edge of the superstructure (see Figure 9).

In the European Community (UNECE Regulation No. 55), this will normally be about 420 mm, but values are allowed up to 550 mm if an appropriate mechanism is adopted for safe operation of the hand lever. For even higher values it is advisable to consult the aforementioned Regulation.
1. Free field for towing hooks

2. Free field for coupling hooks according to standard DIN 74058 ESC-152

In cases where the connection flange of the drawbar coupling does not have holes suitable to those on the existing rear crossbar of the vehicle, the latter may be authorised for modification upon application of adequate reinforcements.

The Bodybuilder has the duty of realising and installing the superstructure so as to allow coupling connection and checks without impairment or hazard of sort.

The trailer drawbar must be guaranteed freedom of movement.
2.6.3 Tow hooks for conventional trailers

According to Directive 94/20/CE, both for the choice of the hook and for the application of any reinforcements to the rear crossbar, it is important to take into account the action of the horizontal forces generated by the masses of the tractor and trailer, based on the following formula (see Figure 10):

\[ D = \frac{g \cdot (T \cdot R)}{(T + R)} \]

- **D** = representative value of tow hook class [kN]
- **g** = acceleration of gravity [m/s^2]
- **T** = maximum mass of the tractor [t]
- **R** = maximum mass of trailer with mobile vertical drawbar [t]

![Figure 10](image)

2.6.4 Tow hook for trailers with central axle

Central axle trailers are defined as those that have the drawbar rigidly connected to the chassis and the axle (or more close axles) placed at half the length of the same chassis.

Compared to the articulated tow hooks, the rigid tow hook acts on the tow hook coupling with the increase of the static vertical loads and, in the braking phase or in the oscillations caused by the road surface, the increase of the dynamic vertical loads. By means of the hook, these loads lead to increases in the torsion of the rear crossbar of the vehicle, as well as push-ups on the overhang.

The use of central axle trailers therefore requires the use of suitable tow hooks and appropriate reinforcement to the tractor chassis (see Table 2.11).

The values of the towed weights and vertical loads allowed are listed on the technical documents of the drawbar coupling manufacturer and on the part manufacture plate (see DIN 74051 and 74052).

Towing hooks that bear special approvals and with values greater than those listed in the above standards may be used. However, these towing hooks may pose restrictions in relation to the type of trailer used (e.g. drawbar length); In addition, the drawbar may require reinforcement for the towing vehicle as well as larger subframe profile section.

With mechanical coupling devices suitable for central axle trailers, the following formulas are valid (see Figure 11):

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

\[ V = a \cdot C \left( \frac{X^2}{L^2} \right) \]

- **D_C** = representative value of drawbar class. This is defined as the determination of the theoretical reference value for horizontal load between tractor and trailer
\[ g = \text{acceleration of gravity [m/s}^2]\]

\[ T = \text{maximum weight of tractor}\]

\[ R = \text{maximum weight of trailer when fully laden}\]

\[ S = \text{vertical static load on the drawbar, namely the mass part of the trailer which, in static conditions, is transmitted to the coupling point on the vehicle. } S \text{ must be } \leq 0.1 \times R \leq 1000 \text{ kg of the trailer [kg]}\]

\[ C = \text{sum of maximum axial loads of the centre axle trailer at full load. It is equal to the maximum mass of the trailer decreased by the vertical static load (} C = R - S)\]

\[ V = \text{value of the intensity of the theoretical dynamic vertical force between the vehicle and the trailer}\]

\[ a = \text{vertical acceleration in the area of the drawbar coupling/hook, in function of the rear tractor suspension, use the following values:}\]

- \[ a = 1.8 \text{ m/s}^2 \text{ of air suspensions}\]
- \[ a = 2.4 \text{ m/s}^2 \text{ for other types of suspensions}\]

\[ X = \text{length of the load bed [m], (see Figure 10)}\]

\[ L = \text{theoretical drawbar length, distance between the centre of the drawbar eye and the centre line of the trailer axles [m], (see Figure 10)}\]

\[ \frac{X^2}{L^2} \geq 1 \text{ if the result is less than the unit, use the value 1}\]

---

If you wish to adapt a vehicle for towing which was not originally designed for this purpose (and in compliance with the limits established by IVECO for each model), only original rear cross members can be mounted. Towable masses and the bearable vertical loads can be defined based on the size of the hole.

In the case of long rear overhangs, and depending on the masses to be towed, it may be necessary to adopt sections which are larger in size than those normally specified (and indicated in Table 2.11).

### Table 2.11 - Longitudinal sections of the subframe for centre axle trailers

<table>
<thead>
<tr>
<th>Models</th>
<th>Profile chassis AxB [mm]</th>
<th>S [mm]</th>
<th>Wheelbase [mm]</th>
<th>Overhang rear. [mm]</th>
<th>R = Maximum weight of the trailer [kg]</th>
<th>S = Vertical static load on the trailer hook [kg]</th>
<th>Material with yield point of 360 N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>60E -/P 65E -/P</td>
<td>172.5x65</td>
<td>4</td>
<td>3105</td>
<td>1313</td>
<td>\leq 10500</td>
<td>\leq 1000</td>
<td>Section modulus W₁ for chassis with mechanical suspension [cm²]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Models</td>
<td>Profile chassis AxB [mm]</td>
<td>S [mm]</td>
<td>Wheelbase [mm]</td>
<td>Overhang rear. [mm]</td>
<td>R = Maximum weight of the trailer [kg]</td>
<td>S = Vertical static load on the trailer hook [kg]</td>
<td>Material with yield point of 360 N/mm²</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------</td>
<td>--------</td>
<td>----------------</td>
<td>---------------------</td>
<td>----------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>60E /P 65E /P</td>
<td>172.5x65</td>
<td>4</td>
<td>3330</td>
<td>1830</td>
<td>≤ 10500</td>
<td>≤ 1000</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3690</td>
<td>1830</td>
<td></td>
<td></td>
<td>44</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4185</td>
<td>2145</td>
<td></td>
<td></td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>4815</td>
<td>2505</td>
<td></td>
<td></td>
<td>78</td>
</tr>
<tr>
<td>75E /P 80EL /P</td>
<td>172.5x65</td>
<td>4</td>
<td>3105</td>
<td>1313</td>
<td>≤ 9500</td>
<td>≤ 950</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3330</td>
<td>1830</td>
<td></td>
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<td>39</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3690</td>
<td>1830</td>
<td></td>
<td></td>
<td>44</td>
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<tr>
<td></td>
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<td>4185</td>
<td>2145</td>
<td></td>
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<td>70</td>
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<td></td>
<td></td>
<td>5</td>
<td>4815</td>
<td>2505</td>
<td></td>
<td></td>
<td>78</td>
</tr>
<tr>
<td>80E /P</td>
<td>195x65</td>
<td>4</td>
<td>3105</td>
<td>1313</td>
<td>≤ 10500</td>
<td>≤ 1000</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3330</td>
<td>1830</td>
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<td>44</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>3690</td>
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<td>57</td>
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<tr>
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<td></td>
<td>4185</td>
<td>2145</td>
<td></td>
<td></td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>4815</td>
<td>2505</td>
<td></td>
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<td>85</td>
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<td>S = Vertical static load on the trailer hook [kg] ≤ 950</td>
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<th>Overhang rear. [mm]</th>
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<th>S = Vertical static load on the trailer hook [kg]</th>
<th>Material with yield point of 360 N/mm²</th>
<th>Section modulus Wₑ for chassis with mechanical suspension [cm³]</th>
<th>Section modulus Wₑ for chassis with air suspension [cm³]</th>
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**Note**  See Table 3.2 (profile dimensions).

### Specification 01

To tow central-axle trailers, the vehicle must have an adequate connection between the chassis and the subframe and, in particular, in the area that goes from the rear end of the overhang to the front support of the rear suspension, longitudinal and transverse sealing plates need to be provided (see Figure 12).

![Figure 12](image-url)

1. Combined reinforcement
2. Shear resistant connections
3. Longitudinal subframe section
4. Vertical static load on the tow hook coupling

$L_u =$ Rear overhang
\( \varphi \) = Length of the reinforcement part in front of the centre line of the rear axle  
\( L_{tt} \) = Length of the reinforcement part behind the centre line of the rear axle

**Table 2.12 - Solutions with combined reinforcement sections**

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<th>B</th>
<th>C</th>
<th>D</th>
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<tr>
<td>( R_{u} ) (N/mm²)</td>
<td>320</td>
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<td>360</td>
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<tr>
<td>Maximum reduction of the section height [mm]</td>
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<td>60</td>
<td>100</td>
<td>120</td>
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<td>( L_{ij} ) (see figure 2.11)</td>
<td>0.5 ( L_{ij} )</td>
<td>0.5 ( L_{ij} )</td>
<td>0.8 ( L_{ij} )</td>
<td>0.85 ( L_{ij} )</td>
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<tr>
<td>( L_{ii} ) (see figure 2.11)</td>
<td>0.6 ( L_{ij} )</td>
<td>0.6 ( L_{ij} )</td>
<td>0.95 ( L_{ij} )</td>
<td>1.0 ( L_{ij} )</td>
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<tr>
<td>Example of combined sections in alternative to C: 250x80x8 [mm]</td>
<td>210x80x8</td>
<td>190x80x8</td>
<td>150x50x8 + angle</td>
<td>130x50x8 + angle</td>
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<tr>
<td>Actual reduction in height [mm]</td>
<td>40</td>
<td>52</td>
<td>92</td>
<td>104</td>
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</table>

(1) These are general instructions which are valid for the materials indicated. The use of materials with superior mechanical characteristics require verification of the overall moment of resistance of the chassis plus the subframe.

The possibility of interrupting the combined reinforcement continuity is limited to special cases and must be authorized. Similarly, when the application of the external reinforcement angle (solutions C and D, see Section 3 - Figure 24), presents difficulties (for example, the presence of suspension mounts or coupling brackets of the air spring) and the notch to be made may excessively reduce the resistance of the section, the solution must be submitted for approval with the proposed reinforcements.

### 2.6.5 Rear crossbar in lowered position

When the tow hook coupling must be lowered from its original position, IVECO may issue an authorisation to lower the original tow hook or install an additional tow hook, which is the same as the original, in a lowered positioned.

Figures 13 and 14 show the examples respectively.

Connection of the drawbar in its new position must be performed in the same way and using screws of the same type (diameter and resistance class) in relation to the original connection.

Anti-unscrewing systems must be used in the connections.

---

**Figure 13**

1. Original rear cross member.  
2. Additional strap  
3. M14 threaded hole - 10.9 (1110 kN)  
4. Connecting corner
The outer corners should have a thickness of not less than that of the side members of the vehicle, they should extend in length for a distance of at least 2.5 times the height of the side member itself (min. 600 mm) and should use a material with the minimum requirements set out in Chapter 3.3 - Paragraph “Choosing the type of connection” (Page 12). The fastening to the vertical rib of the side members must be done with all the union screws of the crossbar to the chassis of the vehicle, integrating them with others whose number and positioning consider the greater time transmitted. In principle, in the lowerings equivalent to the height of the side member, an increase in the number of screws equal to about 40% is predicted.

In applying a supplementary crossbar (see Figure 14) a central coupling plate must be provided, of thickness suited to that of the crossbars.

Figure 14

1. Lowered rear cross member
2. Connecting plate or angle
3. Coupling plate
4. Connection plate
5. C-profile (same dimensions as chassis)
6. Space for rear spring retainer
The movements between the drawbar and the vehicle established by regulations in force must be ensured.
If the local legal regulations provide it, after construction the vehicle must be presented for the required checks.
Figure 14A shows an example of a lowered additional cross member, Figure 14B shows an example of a lowered additional cross member with an added element with a C-shaped profile.
In cases where this solution is chosen on vehicles with short rear overhangs, the external connection angle must be made according to the solution proposed therein. If, after lowering the rear crossbar, the shelves of the guards need to be changed, there must be a method of fastening, resistance and rigidity equivalent to the original. Verify compliance with the standards for positioning the lights.

2.6.6 Towing cross member in a lowered and forward position (close coupling) for central axle trailers

Vehicles that, to tow central axle trailers, must adopt a two beam in a lowered and forward position (close to the rear housings of the rear suspension or air springs), do not require special chassis reinforcement.
The bodybuilder must provide an adequate tow beam and use a suitable tow hook coupling.
The positioning of the hook must be made in order to allow all relative movement between the tractor and the trailer drawbar in the various conditions of use, subject to the necessary safety margins and compliance with any regulations or legal requirements.
Since in these cases the normal version of the under-run protection bar can not be used, the Bodybuilder will be responsible for investigations on possible exceptions permitted or to be taken on the specific solutions (e.g., tilting bumper beam).

2.6.7 Standard cross member reinforcements

In cases where it is necessary to reinforce the standard crossbar and there are no originally reinforced crossbars, you will have to resort to the application of:

- C-profile within the crossbar an adequate reinforcement even of the connections of the same to the side members of the vehicle;
- C profile within the crossbar with connection to the vertical rib of the side member or to the next crossbar of the chassis if it is located in close proximity, according to Figure 15;
1. Original rear cross member.
2. Reinforcing profile
3. Connecting plates or angles

- suitably sized box-shaped crossbar, fastened on the ends to the vertical rib of the side members and connected to the crossbar in the central part, as shown in Figure 16. In vehicles with short rear overhang and in the presence of the subframe, the box profile can be inserted inside the profiles of the subframe, above the crossbar and connected to it by means of a front plate (as in Figure 14).

If in the mounting of the box profile it is necessary to operate on the brackets of the under-run protection bar, there must be a version equivalent to the original in terms of fastening, resistance and rigidity (respect any national legal requirements).
2.6.8 Observations on payload

Static load on the drawbar coupling must not surpass the load allowed on the rear axle or axles of the vehicle. Furthermore, the minimum front axle load must be respected as indicated in Chapter 1.15 (☞ Page 11).

2.6.9 Increase of towable weight

As regards tow vehicles, IVECO may evaluate - in certain cases and for particular applications - the possibility to authorise greater tow weights than those normally allowed.

These authorisations include the towing conditions and, when necessary, provide the instructions relevant to any vehicle modifications or work required: standard crossbar reinforcements (see Figure 13), or installation of a reinforced crossbar when available, or adjustments to the braking system.

The tow hook coupling must be suited for the new use, and its connection flange must coincide with that of the crossbar. Fix the crossbar to the chassis by using flanged head screws and nuts or hex head screws of 8.8 min. class.

Use anti-unscrewing systems.

2.6.10 Nameplates

Some countries require a plate to be applied on the towing device, which must list maximum tow load and maximum vertical load allowed.

If not already mounted, the Bodybuilder shall see to its manufacture and installation.
2.7 ASSEMBLING AN ADDITIONAL AXLE

- The installation of an additional axle includes the perfect integration with the braking system, pneumatic system, wiring and electronic systems: therefore approval by IVECO is necessary. The request of technical information at the axle manufacturer and suppliers of plants and systems involved in the transformation is the responsibility of the bodybuilder, as well as performing the functional and approval tests.

- The granting of the authorisation to install an additional axle and the passing of the approval tests do not exempt the Bodybuilder from full responsibility for processing.

- The addition of an additional axle on vehicles equipped with electronic control systems for braking, grip and stability, necessarily require the updating of the setting parameters of the relevant control units via IVECO teaservices.

2.7.1 General information

On some models of the range, it may be possible to apply an additional axle and therefore increase the gross vehicle weight.

For its implementation, the mass limits and conditions imposed by IVECO must be respected, as well as all other conditions requested by national laws and the necessity to ensure driving safety and proper vehicle function.

Due to the increased GVW, this includes the need to verify the adequacy of the RUP (Rear Underrun Protection) and FUP (Front Underrun Protection) to the new situation and their possible replacement (see Chapters 2.20 (Page 57) and 2.24 (Page 61)).

Any application diagrams sent to IVECO - TECH PE T&H - BODY BUILDER SUPPORT to be examined and authorised must show indications regarding connection of the axle to the chassis, as well as information on the reinforcements and on changes to be made on the chassis; diagrams regarding modifications to systems must also be provided.

With regard to modifications to the chassis, in addition to complying with the indications in the previous paragraphs, it is necessary to consider the increase in stress due to the increase in the permitted load and the different conditions of operating dynamic stress.

**Note** The transformed chassis must, in the corresponding sections, not be subjected to bending loads no greater than on the chassis of the original vehicle.

2.7.2 Reinforcements on the chassis

Figure 17 shows several examples of possible solutions.

The reinforcements must concern the entire length of the chassis, up to the cab.
In the case of a subframe reinforcement, the anchors provided on the chassis may be used (if in existence), otherwise they should be made according to the indications in Chapter 3.1 - Paragraph "Sizing of profiles" (☞ Page 5) and subsequent paragraphs.

We recommend creating a cut-resistant joint in the area of the rear overhang and for about half of the wheelbase length (and always for lengths of at least 2 m from the front axle) (see Figure 17).

> Reinforcement plates may not be mounted directly onto the side member flaps via holes filled with welding material. Negative effects on the strength of the original sections, due to incorrect welding, should be avoided.

2.7.3 Added axle

For the installation of a rear or central third axle the following changes are mandatory:

- use of suitable brake cylinders on the axle for the parking brake;
- adjustment of the brake system.

It is necessary that, of the two ABS solenoid valves on the axle, one handles the right wheels of the engine axle and of the added axle and the other one the left wheels.

a) rear

The installation of an axle behind the engine axle generally results in the lengthening of the chassis overhang (see Figure 18) which is to be carried out according to the indications provided in the Paragraph "Lengthening" (☞ Page 18). This still requires the need for reinforcement as indicated in the Paragraph "Reinforcements on the chassis" (☞ Page 32).
b) central

The installation of an axle in front of the engine axle may make it necessary to reduce the rear overhang (see Figure 19), to be realised according to the indications in Paragraph "Shortening" (Page 18) to respect the technically permissible load.

Special attention must be paid to ensure no interference between the added axle and the propeller shaft.

2.7.4 Steering axles

Steering axles can be installed in both the centre position and the rear position and be either the self-steering or controlled steering type; they must be built and installed in order to ensure the necessary safety for functionality and driving.

- Self-steering axles must be equipped with a device that keeps them in place while reversing, which can be activated from the driver’s seat.
- The application of a controlled steering axle, obtained through the original device of the vehicle’s steering system, requires authorisation from IVECO upon presentation of the supplementary system diagram.
2.7.5  Suspension

The suspension of an additional axle may be mechanical spring or pneumatic, with the possibility of creating a mixed solution with the suspension of the engine axle.

**Note** The solution created should not adversely affect the dynamic behaviour of the vehicle, the working angle and smoothness of the drive line (with the relative overall dimensions in the case of an added axle in front of the drive axle).

If there is a suspension independent of that of the engine axle, in principle rigidity characteristics can be adopted, proportional to those of the original rear suspension, in the ratio of the static loads on the two axles.

**Parabolic suspensions**

Interventions are generally not allowed on this type of suspension.

Exception is made for fittings or special uses for which, in order to increase suspension rigidity, the application of rubber elastic elements may be authorised.

In special cases and only after IVECO approval, the addition of supplemental sheets on the parabolic springs may be allowed; this must be carried out by a specialised spring manufacturer.

2.7.6  Stabilizer bars

In the case of an additional axle with air suspension, it might be necessary, depending on the solution adopted, to provide a stabiliser bar, particularly when there is a superstructure with high centre of gravity.

Similar stability measures should be adopted for mixed suspensions on added rear axles.

2.7.7  Chassis connections

The connections for the added axle to the chassis must be able to react directly on all the longitudinal and transversal forces without transmitting them to the engine axle.

In the points of application of forces (spring supports, brackets for air springs, etc.), suitable cross members or adequate reinforcements to the chassis must be provided.

It is important to remember to create the correct orthogonality and alignment of the added axle, respectively, with the longitudinal axle of the vehicle and with the drive wheel axle.

Check the special equipment available on the market.

2.7.8  Braking system

- Considering the importance for the active safety of the vehicle, extreme care must be given to the braking system in both design and implementation.

The same type of braking units, pipes and couplings as on the original vehicle must be used on the added axle; in particular, the braking unit must be of the type that equips the front axle.

For connection between the fixed parts (chassis) and the axle, it is advisable to use flexible pipes.

Direct connection is allowed between the braking section of the added axle and that of the engine axle.

Verify that the capacity of the air tank is suitable to the dimensions of the new added brake cylinders and, if necessary, mount an additional air tank.

We recommend activating the parking brake on the added axle as well.

Keeping in mind the different gross vehicle weight determined with the intervention, the braking torque must be adjusted to the new static and dynamic loads in order achieve even distribution of braking among the axles.
The total braking capacity of the modified vehicle must be proportional to that of the original vehicle and the performance of the system (service, emergency and parking) must continue in any case to comply with national standards.

**Note** After processing, the vehicle must be presented to the competent authorities for approval verifications (an individual test or approval of that type).

The documentation on the braking to be presented to the approval body (e.g. curves of adhesion and compatibility, distribution, decelerations, heat behaviour, response time, etc.) must be provided by the person carrying out the work or the Manufacturer or the added axle.

Technical documentation with the features of the system and the braking capacities of the original vehicle is available on request.

**Note** For general indications on the braking system, follow what is set forth in Chapter 2.15.

**Note** With regard to the electrical system, follow the indications in Chapter 5.7.

### 2.7.9 Lifting device

The added axle may be equipped with a lifting device and may be used, in special cases and if national laws allow it, for the purpose of increasing grip of the engine axle in specific situations (starting on hills, slippery, snowy or icy roads).

For the device in question, the following conditions must exist:

- in the case of added axles in front of the drive axle, in the condition of maximum lifting of the added axle, there must be sufficient space between the propeller shaft and the added axle to ensure there is no contact or impact;
- implementation depends on issuance by IVECO of the relative permit, on which the maximum permissible load on the overloaded axle is indicated;
- the use is limited to short sections of the route and the speed limit set in the specific authorisation.

Some national regulations allow use of the lifting device even during normal driving, provided that the maximum type approval load established for the drive axle and the permitted speed limit is not exceeded.

In this case it is a good idea to remember the indications in Chapter 1.15 (⇒ Page 11) with regard to the positioning of the centre of gravity of the superstructure plus payload.

**Note** After processing, the vehicle must be presented to the competent authorities for approval verifications (an individual test or approval of that type).

For service and maintenance operations on the added groups, use operating modes and intervention times consistent with the provisions set for the original vehicle and shown on its documentation.

### 2.8 MODIFICATIONS TO THE DRIVELINE

Following modification of the wheelbase, any modification to the driveline must be made according to the layout of the driveline of an equivalent standard production vehicle with a similar wheelbase.

The maximum tilt values of the standard propeller shafts must be respected, also in the event of interventions on the suspension and on the engine rear axle.

If any difficulties arise, contact the IVECO Technical Application and send them a diagram with the length and tilt of the new driveline for a constant-velocity check.

The technical specifications indicated in the manuals provided by the Manufacturers of the drivelines, must be used to ensure correct production and positioning of the sections.
\[ \beta_s = \sqrt{\pm \beta_1^2 \pm \beta_2^2 \pm \beta_3^2} \leq 3^\circ \]

**Maximum allowed angularity**

\( n = \) engine speed  
\( \beta \cdot n < 20,000 \) for classes 2040-2045-2050

Values that must be valid both when the vehicle is empty (tare only) and when the vehicle has a static load considering the maximum allowed load on the rear axle.

The indications provided in this manual serve to safeguard the correct operation of the driveline, limit the sound level and avoid stress transmitted by the drive assembly. In no way does this relieve the bodybuilder of any work related liabilities.

### 2.8.1 Permitted lengths

1. The maximum working lengths which can be produced, for sliding sections "LG" and for intermediate sections "LZ" (see Figure 21) can be determined on the basis of the outer diameter of the pipe on the vehicle and the maximum engine speed (see formula and Table 2.13).

   If the shaft length calculated in this fashion is insufficient for the modification at hand, it is necessary to insert a new section with the same characteristics as those mounted.

2. In some cases, a drive shaft with a larger diameter can be used and calculated (again, see Table 2.13) in relation to the length required and the maximum number of engine rpm.

| LG | Length of sliding sections |
| LZ | Length of intermediate sections |
| LT | Total length |
For sliding shafts, the length LG must be evaluated between the universal joint centres and with the sliding stem in the intermediate position. Always check both stems LG and L2.

The maximum number of engine rpm must be calculated with the following formula:

$$n_G = \frac{n_{\text{max}}}{(i_G + i_V)}$$

- $n_G$: maximum engine speed (rpm)
- $n_{\text{max}}$: engine speed (rpm) at maximum power, see Table 2-12
- $i_G$: gear ratio at highest speed, see Table 2-12
- $i_V$: minimum transfer box ratio, 0.95 for EuroCargo 4x4 and equal to 1 if missing or for shafts upstream of the transfer box

### Table 2.13 - Engine speed [rpm] at maximum output power and gear ratio

<table>
<thead>
<tr>
<th>Engine</th>
<th>Power [HP - kW]</th>
<th>$n_{\text{max}}$ [rpm]</th>
<th>Gearbox</th>
<th>$i_G$</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 cylinders</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F4AFE411E</td>
<td>160 - 118</td>
<td>2200</td>
<td>65700</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6AS700</td>
<td>0.79</td>
</tr>
<tr>
<td>F4AFE411F</td>
<td>190 - 137</td>
<td>2200</td>
<td>65700</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6AS700</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S2500</td>
<td>0.74</td>
</tr>
<tr>
<td>F4AFE411C</td>
<td>210 - 152</td>
<td>2500</td>
<td>65800</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6AS800</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S2500</td>
<td>0.74</td>
</tr>
<tr>
<td>6 cylinders</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F4AFE611A</td>
<td>220 - 162</td>
<td>2500</td>
<td>65800</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6AS800</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12AS1210</td>
<td>0.813</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S2500</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S3000</td>
<td>0.65</td>
</tr>
<tr>
<td>F4AFE611E</td>
<td>250 - 185</td>
<td>2500</td>
<td>65800</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6AS800</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6AS100S + PTO</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6AS100S + PTO</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12AS1210</td>
<td>0.813</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S3000</td>
<td>0.65</td>
</tr>
<tr>
<td>F4AFE611K</td>
<td>280 - 206</td>
<td>2500</td>
<td>65800</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6AS1000</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6AS100S + PTO</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6AS100S + PTO</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>951110</td>
<td>0.75</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>12AS1210</td>
<td>0.813</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S3000</td>
<td>0.65</td>
</tr>
<tr>
<td>F4AFE611D</td>
<td>320 - 235</td>
<td>2500</td>
<td>951110</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12AS1210</td>
<td>0.813</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S3000</td>
<td>0.65</td>
</tr>
<tr>
<td>F4GFE601A</td>
<td>204 - 150</td>
<td>2700</td>
<td>95-75</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S2500</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S3000</td>
<td>0.65</td>
</tr>
</tbody>
</table>
2.8.2 Thickness of the pipe

The pipe thickness depends on the torque that the shaft must transmit, as well as on the construction setting of the driveline (torque, power train ratio, engine axle load).

If using a pipe with a greater diameter than the original pipe, then the thickness should in theory be reduced until the same torsional capacity is achieved; nevertheless, the dimensions of the fork male-end, need for adaptor rings, and the dimensions of pipes on the market must also be taken into account.

Hence, the pipe thickness must be established on a case by case basis in relation to the dimensions of the propeller shaft (e.g. cardan joint size), in concert with the propeller shaft Manufacturer authorised shops.

Minimum operating length (from flange to flange) must be at least 800 mm for sliding shafts and 700 mm for intermediate shafts.

Table 2.14 - Maximum possible lengths

<table>
<thead>
<tr>
<th>Dimensions of the hook</th>
<th>Outer diameter x thickness [mm]</th>
<th>Maximum propeller shaft speed [rpm]</th>
<th>Maximum possible lengths LG to LZ [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2030</td>
<td>90 x 3</td>
<td>2060 1960 1900 1760 1635</td>
<td></td>
</tr>
<tr>
<td>2035</td>
<td>100 x 3</td>
<td>2170 2100 2000 1850 1710</td>
<td></td>
</tr>
<tr>
<td>2040</td>
<td>120 x 3</td>
<td>2420 2350 2220 2070 1850</td>
<td></td>
</tr>
<tr>
<td>2045</td>
<td>120 x 4</td>
<td>2420 2360 2220 2070 1900</td>
<td></td>
</tr>
</tbody>
</table>

Note: The maximum lengths obtainable that are indicated above refer to original shafts; plan for shorter lengths (~10%) for sections obtained after machining.

2.8.3 Positioning of sections

On drivelines with several sections, each axle must be of approximately the same length. Generally speaking, the distance between an intermediate shaft and sliding shaft (see Figure 22) must be no greater than 600 mm, while between two intermediate shafts this difference must not be greater than 400 mm. As regards sliding shafts, there must be a minimum margin of 25 mm between minimum operating length and maximum sealing length; in opening, a covering must be guaranteed between the shaft and the sleeve of approx. 2 times the diameter of the spline shaft.
1. Engine, clutch, gearbox line
2. Intermediate shaft
3. Intermediate shaft bearing
4. Sliding shaft
5. Rear axle casing tilt (static load)
6. Rear axle casing tilt (max compression)
7. Rear axle casing tilt (no load)
8. Intermediate shaft, sliding articulated shaft and rear axle casing axis must have the same tilt.

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

Their tilt may vary up to 1° in regards to that of the engine-clutch-gearbox axle; which may be obtained by placing a wedge between the axle casing and the spring, or by means of adjusting the rear axle reaction bars.

The inclination of the rear axle casing must be no more than 5.5° from the horizontal plane.

When in vehicle loading conditions, the flange of the rear axle is lower than that of the gearbox housing flange, it is necessary to make the inclination of the axle housing and the intermediate shaft greater than that of the engine-gearbox axle. Vice versa, when in vehicle loading conditions, if the flange of the rear axle is higher than that of the gearbox housing flange, it is necessary to make the incline of the axle housing and the intermediate shaft less than that of the engine-gearbox axle.

When wheelbase lengthening is substantial, it may be necessary to mount an additional intermediate section, as indicated in Figure 23. In this case, make sure that the engine-gearbox axle, the second intermediate shaft and the rear axle casing axis when in static load are all aligned with the same tilt.
1. Engine, clutch, gearbox line
2. First intermediate shaft
3. Intermediate shaft bearing
4. Second intermediate shaft
5. Sliding shaft

6. Rear axle casing tilt (static load)
7. Rear axle casing tilt (max compression)
8. Rear axle casing tilt (no load)
9. Gearbox, second intermediate shaft, sliding articulated shaft and axle casing axis must have the same tilt.

The application of resilient mounts must be done using support plates at least 5 mm thick (see Figure 24), connected to cross members with characteristics similar to those specified by IVECO.

In modifying the wheelbase, it is better to plan for removal of intermediate shafts when shaft length is less than approximately 800 mm.

1. Intermediate shaft
2. Support plate
3. Rest plate
4. Intermediate shaft bearing

The considerations made up to this point are valid for vehicles with separate gearboxes.

Furthermore, the wheelbase on these vehicles may not be reduced beyond the shortest value for the series (e.g. tipper truck). We recommend using original IVECO drivelines; if this is not possible, the use of raw steel pipes with a yield load of at least 420 N/mm² (42 kg/mm²) may be used.
The universal joints may not be modified.

Any transformation of the driveline or of any of its parts requires thorough dynamic balancing to be carried out on each modified section.

> **Given that the driveline is an important part of the vehicle in terms of safety, any modifications made must meet the requirements of the maximum safety standards. Therefore, modifications should only be carried out by highly specialised companies, qualified by the Manufacturer of the driveline.**

### 2.9 MODIFYING THE ENGINE AIR INTAKE AND EXHAUST SYSTEMS

**Note** Any interventions, if authorised by IVECO, must not vary the original intake vacuum and exhaust back pressure values.

**Table 2.15 - Maximum pressure levels at intake and exhaust, at normal operating conditions and full load**

<table>
<thead>
<tr>
<th>Engine Model</th>
<th>Engine code</th>
<th>Exhaust back pressure [kPa]</th>
<th>Intake vacuum [kPa]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TECTOR 4 CYLINDERS</td>
<td>F4AFE41I-E*N</td>
<td>41.5</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>F4AFE41T-F*N</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F4AFE41C-E*N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TECTOR 6 CYLINDERS</td>
<td>F4AFE61A-E*N</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F4AFE61I-E*N</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F4AFE61K-E*N</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F4AFE61I-D-E*N</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F4GFE60I-A*J</td>
<td>16</td>
<td>2.5</td>
</tr>
</tbody>
</table>

#### 2.9.1 Intake

The air intake must be mounted as to avoid intake of hot air from the engine compartment, or dust and water.

The intake compartment must be sealed airtight and fitted with rubber gaskets that prevent hot air recirculation. The gaskets must be of high quality as to support a steady temperature of 100 °C, with short durations of 120 °C, without undergoing visible deformations or deteriorations. The compartment must keep airflow sections efficient for the entire circuit.

Any openings made in the box part of the van must have an area of approximately twice that of the cross-section of the pipe upstream of the filter. The protective grids must have a mesh with holes of maximum size 6 mm (to prevent the entry of foreign bodies or cigarette butts) and a minimum size that does not allow blockages.

The following are not allowed:

- alterations or replacement of the original air filter with one of lower capacity;
- interventions on equipment (injection pump, control valve, injectors, etc.) that may compromise good engine performance and affect exhaust gas emissions;
- change the succession Humidity sensor → Brakes air→ Blow by in the segment between air filter and turbine

Lastly, it is necessary to check if new system approval is required in relation to specific national standards (sound level, smokiness).
2.9.2 Engine exhaust

Given the compact nature of the "Hi-SCR" and the optimal arrangement of its assemblies on the chassis:

- any modifications to the exhaust pipe must be limited and implemented taking into consideration not only the Note at the beginning of the Chapter and Table 2.1.5 but also indications for Section 6, page 9;
- Modifications to the silencer body are not permitted.

Vertical exhaust

To realise a vertical exhaust which is different from the one which may be installed as first equipment, it is recommended that the following points are provided for:

- a considerable distance from the air intake conveyor;
- the simplest possible pipe route (curvatures with radii of no less than 2.5 times the outer diameter, passage sections no smaller than those of the original solution, absence of throttling);
- suitable distances (min. 150 mm) from electrical systems and plastic pipes (shorter distances progressively require plate guards, thermal insulators or the replacement of plastic pipes with steel ones);
- a support structure for the vertical part fastened to the vehicle chassis and braced, if necessary;
- a flexible pipe between the part of the exhaust connected to the engine and the part rigidly fastened to the chassis;
- a solution that prevents water entering from the top of the pipe (e.g. curvature).

2.10 WORK ON THE ENGINE COOLING SYSTEM

The good operating conditions of the original system must not be altered, especially for what concerns the free surface of the radiator and pipes (dimension and layout).

If modifications must be made to the cab or full bodywork installed (buses, campers, mobile-shops, etc.) which require work to the cooling system, keep in mind that:

- the effective area for airflow towards the radiator must not be less than that expected for vehicles with standard cabs and must be protected via deflectors and/or conveyors installed in front of the radiator assembly;
- maximum outflow of hot air from the engine compartment must be guaranteed using appropriate deflectors and/or extractors;
- fan performance must not be modified;
- any modifications of the water piping must not compromise complete filling of the circuit (done with a steady flow and without any backflow from the intake until the circuit is filled) and regular water flow; in addition, these modifications must not alter maximum water stabilisation temperature, even in the most demanding conditions of use;
- pipe layout must be done so as to avoid the formation of air pockets (e.g. eliminating siphoning bends or installing required vents) that may make water circulation difficult;
- check that water pump activation at engine start-up and successive operation during idling is immediate (accelerate a few times), even when circuit is not pressurised. During checks make sure that the water pump supply pressure, with engine at top speed and no load, is less than 1 bar.

To check the operation of the cooling circuit we must account for the water supply, bleed and circulation proceeding as follows:

- open the supply valve of the heating system and the heater bleed valves;
- fill the circuit while the engine is off with a flow rate of 8 - 10 l/min, until water seeps from the overflow vent;
- one bleed, close the heater bleed valves;
- start the engine and run idle for 5 minutes, successively check to see that the water level in the supply tank has not dropped below minimum level;
- gradually rev the engine, checking that average pressure in the water pump outlet pipes steadily increases without and discontinuities.
• keep accelerating the engine until the thermostat opens, causing air bubbles to pass through transparent pipes installed between:
  ■ engine output and radiator;
  ■ water supply tank and water pump;
  ■ engine bleed and water supply tank;
• check, after the thermostat has been open for 15 minutes, that there are no more bubbles in the circuit;
• check that, with thermostat open and engine running idle, that average pressure in the water pump outlet pipe is greater than 500 mm water column.

2.11 INSTALLING AN ADDITIONAL HEATING SYSTEM

We recommend using IVECO type heating systems whenever it is necessary to install an additional heating system.

On vehicles where IVECO does not employ these heaters, installation must be done in compliance with the instructions issued by the equipment Manufacturer (installation of heaters, pipes, electric system, etc.) and in relation to the following indications.

The additional heating system must respect all national standards on the subject (e.g. tests, specific installations for the transport of hazardous materials, etc.). It must avoid the use of vehicle equipment that requires certified approval whenever such equipment may cause a negative impact on performance.

In addition, be sure to:
• care for the proper operation of all other vehicle systems (e.g.: engine cooling system);
• check that the battery capacity and alternator power are sufficient for increased current draw (see Chapter 5.7 ) and install a protection fuse on the new circuit;
• to draw off the fuel, connect the fuel supply system to an auxiliary tank. Direct connection to the vehicle tank is allowed under the condition that it occurs independently from the engine fuel supply, and the new circuit must be perfectly airtight;
• route piping and wiring layout (and installation of brackets and flexible fittings) in relation to the spaces available and the influence of heat on the chassis parts. Avoid any exposed parts that may be dangerous, and adopt suitable guards when necessary.

The system must allow easy access and prompt maintenance.

The Bodybuilder must provide all necessary maintenance instructions.

a) Water heaters

When the original vehicle heating and engine cooling circuits are involved (see Chapter 2.10 ( Page 43)), the following must be done to ensure good system operation and safety of the original system:
• carefully define the connection points between the additional and original systems, in agreement with IVECO, if necessary. The added pipes must be made of brass or other alloy resistant to the corrosive action of coolant, the coupling sleeves must respect the requirements put forth by the standard IVECO 18-0400;
• plan for a rational layout of pipes, avoiding bottlenecks and siphoning bends;
• install venting valves (bleed points) to allow proper system filling;
• allow complete circuit discharge, also by installing any additional plugs;
• adopt, when necessary, suitable protections to limit heat loss.

b) Air heaters

On vehicles with diesel fuel and with direct cab installation, pay special attention to the exhausts (to ensure that combustion gasses are not trapped in the vehicle) and the correct distribution of hot air (in order to avoid direct flows).
2.12 INSTALLING AN AIR CONDITIONING SYSTEM

We recommend using original IVECO units for the installation of an air conditioning system. When this is not possible, aside from complying with the specific requirements provided by the manufacturer of the equipment, it is necessary to:

- maintain good performance of the vehicle parts that may be involved in the intervention;
- check that the battery capacity and alternator power are sufficient for increased current draw (see Chapter 5.8 - Paragraphs "Additional batteries" (→ Page 45) and "Additional alternators" (→ Page 46)) and install a protection fuse on the new circuit;
- plan the compressor installation modes with IVECO, if installed on the engine;
- route piping and wiring layout (and installation of brackets and flexible fittings) in relation to the spaces available and the influence of heat on the chassis parts;
- avoid layouts and installations where exposure may be dangerous when the vehicle is moving; fit suitable guards when necessary;
- the system must allow easy access and ensure prompt maintenance.

The Bodybuilder must provide all necessary maintenance instructions upon vehicle delivery.

In addition, in function of the type of system:

a) **cab installed system:**

- condenser installation must not cause negative effects on the engine cooling characteristics (reduction of exposed radiator-engine area);
- condenser installation must not be coupled with the engine radiator, but placed in its own specific compartment with proper ventilation;
- installation of the evaporator unit and of the bellow inside the cab (in cases where not provided directly from IVECO) must be planned as not to negatively impact control functions and access to equipment;

b) **cab roof-installed systems:**

- it is necessary to verify that the mass of the equipment does not exceed the weight allowed by the cab; in addition, the Bodybuilder must define the structural reinforcements to apply to the cab roof in relation to the unit’s weight and type of intervention performed;
- contact IVECO or specific applications that involve an unoriginal compressor (e.g. fridge).

> **Note that in relation to Directive 2006/40/EC on the emissions of air conditioning systems for motor vehicles, the use of fluorinated GHG with overall heating potential over 150 in comparison to CO2 is prohibited.**
Note From 1/1/2017:

a) if an additional climate control system is to be connected to the original system of the vehicle, the new total quantity of fluorinated greenhouse gases contained in the system (expressed in weight and in CO₂ equivalent) must be indicated by a data plate which replaces the original data plate;

b) if an additional independent system is to be added, the specific data plate indicating the fluorinated greenhouse gases must be positioned in line with the access points for the recharging operations.

In both cases, the data plate must be made according to the indications provided in Regulations 517/2014 (EU) and 2015/2068 (EU) in force in the European Union.

2.13 WORK ON THE CAB

2.13.1 General information

Note All interventions on the driver’s cab or on the roof must be authorised by IVECO in advance.

The modifications must not hinder operation of the control devices located in the area of the modification (e.g. pedals, switches, pipes, etc.) nor alter the strength of load-bearing elements (frames, reinforcement profiles, etc.). Care must be taken when dealing with operations that regard the engine cooling and air intake pipelines.

In relation to the variation of cab mass, it is necessary to consider the position of the payload in order to respect the distribution of the permitted axle loads (see Chapter 1.15 (► Page 11)).

As regards operations that entail the removal of internal sound barriers or protective panels (panelling, cladding) be sure to remove only the minimum amount possible; restore the protections as intended in the original design along with their original functionality.

Cab installation of controls and equipment (PTO engage switch, external operator cylinder control, etc.) is allowed as long as:

- installation is rational, performed in good detail and easy to access by the driver;
- the proper safety, control and signalling devices called for by national law are installed.

Make sure that pipe and cable installation is performed properly also in function of cab tilting; adopt the necessary retainers and be sure to plan for appropriate distances from the engine, heat sources and moving parts.

Corrosion protection must be included for each modification to the structure (see Chapter 2.3 (► Page 11)).

The use of zinc coated sheet metal is recommended on both ends of newly inserted sheet metal on cut bodywork in order to avoid ferrous corrosion of the welds (i.e. 18-1318 class ZNT/F/10/25 or I.S. 18-1318 class ZNT/10/25), both surfaces must undergo protective treatment.

Install gaskets with care and apply sealant to areas in need of protection.

Make sure that the seals are water, dust and smoke tight.

The bodybuilder must check that the chassis, after its structural modifications, complies with the standards in force for what concerns both internal and external structure.
2.13.2 Roof interventions

Modifications must be done with care in order to protect the resistance and the protection functions of the cab.

In any applications or units or equipment on the roof, make sure that the mass of the equipment does not exceed that permitted by the cab. These limits can be provided on request, depending on the version.

2.13.3 Spoiler or top-sleeper assembly

The installation must be performed by using the specially crafted fixing points on the cab roof sides and using support devices of appropriate sizes.

If the national standards require it, these installations must be controlled by relevant authorities.

2.13.4 Realization of sleeper cabs

IVECO can authorise the conversion of the standard cab to a special cab or sleeper cab (e.g. for armoured vehicles, public use vehicles, fire brigade vehicles) after assessing the suitability for use of the suspension, tipping and locking systems and confirming these operate correctly even under the new conditions.

In general solutions can be used that are equivalent to those provided by IVECO for the same applications.

To contribute to maintain the rigidity of the cab, it is recommended to keep the rear structure as much as possible unchanged.

It should be noted, however, that the transformation needs new approval tests (seats, seat belts, etc.) and that the relative costs will be at total charge of the bodybuilder.

The increase of the cab weight requires appropriate interventions on the suspension, the tipping device and on the rear coupling.

a) The definition of an appropriate suspension system requires:

- respect the cab structure provided in the standard vehicle;
- prevent that the added weight causes serious damage to the original parts of the cab and on the relative suspension parts;
- ensure the normal oscillations along the vertical, longitudinal and transverse plane.

b) for the tipping it might be necessary to install a cylinder with a greater capacity (with adequate supports) or an extra cylinder, verifying compliance with the minimum distances in relation to the adjacent parts. The areas affected by the thrust of such cylinders must be protected by an excessive concentration of stresses and therefore must be provided:

- the rear-most possible installation of the lifting points;
- suitable coupling zones, both on the cab bottom and on the chassis.

If during the tipping, the cabin exceeds the upper equilibrium point, make sure the added hydraulic system allows to keep it in the limit switch position or otherwise, apply a safety rope.

c) The original coupling device includes a safety lock and an indicator that shows the successful activation: it is suggested to keep this solution unchanged.

If the transformed cab does not have the possibility of tipping, in addition to acting on the suspension as seen above, there must be a movable bonnet, hatches or panels for the inspection and maintenance of the parts below.

In order to facilitate interventions in the workshop it is recommended the installation of a rear coupling point for the lifting or the possibility to apply safety bar.

In the change of the cab can be included the engine air intake and the filter. The use of original elements already provided for similar fittings, can be a good solution and allow the compliance with legislative regulations.

- Note that the cab transformation operations affect the good behaviour and the safety of the vehicle (suspension, tipping manoeuvre) and therefore must be designed and carried out with extreme care.
2.13.5 Protection of the vehicle occupants

Airbags, safety belt fittings, the positioning of reels and pre-tension devices and anchorage of seats are all an integral part of passive safety.

Any modification of these components may compromise the protection of persons on-board and compliance with legal requirements.

Airbag

Work or component installations must not be carried out in areas that may inhibit the correct operation of the airbags.

Consequently, the following must be avoided:

- modifications to the front structure of the vehicle, floor, firewall, sides and dashboard fixture points;
- alterations in the airbag control unit installation area (located under the floor between the front seats) and points involved in the system of sensors and related wiring harness;
- modifications to the steering column;
- replacements or installations of seats a different "H" point compared to the original versions.

⚠️ Since the safety of an electronic system configuration of the vehicle does not need to be changed, the Airbag system cannot be installed as "retrofit" or, vice versa, must not be eliminated.

Anchorage of safety belts

Work in the body areas where there are seat belt fittings may affect the function/operation of these devices.

It is therefore the responsibility of the Bodybuilder to comply with regulations concerning:

- mounting and tightening torques
- choice of seat belts other than original versions;
- uniform operation between original seat belts and seats that may have a different configuration to the originals.

seats

Moving the seats or fitting additional seats (for example, in a van of Cat. N1) is not permitted on vehicles already equipped with additional coupling points and which are the subject of alternative type-approval.

Any other solution is implemented under to total responsibility of the bodybuilder as regards installation and final test procedures (destructive).

2.14 CHANGING TYRE SIZE

⚠️ Replacing the tyres with others of a different size or load bearing capacity compared to the specifications recorded during vehicle type approval requires IVECO certification and verification of whether the electronic management of the braking system requires reprogramming.

The vehicle must successively be presented to the competent Body that will inspect the new tyres and the vehicle documents.

Mounting larger tyres:

- always requires a size check in relation to mechanical components, wheel arches, etc., in the various dynamic, steering and vehicle shaking conditions;
- may entail rim replacement with the consequential need to verify the spare wheel holder modification;
• may affect distance from the ground of the rear under-run protection device and, in this case, a check on standard compliance is required; if necessary the support brackets must be replaced with appropriate and type approved counterparts (see Chapter 2.20 (Page 37));
• requires the need to check compliance of the limit transverse contour allowed in relation to the various standards.

2.14.1 Requirements

**Note** Replacing tyres with others of a different outer diameter affects vehicle performance (for example, speed, max. vehicle ramp slope, tow load, braking force, etc.); therefore the IVECO Body Controller (speedometer, tachograph and speed limiter) must undergo recalibration at an authorised IVECO workshop.

- Tyres of different size and type of structure cannot be mounted on the same axle.

The tyre load bearing capacity and the relative reference speed must be suitable to the vehicle’s performance.

Mounting tyres with lower load bearing capacity or reference speed entails a reduction of allowed loads; on the other hand, mounting tyres with greater load bearing capacity does not automatically entail an increase of load allowed on the axles.

The dimensions and load bearing capacity of the tyres are established by international and national standards (ETRTO, DIN, CUNA, etc.) and are listed in the manuals of their respective Manufacturers.

Particular performance values may be put forth by national standards for special uses, fire-protection, winter services, airport tank trucks, buses, etc.

- If vehicle configuration requires the wheels to be removed, make sure that the contact surfaces between rim and connection flange are clean and free of corrosion when remounting the wheels. Furthermore, tightening of the wheel studs to torque must be ensured in compliance with IVECO Standard 17-9219.

### Table 2.16 - Wheel tightening torque according to IVECO STD 17-9219

<table>
<thead>
<tr>
<th>CODE</th>
<th>CONNECTING ELEMENTS</th>
<th>Thread</th>
<th>CLASS</th>
<th>Torque [Nm]</th>
<th>FEATURES &quot;S&quot; (*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Front and rear wheel mounting</td>
<td>Nut M18x1.5</td>
<td>II</td>
<td>335</td>
<td>410 &quot;S&quot;</td>
</tr>
<tr>
<td>2</td>
<td>Front and rear wheel mounting</td>
<td>Nut M20x1.5</td>
<td>II</td>
<td>540</td>
<td>440 &quot;S&quot;</td>
</tr>
<tr>
<td>3</td>
<td>Front and rear wheel mounting</td>
<td>Nut M22x1.5</td>
<td>–</td>
<td>580</td>
<td>650 &quot;S&quot;</td>
</tr>
</tbody>
</table>

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

- If using brackets to mount aesthetic studs positioned between the rim / lug or stud, or if using rims thicker than the original, geometric mounting functionality must be ensured through appropriate lengths of stud threading in the locking hole.
2.15 WORK ON THE BRAKING SYSTEM

2.15.1 General information

- No modifications to the adjustment unit, control valve, brake cylinders, valves, pedalbox, components of the AEBS, brake callipers, discs and pads (with the exception of normal replacement with spare parts), since they are safety components.

- Any changes to the braking system (modification of pipes, installation of additional operating cylinders etc.) requires the authorisation of IVECO.

Note For new units, it is advisable to prefer the same brands as those fitted to the original vehicle.

If the control valves, dryer, etc. are moved, restore the same type of installation originally required, ensuring the correct functionality. The interventions on the dryer must also not affect the conditions of cooling air coming from the compressor.

If moving a converter, slope the metal pipes between the cylinder and calliper and between the cylinder and oil tank so that any air bubble can return to the tank and does not remain trapped in the circuit.

The maximum lengthening of the air pipe connected to the converter must be less than a metre, to avoid having to reprogram the response time of the braking system.

If required by national regulations, the vehicle must be presented to the competent authority for testing.

2.15.2 Brake pipe

Note In the case of changes to the wheelbase or moving the units, the brake lines involved should preferably be replaced with new ones and in one piece; if this is not possible, the couplings to be used must be of the same type as the original ones.

- We would like to underline the dangers related to the full or partial painting of the pipes; therefore, during the intervention, the pipes must be properly masked.

When replacing, it is necessary to comply with the minimum internal dimensions of the existing pipes.

The characteristics and the material of the new pipes must match those originally used on the vehicle.

The installation must be carried out so that the system is adequately protected.

For the supply of materials and their installation it is advisable to contact a Service Centre or Authorised Workshop.

Plastic pipes

In both the addition of new pipes and in the replacement of others, it should be noted that plastic material is not allowed:

- in areas where the internal/external temperature of the pipe may exceed 80 °C, (e.g. within 100 mm from the engine exhaust outlet or section of pipe at a distance of less than 3 mm from the compressor outlet);
- between the chassis and moving parts, where special flexible pipes should be used;
- on hydraulic lines.

Operations must provide:

- materials and dimensions: Standard DIN 74324 (IVECO STD 18-0400) Maximum operating pressure 12.5 bar
- radii of curvature (referring to the centre line of the pipe):
  - Φ 6 to 35 mm
  - Φ 8 to 55 mm
- Φ 12 to 85 mm
- Φ 16 to 85 mm

**Preparation and assembly (IVECO STD 17-2403)**
Cut the pipe at right angles (15° maximum error), using a special tool in order to avoid imperfections that affect the sealing. Permanently mark the section of pipe (dimension L in Figure 25) to be inserted into the coupling to ensure secure sealing. Mark the pipe to avoid assembly errors in case of subsequent repair operations. As much as possible, use the same couplings as the original ones, or otherwise belonging to the normal production of specialised manufacturers in the sector.

![Identification of pipe limit and marking](image)

1. Identification of pipe limit
2. Marking

As much as possible, use quick-fit couplings.

- **For each intervention on the piping, verify whether there is the need, depending on the supplier, to use always new couplings or if it is possible to reuse those originally present through the use of appropriate tools (pliers).**

When the space conditions require it (e.g. in proximity of curves), couplings with metal inserts can be used. Before inserting the pipe into the coupling, screw the coupling into the threaded insert of the same component (e.g. pneumatic valve), using the following values for tightening:

**Table 2.17**

<table>
<thead>
<tr>
<th>Thread</th>
<th>Tightening torque [Nm ± 10%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>M12 x 1.5 mm</td>
<td>20</td>
</tr>
<tr>
<td>M14 x 1.5 mm</td>
<td>24</td>
</tr>
<tr>
<td>M16 x 1.5 mm</td>
<td>30</td>
</tr>
<tr>
<td>M22 x 1.5 mm</td>
<td>34</td>
</tr>
</tbody>
</table>

Insert the pipe into the coupling for the previously marked stretch of length L, using a force of between 30 and 120 N, depending on the size of the tube.
The replacement of components (valves, etc.) is made possible because the engagement and coupling allow an internal rotation during the operation of unscrewing and screwing.
**Vehicle pipe installation**

Before use, the new pipes must be thoroughly cleaned inside, for example by blowing air with a compressor.

The pipes must be fixed to the frame with elements which envelop the pipe completely and which may be metal with rubber/plastic protection or be made of plastic material.

Provide appropriate distances between one fastening element and the other: generally, max. 500 mm for plastic pipes and max. 600 mm for metal pipes can be considered.

In order to avoid deformations and tensions at the time of closure of the couplings for the plastic pipes, it is necessary to take care of the line and the accommodation of the fastening elements, rubbing should be avoided with the fixed parts of the vehicle and meet the necessary safety distances from moving parts and heat sources.

In passing the pipes through the chassis (side members or crossbars), take precautions to avoid damage. One solution would be to use a coupling passing directly through or at an angle, or a rubber protective eyelet, as shown in Figure 26.

![Figure 26](image-url)

1. Pipe  
2. Through-coupling  
3. Chassis  
4. Rubber protection

⚠️ **After each intervention is on the system or equipment, brake efficiency should be checked.**

⚠️ **Bring the pressure to its maximum level on the air system. Check for leaks in the areas affected by the intervention.**

To ensure that the connections have been properly made, the air tank corresponding to an axle can be emptied; the pressure control on the in-vehicle indicator and the verification, by operating the brake pedal, on the remaining braking section(s), allow such verification.

Hydraulic circuits must have the normal air bleed operation.
2.15.3 Electronic braking control devices

In case of changes to the wheelbase, the original position for ABS modulators must be maintained relative to the axis rear wheels. The wiring between the sensors on the rear axle and the control unit, as well as between the control unit and the modulators, must be adjusted using new cables or extension cables with appropriate connectors. The brake piping upstream of the modulators must also be adequate.

2.15.4 Withdrawing air from the system

In vehicles with a pneumatic brake system it is possible to withdraw a small amount of air from the tank in the auxiliary circuit. This withdrawal should only occur through a limited return valve, which can avoid the lowering of the pressure below the threshold of 8.5 bar in the operating brake circuit and the auxiliary circuit.

Take the air directly from the 4-way safety valve (exit 24) of the braking system.

If you require larger quantities of air you have to assemble an additional tank.

In this case, however, it is necessary to ensure that the standard compressor is able to fill the tank within the specified time, otherwise you will need to install a higher capacity compressor.

If air tanks are added to the air suspension (connection 25, Air Drying Unit), the APU (Air Processing Unit) regeneration volume must be checked.
2.16 ELECTRICAL SYSTEM: CURRENT INTERVENTIONS AND DRAWS

For information on work on the electrical system, refer to what is described in Section 5 - Chapter 5.7.

2.17 PART RELOCATION AND ANCHORAGE OF ADDITIONAL UNITS AND EQUIPMENT

The movement of units (batteries, compressors, spare wheel, fuel and urea tanks, etc.) to allow the installation of equipment is allowed on the condition that:

- the functionality of the unit is not compromised;
- the original type of connection is restored;
- the new placement and distribution of mass is compatible with that originally established (see Chapter 1.15 (Page 11)).

To minimise torsional stress on the chassis of the vehicle it is advisable to perform the installation in correspondence with a crossbar, especially in the case of high mass units.

Depending on the use of the vehicle, applications should always provide a sufficient margin in their height from the ground.

The holes to be drilled for the new arrangement should be made on the rib of the side member, according to the regulations given in Chapter 2.2 (Page 7) and taking care to use the existing holes as much as possible.

2.17.1 Converting the suspension from mechanical to pneumatic (for the mobile shop version)

This type of transformation is generally authorised on the rear axle. Other solutions proposed by Bodybuilders may be taken into consideration.

The bodybuilder that intents to perform the intervention must present a detailed documentation to IVECO in order to obtain a technical approval.

In case of installation of not original components, it is noted that any approval is issued on the basis of a specially planned evaluation of their characteristics and without the contribution of specific tests, unlike when use of components of first use.

Therefore, for this particular type of transformation, IVECO shall be relieved from any liability that may be attributed to the new component.

2.17.2 Horn

The displacement of the horn obligates the bodybuilder for a new approval. Also in the new position, the device must ensure the acoustic performance set by the regulations and must be adequately protected from exposure of weathering and/or soiling. IVECO reserves the right to void the warranty on the moved component.

2.17.3 Spare wheel holder

For chassis cabs not supplied with a spare wheel holder, or in cases where it is necessary to move the spare wheel, a special support must be made that allows rapid extraction and meets a minimum exit angle of 7°.

To secure the spare wheel with a support applied to the rib of the side member, we recommend the application of a local reinforcement plate arranged inside the side member itself and sized depending on both the mass of the wheel and the presence or absence of other reinforcements on the side member.
2.17.4 Additional fuel tank (diesel vehicles only)

If filling the fuel tank is hindered by a superstructure, the tank support brackets can be placed lower down, with a displacement of a drilling module (45 mm).

When necessary to change the autonomy compared to the standard configuration, it is possible to:

- replace (both for capacity increase and decrease) the tank with another tank envisaged for the series;
- add an additional tank, chosen if possible from the standard ones and compatible with available space.

If the addition is made on the same side of the chassis, the two tanks can be connected with a flexible hose (at least in part) and fuel can always be drawn from the original tank (Fig. 28A).

When instead the additional tank is positioned on the opposite side of the chassis compared to the original, it is advisable to implement a scheme like the one in Figure 28 B, where the implementation of a diverter allows to alternatively use the two tanks.

![Figure 28](image_url)

The chosen solution must be implemented in compliance with specific regulations.

The piping additions must ensure prefect sealing, have technical features and internal dimensions not less than those provided for in the original system and be properly clamped.

**Note** We highlight the need to:

- implement or realise a new measurement system that always provides correct information on the actual quantity of fuel in the tanks;
- use a specific indicator instrument and separate from the original.

2.17.5 Fuel tank movements (diesel vehicles only)

a) Vertical movements are permitted as long as the absolute minimum pressure at the inlet of the LP/HP pump is 500 mbar at sea level. The minimum pressure at the LP/HP pump inlet can increase if the vehicle is used in at higher altitudes. Lower pressure values, below 350 mbar at the LP/HP pump inlet must be avoided.

b) On MLC and MLL chassis cab vehicles without "Retraction of assemblies" optional 75435, horizontal repositioning in relation to the original position is possible when this involves a maximum extension of 500 mm for the return and delivery pipes.

For greater extensions, up to a maximum of 1000 mm, the standard fuel pre-filter is to be replaced with a different type able to create a lower drop in pressure on the line.
2.17.6 Moving to the opposite side member (diesel vehicles only)

The fuel tank can be moved to the left side member providing a minimum distance of 70 mm from the muffler is maintained. In any case, no distance less than this value is permitted.

2.17.7 Chassis with free right side (diesel vehicles only)

If the right side of the chassis, between the front mud guard and the rear wheels, must be free of all suspended assemblies, you may:

- request (where possible) opt 75501 for the air filter to be moved in front of the front axle;
- reposition the fuel tank on the left side of the chassis;
- Reposition the urea tank on the basis of the possibilities stated in Chapter 6.4 (➡ Page 6), page 9 and following.

Figure 2.30 shows some of the possible positions, especially for the urea tank.

1. Fuel tank (new position)
2. Urea tank behind the cab (standard position, forward)
3. Urea tank on the left side between the fuel tank and the spare wheel (alternative position)
2.18 TRANSPORT OF HAZARDOUS MATERIALS (ADR)

Each vehicle complies fully with the technical specifications of Regulation 105 - Series 06/01 - attachment "B" of the Agreement ADR 2019 - Part 9 (Requirements relating to the construction and approval of vehicles) with regards to the paragraphs:

- 9.2.2.2 (pipes)
- 9.2.2.3 (Fuses and circuit breakers)
- 9.2.2.5 (Lighting)
- 9.2.2.6 (Electrical connections between vehicles and trailers)
- 9.2.2.7 (Voltage)
- 9.2.2.8.1 (Battery cut-off)
- 9.2.2.8.4 (Battery cut-off)
- 9.2.2.8.5 (Battery cut-off)
- 9.2.2.9 (Permanently powered circuits)
- 9.2.4.3 (Fuel tanks)
- 9.2.4.4 (Engine without CNG - EXII and EXIII)
- 9.2.4.5 (Exhaust gas device)
- 9.2.6 (Coupling device for vehicles with engine and trailer)

Note Compliance with these requirements by the additional structures and their connections to "incomplete" vehicles, is the full responsibility of the bodybuilder.

⚠️ EUROCARGO CNG vehicles cannot be outfitted for the transport of hazardous goods of category EXII and EXIII because they do not comply in terms of the cylinders and engine fuel supply system.

2.19 INSTALLING A RETARDER

The application of a retarder brake in after-sales requires authorization from IVECO.

The possibility of adopting a different brake type from the original (for example, with electro-magnetic actuation) requires compatibility with the characteristics of the vehicle and what has already been approved by IVECO.

Please note that any unauthorised work on the original retarder will invalidate the vehicle warranty.

2.20 REAR UNDER-RUN PROTECTION (RUP)

The maximum distance between the rear under-run protection device (RUP = Rear Under-run Protection) and the rear-most point of the superstructure is 400 mm, less the deformation observed in the approval phase (on average 10 mm).

If the changes on the chassis require the adaptation of the rear overhang, the under-run protection must be placed by performing the same connection to the chassis as provided in the original version.

In the transformation of the vehicle or in the application of special equipment (e.g. rear tail lifts), it may be necessary to modify the structure of the under-run. The intervention shall not change the resistance characteristics and the original rigidity.

The compliance of the modified device with standards in force must be demonstrated to the competent authorities by appropriate documentation or test certificates.
2.21 REAR MUD GUARDS AND WHEEL ARCHES

On cab version vehicles without rear fenders, the Bodybuilder must implement solutions equal to those provided by IVECO. For the realisation of the fenders, the wheel arch boxes and the shaping of the superstructure, keep in mind that:

- the free shaking of the wheels must be ensured even in the conditions of use with chains; any indications on limit values can be requested via the Support Service;
- the width of the mudguard must be greater than the maximum dimensions occupied by the tyres, within the limits set by the regulations;
- the support structure of the fender must have adequate strength and be able to limit the vibrations;
- the connection may be made on the vertical rib of the side members of the vehicle (only using the existing holes) or directly under the applied superstructure (see Figure 32).

The first and the second point are also to be considered in the implementation of wheel arches.

![Figure 31](image-url)

2.22 MUDFLAPS

Once outfitting is complete, the mudflaps must be included in the vehicle equipment if and as indicated by the regulations in force.
2.23 SIDE PROTECTIONS

In some countries, regulations (national or UNECE) require the application of side protections. Compliance with the characteristics requested must be endured by the Bodybuilder that completes the vehicle.

In permanently applied superstructures (e.g. fixed bodies, vans) side protection can be applied on the basis of their structure (e.g. backbone of the floor beams), while for mobile superstructures (e.g. tipping bodies, interchangeable equipment, hook lifts) the connection can be made by means of suitable supports on the subframe or directly on the chassis. In the latter case, use the existing holes on the vertical rib of the side member as much as possible, in compliance with Chapter 2.2 (Page 7).

In implementing the outer protection, as required by the regulations (e.g. EC Directive), it is permitted to use either a single section with a surface extending in the vertical longitudinal sections, with pre-set dimensions and distances between them.

The protection must be connected to the support structures in order to be quickly removed or reversed in case of maintenance or repair of the units behind them.

Special attention should be paid to ensure the distances established by the Regulations in relation to the various parts of the vehicle.

Figure 33 shows:

- a side protection solution in case of a fixed body, made in compliance with the relevant EC Directives,
- an example of a support for fixing the combined lateral protection and the mudguard for the rear wheels, suitable for mobile superstructures.
**EUROCARGO Euro VI - Step D – BODYBUILDER INSTRUCTIONS**

**CHASSIS INTERVENTIONS**

**2.23 SIDE PROTECTIONS**

---

**Figure 32**

A. With the lower part of the superstructure over 1300 mm from the ground, or with the width of the superstructure below the external tyre dimension.

B. Permissible sag under the test load: ≤ 30 mm on the rear part (last 250 mm of the device); ≤ 150 mm on the remaining parts

C. Support for fixing the combined lateral protection and the mudguard for the rear wheels
2.24 FRONT UNDER-RUN PROTECTION (FUP)

There are different fixing positions to the chassis for the front under-run protection bar (FUP = Front Underrun Protection). This way it is possible to comply with UNECE Directive No. 93 even with the new vehicle set-up after outfitting, the new loads on the axles and/or the use of different tyres.

On vehicles 120E with added third axle it is necessary to use the front under-run protection of the vehicle 140E.

On the vehicles 150E, 180E and 190EL the first entrance step in the cab is fixed to the FUP; the change of its position leads to the replacement of the fixing bracket of the step in order to keep its position unchanged with respect to the cab.

2.25 REAR-VIEW MIRRORS

The table shows the main dimensions of the arms of the approved rear-view mirrors according to the maximum width of the complete vehicle and the position of the driver.

**Table 2.18 - Arms for approved rear-view mirrors**

<table>
<thead>
<tr>
<th>Vehicle width</th>
<th>Left-hand drive</th>
<th>Right-hand drive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Driving side</td>
<td>Passenger side</td>
</tr>
<tr>
<td>2300–2450</td>
<td>152 x 793 x 151</td>
<td>154 x 793 x 158</td>
</tr>
<tr>
<td>2400–2500</td>
<td>209 x 793 x 209</td>
<td>211 x 793 x 214</td>
</tr>
<tr>
<td>2500–2600</td>
<td>310 x 793 x 303</td>
<td>304 x 793 x 310</td>
</tr>
<tr>
<td></td>
<td>209 x 793 x 209</td>
<td>211 x 793 x 214</td>
</tr>
</tbody>
</table>

![Figure 33](image-url)
SECTION 3

APPLICATIONS OF SUPERSTRUCTURES
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APPLICATIONS OF SUPERSTRUCTURES

3.1 CONSTRUCTION OF THE SUBFRAME

The purpose of the subframe is to ensure a uniform load distribution on the vehicle chassis and the necessary cooperation with it to the effects of resistance and stiffness, depending on the vehicle’s specific use.

3.1.1 Material

In general, if the stresses on the subframe are not high, the material for its realisation may have characteristics inferior to those of the chassis, notwithstanding the need to have good characteristics of weldability and limits that are not lower than the values (I) shown in Table 3.1.

In cases where the stress limits require it (e.g. for crane applications), or if you want to avoid high section height, materials with superior mechanical characteristics may be used. You should, however, keep in mind that the reduction of the time of inertia of the reinforcing section involves bending and higher stresses on the main chassis.

Following are the characteristics of certain materials which were taken into account in some of the applications stated below.

Table 3.1 - Material to be used for the construction of superstructures Std IVECO 15-2110 and 15-2812

<table>
<thead>
<tr>
<th>Name of steel</th>
<th>Breaking strength [N/mm²]</th>
<th>Yield stress [N/mm²]</th>
<th>Elongation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVECO</td>
<td>Fe 360D</td>
<td>360 (I)</td>
<td>235 (I)</td>
</tr>
<tr>
<td>EUROPE</td>
<td>S235J2G3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GERMANY</td>
<td>ST37-3N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.K.</td>
<td>40D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IVECO</td>
<td>Fe E420</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>Q5E420TM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.K.</td>
<td>50F45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IVECO</td>
<td>Fe S10D</td>
<td>520</td>
<td>360</td>
</tr>
<tr>
<td>EUROPE</td>
<td>S355J2G3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GERMANY</td>
<td>ST52-3N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.K.</td>
<td>50D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.1.2 Dimension of sections

The following table shows the values of section modulus Wₖ for C-shaped sections recommended by IVECO.

The indicated value Wₖ refers to the actual section and takes into account the radii of curvature of the section (can be calculated with good approximation by multiplying the value obtained by 0.95 considering the section composed of simple rectangles). Profiles of different section may be used in lieu of those specified, provided that section modulus Wₖ and inertia time J, of the new C section are not of a lesser value.

Table 3.2 - Profile dimensions

<table>
<thead>
<tr>
<th>Section modulus Wₖ, [cm⁴]</th>
<th>Recommended C profile [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>16 ≤ W ≤ 19</td>
<td>80 X 50 X 4</td>
</tr>
<tr>
<td>20 ≤ W ≤ 23</td>
<td>80 X 60 X 4</td>
</tr>
<tr>
<td>24 ≤ W ≤ 26</td>
<td>80 X 60 X 6</td>
</tr>
<tr>
<td>27 ≤ W ≤ 30</td>
<td>80 X 60 X 7</td>
</tr>
<tr>
<td>31 ≤ W ≤ 33</td>
<td>80 X 60 X 8</td>
</tr>
</tbody>
</table>
### Section modulus $W_s$ [cm$^3$] | Recommended C profile [mm]
--- | ---
34 ≤ $W_s$ ≤ 36 | 100 × 60 × 6
37 ≤ $W_s$ ≤ 41 | 100 × 60 × 7
42 ≤ $W_s$ ≤ 45 | 80 × 80 × 8 | 100 × 60 × 8
46 ≤ $W_s$ ≤ 52 | 120 × 60 × 6 | 120 × 60 × 7
53 ≤ $W_s$ ≤ 58 | 120 × 60 × 8
59 ≤ $W_s$ ≤ 65 | 140 × 60 × 7 | 120 × 70 × 7
66 ≤ $W_s$ ≤ 72 | 140 × 60 × 8 | 120 × 80 × 8
73 ≤ $W_s$ ≤ 79 | 160 × 60 × 7
80 ≤ $W_s$ ≤ 88 | 180 × 60 × 8
89 ≤ $W_s$ ≤ 93 | 160 × 70 × 7 | 180 × 60 × 7 | 140 × 80 × 8
94 ≤ $W_s$ ≤ 104 | 180 × 60 × 8
105 ≤ $W_s$ ≤ 122 | 200 × 80 × 6 | 200 × 60 × 8 | 180 × 70 × 7
123 ≤ $W_s$ ≤ 126 | 220 × 60 × 7
127 ≤ $W_s$ ≤ 141 | 220 × 60 × 8
142 ≤ $W_s$ ≤ 160 | 200 × 80 × 8 | 240 × 60 × 8
161 ≤ $W_s$ ≤ 178 | 220 × 80 × 8 | 240 × 70 × 8
179 ≤ $W_s$ ≤ 201 | 250 × 80 × 7 | 260 × 70 × 8
202 ≤ $W_s$ ≤ 220 | 250 × 80 × 8 | 260 × 80 × 8
221 ≤ $W_s$ ≤ 224 | 220 × 80 × 8 | 280 × 70 × 8
225 ≤ $W_s$ ≤ 245 | 250 × 100 × 8 | 280 × 80 × 8
246 ≤ $W_s$ ≤ 286 | 280 × 100 × 8
290 ≤ $W_s$ ≤ 316 | 300 × 80 × 8
316 ≤ $W_s$ ≤ 380 | 340 × 100 × 8
440 | 380 × 100 × 8
480 | 400 × 100 × 8

While the section modulus represents a decisive value for the stress of the material, the moment of inertia is important mainly for the flexural hardness and for the quota of the bending moment to be taken, depending on the connection used.

#### 3.1.3 Subframe dimension

In case of elastic connection between chassis and subframe the bending moment $M_s$ must be subdivided proportionately between chassis and subframe at the moments of inertia of the sections:
3.1 CONSTRUCTION OF THE SUBFRAME

\[ M_f = M + M_t \]
\[ \frac{M_c}{M_t} = \frac{l_c}{l_t} \]
\[ M_c = M_f \cdot \frac{l}{l_t + l_c} \]
\[ \sigma_c = \frac{M_c}{W_c} \leq \sigma_{amn} \]
\[ \sigma_t = \frac{M_t}{W_t} \leq \sigma_{amn} \]

\( M_f \) = static bending moment generated by the superstructure [Nmm]
\( M_c \) = part of the static bending moment \( M \), applied to the subframe [Nmm]
\( M_t \) = part of the static bending moment \( M \), applied to the chassis [Nmm]
\( I_s \) = moment of inertia of the section of the subframe [mm\(^4\)]
\( I_c \) = moment of inertia of the section of the chassis [mm\(^4\)]
\( \sigma_c \) = maximum static stress applied to the subframe [N/mm\(^2\)]
\( \sigma_t \) = maximum static stress applied to the chassis [N/mm\(^2\)]
\( W_c \) = section modulus of the section of the subframe [mm\(^3\)]
\( W_t \) = section modulus of the section of the chassis [mm\(^3\)]
\( \sigma_{amn} \) = maximum static stress allowed on chassis [N/mm\(^2\)] see Chapter 2.1, Par. "Stresses on the chassis" (⇒ Page 7)

3.1.4 Aluminium subframe

When using materials with different characteristics from those of steel (e.g. aluminium), the size and structure of the subframe must be appropriately adjusted.

1. When the contribution of the subframe is mainly that of providing a uniform distribution of load and the chassis has the fundamental task of resistance, aluminium longitudinal profiles having dimensions similar to those indicated for the steel can be used. Typical examples are fixed bodies, vans and tanks, provided that the supports are continuous and close-up in or in the immediate vicinity of the suspension mounts. An exception is made in cases where high stresses on the chassis require relatively large sections of the steel reinforcement, cut-resistant links.

2. When the subframe is prompted to make a contribution in terms of strength and hardness (e.g. superstructures with high concentrated loads, tipping bodies, cranes, central axle trailers, etc.), the use of aluminium is generally not recommended and should be authorised from time to time by IVECO.

Please note that in defining the minimum size of the reinforcement profiles in addition to the limit of the allowable stress for aluminium, reference must be made to the different Elastic Modulus with respect to steel (approx. 7,000 kg/mm\(^2\) against 21,000 kg/mm\(^2\) for steel) which involves greater dimensioning of the profiles.

Similarly, when the connection between the chassis and subframe is such as to ensure the transmission of the shear stresses (connection with plates), in checking the stresses at the two ends of the individual section, it is necessary to define the new neutral axis for this, on the basis of the different elastic modulus of two materials.

The collaboration requirement for aluminium means, in short, large and not very convenient dimensions.
3.2 ELEMENTS MAKING UP THE SUBFRAME

3.2.1 Longitudinal sections

The side members of the added structure must be continuous, extended as much as possible toward the front of the vehicle and towards the rear area of the front spring support; in addition, they must rest on the chassis and not on the brackets.

In order to achieve a gradual reduction of the resistant section, the front ends of the profile must be tapered in height with an angle not exceeding 30°, or another form of equivalent tapering (see Figure 2); the front end in contact with the chassis must be properly coupled, with min. radius of 5 mm.

![Figure 2](image)

In cases in which the components of the cab rear suspension do not allow the passage of the profile in the entire section, this can be realised as in Figure 3. If, due to construction, there are high bending moments on the front of the chassis (e.g. in the case of a crane with the working range on the front of the vehicle), the profile of the subframe must be dimensioned to cope with such forces.

![Figure 3](image)

The possibility of building a subframe narrower than that of the vehicle chassis is permitted only in special cases (e.g. roll-off outfittings with sliding systems on rollers, where the mechanical or hydraulic devices are standardised). In these cases, precautions must be taken to achieve a correct transmission of forces between the structure of the subframe and the vertical rib of the chassis. This can be achieved by inserting an intermediate profile suitably adapted to the side member, or by applying an adequately stiffened connecting bracket.

The shape of the profile section is defined taking into account the function of the subframe and the type of overlying structure. Open C profiles are advisable when the subframe needs to adapt to the vehicle chassis and boxed sections when greater stiffness of the assembly is required.
Care should be taken to achieve a gradual transition from the boxed section to the open section, as in the examples in Figure 4.

1. Normal boxed profiles
2. Gradual passage from the boxed section to the open section
3. 1.5 mm lintel (width of the wing of the profile)

- It is necessary to create continuity of support between the profiles of the subframe and those of the chassis; if this is not obtained, the continuity can be restored by means of interposition of strips of sheet metal or light alloy.

If there is to be a rubber undercraw element we recommend characteristics and thicknesses similar to those used for normal production (hardness 80 Shore, max thickness 3 mm). Its use can prevent abrasive actions that can cause corrosion in the joining between materials of different composition (e.g. aluminium and steel).
The dimensions prescribed for the side members of the various types of superstructures are the recommended minimum values and, as a rule, are valid for vehicles with wheelbases and rear overhangs provided as standard (see Tables from 3.4 to 3.9, 3.11, 3.13 and 3.15). In all cases similar profiles can be used, but with moments of inertia and resistance that are not lower. These values can be obtained from the technical documentation of the profile manufacturers.

### 3.2.2 Cross member

A sufficient number of crossbars, possibly to be placed in correspondence with the fastening clamps to the chassis, must brace the two sections of the subframe.

The crossbars may be open section (e.g. C), or closed section where you would want to impart greater stiffness.

In their connection, suitable gusset plates as in the figure must be used to give adequate resistance to the connection (see Following figure, left part). When you want to achieve greater stiffness in the connection, it can be carried out according to the following Figure on the right.

![Cross member diagram](image)

#### Figure 5

### 3.2.3 Stiffening of the subframe

For some superstructures (e.g. tipping bodies, concrete mixers, cranes on rear overhang, superstructures with high centre of gravity), the subframe should be stiff in the back.

This can be achieved by increasing the scope of stiffness to obtain:

- boxing the longitudinal sections in the rear area;
- adopting closed section crossbars (see Figure 6);
- applying cross diagonals (see Figure 7);
- applying a torsion-resistant longitudinal element (see Figure 8).

In general the use of boxed longitudinal sections should be avoided in the front part of the subframe.
3.2 ELEMENTS MAKING UP THE SUBFRAME
3.2.4 Self-supporting superstructures with subframe functions

The interposition of a subframe (longitudinal and transverse) can be omitted in the case of installation of self-supporting superstructures (e.g. vans, tanks), or when the underlying structure of the equipment to be installed already has the subframe conformation.

3.3 CONNECTION BETWEEN CHASSIS AND SUBFRAME

3.3.1 Choosing the type of connection

The choice of the type of connection to be used, if not provided by IVECO originally, is very important for the purposes of contribution of the subframe in terms of strength and rigidity.

It can be elastic (brackets or clamps) or rigid, resistant to shear stress (plates sealed longitudinally and transversally); the choice must be made according to the type of superstructure to be applied (see Chapters 3.4 to 3.16), by evaluating the stresses that the added equipment transmits to the chassis, both in static and dynamic conditions. Number, size and construction of the anchors, reasonably allocated in the length of the subframe, must be such as to ensure a good connection between the chassis and the subframe.

The screws and the clamps must have material strength class of not less than 8.8, and the nuts must be fitted with systems that prevent unscrewing. The first anchor should be positioned, if possible, at a distance of about 250-350 mm from the front end of the subframe.

The elements for the original connection already existing on the vehicle chassis must be preferred.

The respect of the distance indicated above for the first anchoring must be ensured especially in the presence of superstructures with concentrated loads behind the cab (e.g. crane, front body tilting cylinder, etc.), in order to improve the magnitude of the chassis stresses and contribute more to the stability. Provide additional connections if necessary.

If you have to install a superstructure with features different from those for which the chassis was designed (e.g. a tipping body on a chassis built for a fixed body) suitable connections must be provided (e.g. replacement of brackets with shear resistant plates in the rear area of the chassis).
3.3 Connection between Chassis and Subframe

In anchoring the structure to the chassis, welding must not be performed on the vehicle chassis, nor may holes be drilled into the wings of the side members.

Note In order to improve the longitudinal and transverse containment of the connection, holes are permitted on the wings of the side members only in the rear end and provided the anchoring of any cross members is not weakened (see Figure 13).

If applicable, evaluate a solution as indicated in Figure 12, i.e. the use of the screws that connect the rear cross member to the chassis.

3.3.2 Characteristics of the connection

Elastic connections (see Figures 9, 10 and 11) allow limited movement between the chassis and the subframe; these connections make it possible to consider parallel cooperation of the two resistant sections, where each assumes a share of the bending moment proportional to its moment of inertia.

In the rigid connections (see Figure 12), a single resistant section can be considered for the two profiles, on the condition that the number and distribution of the connections are such as to withstand the consequent cutting forces.

The possibility of establishing a single resistant section between the chassis and the subframe allows you to achieve greater resistant capacity compared to the connections with brackets or clamps, obtaining the following benefits:

- lower height of the subframe profile to equal bending moment acting on the section;
- greater bending moment allowed, equal to the dimensions of the subframe profile,
- further increase in the resistance capacity if materials with high mechanical properties are adopted for the subframe.

3.3.3 Connection with brackets

Some examples of achievements of this type of connection, are shown in Figure 9.
For the elasticity of the connection it is necessary that, before the closure of the clamping screws the distance between the brackets of the chassis and the subframe is 1–2 mm; greater distances should be reduced by means of suitable spacers. At the closure of the screws, brackets must be brought into contact.

The adoption of screws of a suitable length promotes the elasticity of the connection.

The brackets must be fixed to the rib of the side members of the vehicle by means of screws or nails.

In order to better contain the loads in the transverse direction, the brackets are normally applied so that there is a slight protrusion perpendicular to the upper edge of the chassis. If instead the brackets must be applied exactly to the wire, the side guide for the superstructure must be assured with other devices (e.g. using guide plates connected only to the subframe, or only to the vehicle chassis, see Figure 12). When the front connection is elastic (see Figure 10), the lateral containment must be assured even in conditions of maximum torsion of the chassis (e.g. off-road applications).

In the event in which the vehicle chassis is already equipped with brackets for the attachment of a body of a type established by IVECO, these brackets must be used for this purpose. For the brackets applied to the subframe or to the superstructure, resistance characteristics not less than those originally mounted on the vehicle should be provided (see Table 2.1 and Table 3.1).
3.3.4 Connections with greater flexibility

When the connection needs greater flexibility (e.g., vehicles with high stiffness of the superstructure such as vans, tanks, etc., used on winding roads or in poor conditions, vehicles for special use, etc.), hardware of the type indicated in Figure 10 should be adopted in the area behind the driver’s cab. Brackets accompanied by rubber plugs (1) or coil springs (2) should be used.

![Figure 10](image)

1. Rubber block

2. Coil spring

In the case of superstructures that generate high bending and twisting moments (e.g., a crane behind the cab), the subframe must be properly sized to support them.

The elastic element characteristics should be suited to the stiffness of the superstructure, the wheelbase and the type vehicle use (irregular road conditions).

Using rubber plugs, use materials that ensure good elasticity over time; provide adequate instructions for the periodic control and eventual restoration of the torque.

If necessary, the total capacity of the connection can be restored by installing cut-resistant hardware in the rear suspension area.

In versions where the vehicle is lifted by hydraulic stabilisers (e.g., cranes, aerial work platforms), limit the collapse of the elastic element (30–40 mm) to ensure sufficient cooperation of the subframe and avoid excessive bending moments on the original chassis.

3.3.5 Connections with clevis fasteners or clamps

Figure 11 shows the main constructions of this type.

In this case the bodybuilder must interpose a spacer (preferably metal) between the wings of the two side members and in correspondence to the clevis fasteners, in order to avoid the bending of the wings under the pull of the clevis fasteners.

In order to drive and better contain the transverse direction of the structure added to the chassis, this type of fixing can be completed with the addition of plates welded to the subframe as shown in Figure 12.

The characteristics of this connection advise against a general integral use on the vehicle; in any case, to give the added structure the suitable containment in the longitudinal direction as well as adequate stiffness, it is necessary to integrate the fastening to the rear part with longitudinal and transverse sealing plates.

For this purpose, it is also possible to use connections by means of screws at the rear end of the chassis as shown in Figure 13.
3.3.6 Connection with longitudinal and transverse sealing plates (rigid connection)

The type of mounting shown in Figure 11, made with plates that are welded or bolted to the subframe and fixed with nails or screws to the vehicle chassis, ensures a good capacity for reacting to longitudinal and transverse thrusts and the greatest contribution to the stiffness of the assembly.
For the correct use of these plates, please keep in mind that:

- the vertical rib of the chassis should be fastened only after making sure that the subframe is snug against the chassis itself;
- the distribution must be limited to the central and rear area of the chassis;
- the number and the thickness of the plates and the number of fixing screws must be adequate to withstand the bending moments and cutting of the section.

If the superstructure generates high bending and twisting moments on the chassis and its resistant capacity has to be increased by adopting a cut-resistant connection between the chassis and the subframe, or if you want to contain the height of the subframe as much as possible (e.g. central axle trailers, crane on rear overhang, tail lifts, etc.), use the information supplied in the table below (valid for all models):

| Table 3.3 |
|-----------------|-----------------|-----------------|-----------------|
| Chassis and subframe height/section ratio | Max. distance between the centre lines of the cut-resistant plates [mm] (1) | Minimum characteristics of the plates | Dimensions of the screws (2) (min. 3 screws per plate) |
| ≥ 1.0 | 500 | 8 | M14 |

(1) The increase in the number of screws for each plate makes it possible to proportionally increase the distance between the plates (a double number of screws may allow a greater distance between the plates). In high stress areas (e.g. the rear spring supports, the tandem axle springs and the air springs), it is necessary to provide a distance between the plates, reduced as much as possible.

(2) In the presence of contained thicknesses of the plates of the chassis and the subframe, it is advisable to connect by adopting spacer bushes, in order to use longer screws.

### 3.3.7 Mixed connection

Based on the indications in Chapter 3.1 (⇒ Page 5) for realisation of the subframe and the considerations of Chapter 3.3 (⇒ Page 12), the connection between the vehicle chassis and the reinforcing subframe may be of mixed type, i.e. obtained by rationally using the elastic connections (brackets, clevis fasteners) and rigid connections (longitudinal and transverse sealing plates).

Generally, it is preferable to have elastic connections in the front part of the subframe (one or two per side), while connections are recommended with plates toward the rear of the vehicle when it the added structure requires a greater contribution to the overall stiffness (e.g. tippers, cranes on rear overhang, etc.).

For this purpose, it is also possible to use connections by means of screws at the rear end of the chassis as shown in Figure 13.
3.4 CONTAINER APPLICATION

3.4.1 Dimensions and centres of gravity

Check the correct load distribution and in particular, respect the indications regarding the height of the centre of gravity as provided in Section 1 using suitable construction precautions and ensure that the transported load has maximum stability while running.

3.4.2 Fixed bodies

The application on normal cab vehicles, valid only for road services, is normally made through a support structure consisting of longitudinal and transverse profiles. The minimum Approximate sizes of the longitudinal sections are shown in Table 3.4.

Table 3.4

<table>
<thead>
<tr>
<th>Model</th>
<th>Wheelbase [mm]</th>
<th>Modulus of resistance $W_c$ [cm$^2$] of the minimum reinforcement section</th>
</tr>
</thead>
<tbody>
<tr>
<td>60E, 65E, 75E, 80EL</td>
<td>up to 3690</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>and 3690</td>
<td></td>
</tr>
<tr>
<td>80E, 90E, 100E</td>
<td>up to 3690</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>and 3690</td>
<td></td>
</tr>
<tr>
<td>110E, 110EL, 1120EL, 120E, 140E, 150E, 160E</td>
<td>up to 3690</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>and 3690</td>
<td></td>
</tr>
<tr>
<td>180E, 190EL</td>
<td>all</td>
<td>57</td>
</tr>
</tbody>
</table>

Note  For the dimensions of the profiles see Table 3.2.

Fastening is achieved through specially crafted brackets along the vertical rib of the side members; if such connections have not already been specified by IVECO, they must be made according to the instructions in Paragraph "Connection with brackets" (☞ Page 13). To achieve adequate longitudinal containment, in the case of connections with brackets or clamps it is good practice to provide a rigid connection on the end of the rear overhang (one per side), obtained with screws or plates on the upper flange of the side member (see Figures 12 and 13).

In no other case should new holes be made on the wings of the main side members.
In cases in which the body uses elevated supports above the subframe (e.g. crossbars), it is necessary to suitably stiffen such supports, to contain the longitudinal thrusts, as shown in Figure 14.

The front wall of the body must have the necessary strength and toughness to support the forces generated by the transported load, in the case of sudden and high decelerations.

1. Subframe
2. Brackets
3. Containment elements

For special equipment where a reinforcing section of moderate height is needed, the structure of the subframe can be integrated by brackets for the anchorage of the bodywork so as to affect the height across the section of the reinforcing longitudinal profile (see Figure 15).

In these cases, the rear wheel arches can be inserted into the equipment crankcase.
In the case of self-supporting superstructures having the support backbone with the function of the subframe, the application of the previously indicated reinforcing profiles can be omitted.

### 3.4.3 Tipping bodies

The use of tipper bodies, rear and three sided, generally subjects the chassis to considerable stress. Therefore, please observe the following indications.

1. The use of a stabilizer bar on all IVECO models for which it is an optional, is recommended.
2. The subframe must be:
   - suitable for the type of vehicle and conditions of use,
   - with appropriately sized crossbars and side members,
   - with the rear end stiffened with boxing and crossbraces (see Figure 6 and Figure 7). The connections to the chassis must be elastic (brackets or supports) at the front end, whereas the rear section requires stiff connections (cleat plates) (see Figure 12) to allow the additional structure to contribute more effectively towards the rigidity of the assembly. Omega shelves can be used on vehicles on where these are originally fitted.
3. The rear tipping hinge must be fitted on the subframe; its position must be as near as possible to the rear support of the rear suspension. In order not to affect the stability of the vehicle during tipping and to not excessively increase the stress on the chassis, it must be respected the distances indicated in Figure 16. If for technical reasons this cannot be achieved, small increases may be permitted provided a higher strength subframe is used, in order to increase the rigidity of the rear end. Where long bodies are needed to transport large volumes, it is advisable to lengthen the wheelbase of the vehicle.
4. Great care must be given to the positioning of the lifting device both in terms of providing support of adequate strength and in order to correctly position the mountings. In any case, it is advisable to place the ram to the front of the centre of gravity of the body and payload so as to reduce the extent of the localized load.
5. In rear tipping it is recommended that a stabiliser is fitted to guide the container, particularly when the lifting cylinder is located behind the cab.
6. The lifting device hinge must be mounted on the subframe. The useful volume in the body must conform with the maximum permissible load on the axles, to the density of the material to be transported (a density mass of approximately 1600 kg/m³ is to be used for excavated material). In the case of transporting freight with a low density, 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).
7. The bodybuilder must ensure the functioning and safety of all parts of the vehicle (e.g. the positioning of lights, tow hook coupling, etc.) and ensure that, following the addition of the structure, vehicle stability is guaranteed during tipping operations.

⚠️ The air springs must be completely discharged during unloading operations, to ensure stability of vehicles equipped with air suspensions. There must also be a nameplate highlighting this indication. See also Specification 01 in Chapter 5.2.
3.4.4 Heavy-duty services

Table 3.5 shows which vehicles may be ordered for heavy-duty services and the indications for the main sections of the subframe. For its dimensions, depending on the section modulus $W_s$, see table 3.2.

In the event of tippable superstructure assembly on vehicle chassis already equipped with brackets, replace them with longitudinal and transverse seal plates, in the segment between the front engine axle suspension support and the rear chassis end or apply additional plates.

Special attention must be paid to ensure adequate stability to the vehicle during the rear tipping of the body.

For vehicles that are transformed even through two rear axles, is prescribed that:

- the box section for the longitudinal reinforcement section (see Figure 4) involves the segment between the rear edge and approx. 1300 mm in front of the centre line of the two axles;
- the diagonal cross bracings involve the area between the centre line of the double axle and the rear end of the chassis;
- the tipping support is to be positioned no more than 1400 mm from the centre line of the double axle.

<table>
<thead>
<tr>
<th>Model</th>
<th>Wheel base (mm)</th>
<th>$W_s$, [cm$^2$] of the minimum section bar of the subframe (Yield point of the material used = 360 N/mm$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60K, 65K, 75K</td>
<td>All</td>
<td>39</td>
</tr>
<tr>
<td>80K, 90K, 100K</td>
<td>All</td>
<td>46</td>
</tr>
</tbody>
</table>
### 3.4 CONTAINER APPLICATION

<table>
<thead>
<tr>
<th>Model</th>
<th>Wheel base (mm)</th>
<th>Section modulus $W_s$ [cm$^3$] of the minimum section bar of the subframe (Yield point of the material used = 360 N/mm$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>120K</td>
<td>All</td>
<td>45</td>
</tr>
<tr>
<td>140K</td>
<td>All</td>
<td>53</td>
</tr>
<tr>
<td>150K, 160K</td>
<td>All</td>
<td>89</td>
</tr>
<tr>
<td>180K</td>
<td>3690</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>4815</td>
<td>105</td>
</tr>
</tbody>
</table>

**Note**  For the dimensions of the profiles see Table 3.2.

#### 3.4.5 Light services

For these applications, we recommend using models with short wheelbases. The sections to be used are given in Table 3.6. It is understood that the vehicle must be used for light duty on roads which are in a good condition, to transport freight with a low volumetric mass.

In addition to respecting the general specifications indicated above, in order to give the vehicles the required rigidity and stability, the following must be observed:

- carefully check the chassis specifications (suspension, chassis, number of axles) so as to select a vehicle suitable for the body and its intended use;
- the rear end of the subframe must be stiffened using box-type sections, crossbraces, cleat plates etc.;
- the tipping supports must be placed as near as possible to the rear supports of the rear suspension;
- in cases of vehicles with a wheelbase greater than the short wheelbase envisaged, stiffen the rear tipping support so as to contain sag and ensure good side stability during operation; the tipping angle should be between 35° and 45° and the user should be informed that tipping should be done on as flat a surface as possible;
- use the most rigid rear suspension available and the rear stabilizer bar; when parabolic rear springs are used, the rigidity can be increased using flexible parts rubber elements which operate at static load;
- for vehicles with rear air suspension, discharge the air from the springs during the tipping operation to allow the vehicle the greatest stability of the suspensions while the material is descending; It is important that this operation takes place automatically using the load lifting control whereas the resetting can be combined with the body lowering control;

**Table 3.6**

<table>
<thead>
<tr>
<th>Model</th>
<th>Section modulus $W_s$ [cm$^3$] of the minimum section bar of the subframe (Yield point of the material used = 360 N/mm$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60E, 65E, 75E, 80EL</td>
<td>26</td>
</tr>
<tr>
<td>80E, 90E, 100E</td>
<td>39</td>
</tr>
<tr>
<td>110EL, 120EL</td>
<td>57</td>
</tr>
<tr>
<td>120E</td>
<td>31</td>
</tr>
<tr>
<td>140E</td>
<td>46</td>
</tr>
<tr>
<td>150E, 160E</td>
<td>46</td>
</tr>
<tr>
<td>180E, 190EL</td>
<td>69</td>
</tr>
</tbody>
</table>

**Note**  For the dimensions of the profiles see Table 3.2.
3.4.6 Roll-off bodies

The possibility of installing structures for moving roll-off containers (containers moved down to the ground, by depositing or rear sliding, using an on-board vehicle crane) is not universally applicable and should therefore be assessed with IVECO according to each type of vehicle.

With this type of outfitting, there may be additional stresses during the loading and unloading phases compared to those of vehicles with a fixed body; therefore, the subframe to be used must be at least of the dimensions established for light tipping bodies (see Paragraph "Light service" (☞ Page 22)).

In the case of vehicles with long wheelbases or rear overhangs, it may be necessary to use sections of greater dimensions.

The interchangeable superstructure must rest on the vehicle chassis along its entire length or at least be in contact with an extensive area of the suspension attachment areas.

The lifting devices (on-board crane system) must be fixed to the subframe as indicated in Chapter 3.8 (☞ Page 26).

Vehicle stability must be guaranteed in compliance with standard DIN 30722 during loading and unloading operations. The use of stabilizers is recommended at the rear end, to be used particularly with roll-off vehicles. These supports are, in any case, essential if the rear axles have air or mixed suspension.

⚠️ During the offloading phase to ensure stability of vehicles equipped with air suspensions, the air springs must be completely discharged. There must also be a nameplate highlighting this indication. See also Specification 01 in Chapter 5.2.

It is important, with this type of vehicle, to adhere to the indications concerning the height of the centre of gravity (see Chapter 1.15 (☞ Page 11)): when containers for high payloads are used, use the most rigid rear suspension and rear stabilizer bar available if IVECO provides for this.

The distance between the last rear axle and the sliding pivot must not exceed 900 mm.
3.5 TRACTOR FOR SEMI-TRAILER

There are no versions in the Eurocargo range which are intended for towing semi-trailers.

Conversion from chassis cab vehicle (category N2 or N3) to tractor is complex and involves operations on the vehicle which, as indicated in Chapter 1.3, require a specific IVECO authorisation.

This authorisation includes the technical instructions (structure, fifth wheel, braking, electrical system, etc.) that the bodybuilder must observe, in addition to the indications for the permitted masses and the necessary precautions for its use.

3.6 TRANSPORT OF INSEPARABLE MATERIALS (TRAILER TRUCKS)

Not provided.

3.7 INSTALLATION OF TANKS AND LOOSE MATERIAL CONTAINERS

3.7.1 Installation with a subframe

The installation of tanks and containers is carried out, as a rule, using a suitable subframe.

The approximate dimensions of the section to be used for the subframe are shown in Table 3.7.

<table>
<thead>
<tr>
<th>Model</th>
<th>Section modulus $W_t$ [cm$^2$] of the minimum section bar of the subframe (Yield point of the material used $= 360$ N/mm$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60E, 65E, 75E, 80EL</td>
<td>46</td>
</tr>
<tr>
<td>80E, 90E, 100E, 110EL, 120EL</td>
<td>57</td>
</tr>
<tr>
<td>120E, 140E, 150E, 160E</td>
<td>89</td>
</tr>
<tr>
<td>180E, 190E</td>
<td>99</td>
</tr>
</tbody>
</table>

Note  For the dimensions of the profiles see Table 3.2.

The assembly of tanks, or stiff torsional structures in general, must ensure sufficient and gradual flexibility of the chassis, in order to avoid high stress areas.

The use of flexible parts is recommended for the connections between the cistern body and the subframe (see Figure 18) in the front part and rigid supports resistant to the longitudinal and transverse forces towards the rear part.
As previously mentioned, the stiff connections positioned in correspondence with the rear suspension mounts are more suitable for transmitting forces directly to the suspension elements; elastic connections are to be arranged near the front suspension rear mount.

If this is not carried out, use suitably oversized longitudinal reinforcement sections with respect to those shown in Table 3.7.

When defining elastic connections, consider the rigidity of the chassis in the area where the connections are to be applied and the type of functions for which the vehicle is intended.

### 3.7.2 Installation without a subframe

The installation of tanks directly on the chassis is possible under the following conditions:

- the distance between the various rests must be established according to the load to be transmitted (approximately no more than 1 m);
- the rests must be made to uniformly distribute the load on a suitably wide surface and with bracing to contain longitudinal and transverse forces.
- anchoring must be sufficiently extended in width (approximately 600 mm) and arranged near suspension mounts (maximum distance 400 mm).
- Specifically, the front anchoring flexibility must be suited to contain the necessary torsional movements of the chassis;
- other anchoring solutions must be authorised by IVECO.
A suitable subframe which ensures good distribution of load and suitable torsional rigidity for the chassis-subframe assembly must be ensured by means of shear resistant connections when two or more separate containers are applied on the vehicle. A good solution consists in a stiff connection which joins the containers.

The maximum volume, the degree of filling of the container and the volumetric mass of the transported goods must be defined in observance of the axle weight limits. In the case of tanks and single containers made with separate compartments, the minimum ratio between front axle weight and total fully loaded weight as well as the maximum loads on axles must be respected in all conditions of load (see Chapter 1.15 (⇒ Page 11)).

In consideration of the type of outfit, the use of vehicles equipped with stabilizer bars is recommended and particular attention should be paid to limiting, as far as possible, the height of the overall centre of gravity (see Chapter 1.15 (⇒ Page 11)); use of a vehicle with stabilizer bars is recommended.

In tanks and containers for liquids, transverse and longitudinal partitions are to be used. In fact, if these are not completely full, the dynamic thrust which the liquid generates while the vehicle is in motion could negatively influence the vehicle’s handling and resistance. Similarly, avoid dynamic loads on coupling devices for trailers and semi-trailers.

Follow the safety laws in force for containers intended to carry flammable liquids (see Chapter 2.18).

### 3.8 INSTALLING A CRANE

The selection of the crane must be made with due consideration to its characteristics and 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) and verifying those required for the vehicle.

- **In order to ensure stability while the crane is operating, the stabilisers (hydraulic if possible) must be used and be in contact with the ground.**

- **In the case of vehicles equipped with air suspensions, lifting with stabilisers should only be performed with the bellows inflated. This precaution is required to prevent the bellows from detaching from the corresponding plates; this should be indicated on an appropriate plate.**
As a general rule, the installation of a crane requires the use of a suitable subframe, the construction of which must take into account the general specifications (see Chapter 3.1 (Page 5)), and with the dimensions of the sections given in Tables 3.8, 3.9 and 3.11.

In those cases where no specific subframe is required (cases indicated with the letter A in the aforesaid tables) it is still necessary to provide a suitable mounting base for the crane on the chassis (the length of the sections must be at least 2.5 times the width of the base structure of the crane) in order to distribute the load and the stresses which develop during crane operation.

If the vehicle outfitting requires the use of a section with section modulus greater than that required for the crane (e.g. tipper), this section may also be considered for the crane.

Special cases, whose $M_G$ value falls within the areas designated by letter "E" in the mentioned Table (or for higher values) must be checked individually each time and must receive specific authorisation from IVECO.

\[ M_{G\ max} = (W_L \cdot L + W_C \cdot l)_{max} \]

- $W_L = \text{mass applied to crane extremity [kg]}$
- $L = \text{horizontal distance between the payload application point} W_L \text{ and vehicle centre line [m]}$
- $W_C = \text{mass of the crane at its centre of gravity [kg]}$
- $l = \text{horizontal distance between centre of gravity of crane and vehicle centre line [m]}$

» The Bodybuilder must, case by case, check the vehicle stability and take all necessary precautions for its correct and safe use. The crane manufacturer and the Bodybuilder are responsible for defining the type and number of stabilisers as well as selecting the subframe on the basis of the maximum static moment and the position of the crane.
3.8.1 Crane behind the cab

To arrange appropriate spaces behind the cab for the installation of the crane and the stabilisers, it is recommended that optional 75435 "Retraction of Assemblies".

The fastening of the reinforcement sections to the chassis must be carried out using the standard brackets (see Figure 21), supplementing them, if necessary, with other fasteners of elastic type (brackets or clamps) in order to keep the flexural and torsional characteristics of the chassis as unchanged as possible.

The dimensions of the reinforcement sections to be used for this type of connection are shown in Table 3.8.

On vehicles for road use only, shearing resistant connections may be used for fastening the subframe to reduce the subframe section height (see Figure 22) is requested. The minimum reinforcement section dimensions for all these applications are given in Table 3.9.

The implementation of constant diameter sections for the entire length of the vehicle is recommended; section diameter reductions (always gradual) are possible in the areas in which the bending moment induced by the crane assumed values corresponding to the boxes marked "A" in Tables 3.8 and 3.9 as possible.

The section of the crane subframe (see Figure 21) can be integrated towards the rear end with that envisaged for another possible superstructure; the length "Lv" must in no case be less than 35% of the wheelbase if the superstructure section diameter is smaller.

---

**Figure 21**

1. Reinforcing profile
2. Connections
3. Crane connections
4. Stabilisers
### Table 3.8 - Crane behind cab (subframe secured with shelves or flanges)

<table>
<thead>
<tr>
<th>Model</th>
<th>Section chassis [mm]</th>
<th>Total torque Mₜ max [kNm]</th>
<th>Minimum value of the section modulus of the subframe section Wₜ [cm⁴]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>60E, 65E, 75E, 80EL</td>
<td>172.5x65x4</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>172.5x65x5</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>80E, 90E, 100E</td>
<td>195.5x65x4</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>80E, 90E, 100E</td>
<td>110EL⁽¹⁾, 120EL⁽¹⁾</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>110EL⁽¹⁾, 120EL⁽¹⁾</td>
<td>195.5x65x6</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>120E, 140E, 150E, 110EW</td>
<td>240x70x5</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>120E, 140E, 150E, 160E, 150EW</td>
<td>240x70x6</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>120E, 140E, 150E, 160E</td>
<td>240x70x6.7</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>150E, 160E</td>
<td>240x70x7.7</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>180E, 190EL</td>
<td>262.5x80x6</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>262.5x80x6.7</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>262.5x80x7.7</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

A = The reinforcement section envisaged for the relative superstructure is sufficient (e.g. Table 3.4 for normal containers). Close the reinforcement section in the crane assembly area. In the crane area, brace the reinforcement profile sections which have a thickness of less than 5 mm.

E = To be checked case-by-case. Send IVECO technical documentation with verification of stress and stability.

⁽¹⁾ In the long cab version use a section with section modulus Wₜ not less than 57 cm⁴.

**Note** For the dimensions of the profiles see Table 3.2.
The application of cranes on off-road vehicles may require flexible connections on the front and middle parts between chassis and subframe (see Figure 10) so as not to excessively restrict torsional movement of the chassis. In these cases, the crane is practically connected to the subframe only, the dimensions of the longitudinal sections must therefore be suited to withstand the moment induced when the crane is used.

The vehicle elements arranged behind the cab (e.g., the gearbox controls, air filter, cab tilt locking device etc.) must be arranged to ensure functionality; moving certain units such as battery boxes, fuel tanks etc. is allowed providing that the original connection type is restored.

The body or equipment must normally be retracted to arrange the crane behind the cab.

In the specific case of tipping equipment, particular attention must be paid to arranging the mounts of the lifting device and the tipper rear hinges which must be as retracted as possible.

### Table 3.9 - Cranes mounted behind cab (subframe secured with shear resistant plates)

<table>
<thead>
<tr>
<th>Model</th>
<th>Section chassis [mm]</th>
<th>Total torque M₀ max [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>60E, 65E, 75E, 80EL</td>
<td>172.5x65x4</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>172.5x65x5</td>
<td>A</td>
</tr>
<tr>
<td>80E, 90E, 100E</td>
<td>195.5x65x4</td>
<td>A</td>
</tr>
<tr>
<td>80E, 90E, 100E, 110EL⁹, 120EL⁹</td>
<td>195.5x65x5</td>
<td>A</td>
</tr>
<tr>
<td>110EL⁹, 120EL⁹</td>
<td>195.5x65x6</td>
<td>A</td>
</tr>
<tr>
<td>120E, 140E, 150E, 110EW</td>
<td>240x70x5</td>
<td>A</td>
</tr>
<tr>
<td>120E, 140E, 150E, 160E, 150EW</td>
<td>240x70x6</td>
<td>A</td>
</tr>
<tr>
<td>120E, 140E, 150E, 160E</td>
<td>240x70x6.7</td>
<td>A</td>
</tr>
<tr>
<td>150E, 160E</td>
<td>240x70x7.7</td>
<td>A</td>
</tr>
<tr>
<td>180E, 190EL</td>
<td>262.5x80x6</td>
<td>A</td>
</tr>
</tbody>
</table>

(1) Minimum value of the section modulus of the subframe section Wc, [cm³]
A = The reinforcement section envisaged for the relative superstructure is sufficient (e.g. Table 3.4 for normal containers). Close the reinforcement section in the crane assembly area. In the crane area, brace the reinforcement profile sections which have a thickness of less than 5 mm.

E = To be checked case-by-case. Send IVECO technical documentation with verification of stress and stability.

(1) In the long cab version use a section with section modulus W, not less than 57 cm³.

Note  For the dimensions of the profiles see Table 3.2.

**Specification 01**

Should it be necessary to reduce the height of the subframe section (using shear resistant connections between the chassis and subframe), combined sections may be used in place of the channel section as indicated in Table 3.10, on condition that the wing width and thickness are not less than those of the section recommended by IVECO (Table 3.9). The possibility of using materials with superior mechanical characteristics requires verification of the total moment of resistance of the chassis plus subframe.

Since reducing the height of the section also reduces the torsional resistance, in the crane support area, the Bodybuilder must take the necessary measures so as to ensure adequate torsional rigidity of the subframe: for this reason it is recommended that sections with a height of less than 120 mm are not used. However, since such arrangements limit the torsional capacity of the vehicle chassis, their realization must be provided only for road use.

**Table 3.10 - Crane behind cab (solutions with combined reinforcement sections)**

<table>
<thead>
<tr>
<th>Material yield strength R_y (N/mm²)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>320</td>
<td>320</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>Maximum reduction of the section height [mm]</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>L_v (see figure 21)</td>
<td>0.25 L_v or 0.35 L_v or 0.55 L_v or 0.60 L_v</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Example of combined sections in alternative to C 250x80x8 [mm]</td>
<td>210x80x8</td>
<td>190x80x8</td>
<td>150x50x8 + angle</td>
<td>130x50x8 + angle</td>
</tr>
<tr>
<td>Actual reduction in height [mm]</td>
<td>40</td>
<td>52</td>
<td>92</td>
<td>104</td>
</tr>
</tbody>
</table>

(1) These are general instructions which are valid for the materials indicated. The use of materials with superior mechanical characteristics require verification of the overall moment of resistance of the chassis plus the subframe.
3.8 Installing a Crane

3.8.2 Crane on the rear overhang

The subframe should extend for the entire length of the vehicle to the rear part of the cab; The dimensions of the longitudinal sections are shown in Table 3.11.

Considering the particular distribution of weights on the vehicle (load concentrated on overhang) and to ensure the necessary torsional rigidity for good performance on the road and during the working phase of the crane, the subframe must be suitably stiffened in relation to the crane capacity. Therefore, the use of (see Chapter 3.2 (Page 8)) box sections and cross bracings in line with the rear suspension and along the entire length Lv (see Figure 24) is requested.

The passage between box section s and open sections must be well fitted as shown in Figure 23.

Shear resistant connections (a sufficient number of plates spaced at a maximum distance of 700 mm) must be used in the box section for fastening to the chassis, given that elastic fastenings are used on the front end. Check that the ratio between front axle and rear axle weight respects the limit defined for each vehicle under any load condition (see Chapter 1.15 (Page 11)).

Considering that the necessary subframe rigidity depends on various factors (e.g. crane capacity, resting surface dimensioning, vehicle tare weight, chassis overhang), instructions valid for all situations cannot be given. For this reason bodybuilders shall, if necessary, proceed also by testing the vehicle's stability. If the test results show that rigidity is insufficient, the bodybuilder will adopt suitable precautions so as to obtain correct realisation.
The rear overhang of the crane (measurement L_n, see Figure 24) must be limited, to the extent possible, (never exceed 50% of the wheelbase) to maintain good vehicle driving characteristics and acceptable stress regimes for the chassis.

For vehicles with additional liftable rear axle, the minimum load on the front axle must be tested with the rear axle raised (in countries where travelling with the vehicle in this condition is allowed) (see Chapter 1.15 (Page 11)). The axle must be lowered while travelling if the minimum required value is not obtained.

1. Subframe on the entire body length
2. Plates
3. Brackets
4. Crane connections
5. Stabilisers
6. Connecting corner

**Table 3.11 - Crane on the rear overhang (subframe secured with shear resistant plates)**

| Models | Section chassis [mm] | 20 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 | 260 | 280 |
|--------|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|        |                      | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 | 260 | 280 | 300 |
| 60E, 65E, 75E, 80EL | 172.5x65x4          | A  | A  | A  | 23 | 32 | 57 | 110| 110| 135| E   |
|        | 172.5x65x5          | A  | A  | A  | 23 | 32 | 57 | 71 | 110|    | E   |
| 80E, 90E, 100E | 195.5x65x4          | A  | A  | A  | 23 | 42 | 71 | 110| 110| 135| E   |
|        | 195.5x65x5          | A  | A  | A  | 23 | 32 | 57 | 71 | 110|    | E   |
| 80E, 90E, 100E, 110EL(3), 120EL(3) | 195.5x65x6 | A  | A  | A  | 32 | 42 | 71 | 110| 110| 135| E   |
| 120E, 140E, 150E, 110EW | 240x70x5 | A  | A  | A  | A  | A  | A  | 23 | 71 | 110|    | E   |
| 120E, 140E, 150E, 160E, 150EW | 240x70x6 | A  | A  | A  | A  | A  | A  | 23 | 42 | 71 | 110| 135| E   |
| 120E, 140E, 150E, 160E | 240x70x6.6 | A  | A  | A  | A  | A  | A  | 23 | 32 | 57 | 71 | 110| 135| E   |
| 150E, 160E | 240x70x7.7 | A  | A  | A  | A  | A  | A  | 23 | 32 | 57 | 57 | 110| 135| 173| E   |
| 180E, 190EL | 262.5x80x6 | A  | A  | A  | A  | A  | 23 | 23 | 42 | 71 | 110| 137| 222| 246| 246| E   |

**Minimum value of the section modulus of the subframe section W_n [cm^3]**
### 3.8 Installing a Crane

#### Table 3.12 - Crane mounted on rear overhang (solutions with combined section reinforcement structures)

<table>
<thead>
<tr>
<th>Models</th>
<th>Section chassis [mm]</th>
<th>Total torque $M_T$ max [kNm]</th>
<th>Minimum value of the section modulus of the subframe section $W_s$ [cm$^3$]</th>
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**Note** For the dimensions of the profiles see Table 3.2.

#### Specification 02

Should it be necessary to reduce the height of the subframe box section (using shear-resistant connections between the chassis and subframe), combined sections may be used instead of the channel section as indicated in Table 3.12, provided that the width of the wing and thickness are not less than those of the section recommended by IVECO (Table 3.11). The possibility of using materials with superior mechanical characteristics requires verification of the total moment of resistance of the chassis plus subframe.

Since reducing the height of the section also reduces the torsional resistance, in the crane support area, the Bodybuilder must take the necessary measures so as to ensure adequate torsional rigidity of the subframe: for this reason it is recommended that sections with a height of less than 120 mm are not used. However, since such arrangements limit the torsional capacity of the vehicle chassis, their realization must be provided only for road use.

**3.8.3 Removable cranes**

The installation of removable cranes on the rear overhang may be carried out according to the specifications of the previous paragraph provided the type of fixing used between the crane and the subframe does not cause additional stress to the vehicle chassis. Since the vehicle may be used with or without the crane (where permitted), it is recommended that the position of the payload is marked on the superstructure.

If the possibility for the vehicle to tow a trailer is maintained, all the regulations for the correct coupling must be observed.
3.9 INSTALLATION OF TAIL LIFTS

Note  The installation of tail lifts must be carried out with due regard for the maximum permissible weights on the rear axles of the vehicle and of the minimum load established for the front axle (see Chapter 1.1.5 ( ⇒ Page 11)). If this is not possible, the rear overhang will have to be reduced.

The tail lift must be fastened with a structure that ensures appropriate weight distribution, especially in the case of specific outfits with no subframe (e.g. box truck bodies, pick-up bodies with cross-members).

The dimensions of the sections to be used can be defined:

- using Table 3.13 in the case of standard overhangs and stresses induced by the normally available tail lifts;
- using the indications provided in Figure 23, in the case of other overhangs and/or particular tail lifts (as for example, those with a vertical rest position).

To ensure the necessary strength and rigidity, and especially in the case of overhangs exceeding 1,500 mm, the connection between the chassis and the subframe must be made using shear-resistant plates (spaced no further than 700 mm from one another) in the area of the rear overhang, and must continue up to the front support of the rear suspension (see Figure 25).

3.9.1 Procedure for calculating the chassis bending moment during loading of tail lift

![Diagram](image)

\[ W_{TL} = \text{Weight of tail lift} \]
\[ W_{L} = \text{Tail lift capacity} \]

The bending moment on the chassis may be obtained using the following ratio:
M [Nm] = W_T A + W_TL B for tail lifts without stabilisers
M [Nm] = W_T C + W_TL D for tail lifts with stabilisers

To compensate for chassis flexing, which is inevitable when the tail lift is in operation, the bodybuilder may use reinforcement structures with larger dimensions than those indicated in Table 3.13.

Tail lifts must be installed ensuring that the maximum permissible loads on the rear axle or axles of the vehicle are not exceeded, and that the minimum load established for the front axle is maintained (see Chapter 1.15 (⇒ Page 11)); if this is not possible, the rear overhang will have to be reduced.

**Table 3.13 - Installation of tail lifts**

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<th>Overhang [mm]</th>
<th>Tail lift capacity in kN (kg)</th>
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## 3.9 INSTALLATION OF TAIL LiftS

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</tr>
<tr>
<td></td>
<td>6210</td>
<td>2235</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>6570</td>
<td>2775</td>
<td>A</td>
</tr>
</tbody>
</table>

A = The reinforcement section envisaged for the relative superstructure is sufficient (e.g. Table 3.4 for normal containers).

Note For the dimensions of the profiles see Table 3.2.
The Bodybuilder must carefully assess any variations in the stability and alignment of the vehicle caused by suspension compression and the chassis during all stages in the operation of the tail lift. Always evaluate whether using stabilisers is advisable even if their use is not rendered necessary by the stresses sustained by the chassis.

The stabilisers, preferably hydraulically operated, are to be attached to the platform’s supporting structures and must be used during all loading procedures with the tail lift.

When installing electro-hydraulic tail lifts, ensure that the capacity of the batteries and the power of the alternator are adequate (see Chapter 5.7).

In the case of vehicles with liftable third axle, the use of a tail lift when the third axle is lifted is only permitted using stabilisers.

The bodybuilder will be responsible for any modification to the under-run protection cross member, or for installing a different type (see Chapter 2.20 (Page 57)), for preserving visibility of the rear lights, for the overhang angles, and for the positioning of the tow hook coupling as provided by the respective national requirements.

**Specification 03**

Should it be necessary to reduce the height of the subframe (using shear-resistant connections between the chassis and subframe), combined sections may be used instead of the channel section (see Table 3.14), provided that the width of the wing and the thickness are not less than the corresponding dimensions of the section indicated in Table 3.13.

The possibility of using materials with superior mechanical characteristics requires verification of the total moment of resistance of the chassis plus subframe.

**Table 3.14 - Installation of tail lifts (solutions with combined section reinforcement structures)**

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material yield strength $R_{y}$ [N/mm²]</td>
<td>320</td>
<td>320</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>Maximum reduction of the section height [mm]</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>$L_{y}$ (see figure 25)</td>
<td>0.50 $L_{y}$</td>
<td>0.60 $L_{y}$</td>
<td>0.80 $L_{y}$</td>
<td>0.85 $L_{y}$</td>
</tr>
<tr>
<td>$L_{y}$ (see figure 25)</td>
<td>0.60 $L_{y}$</td>
<td>0.65 $L_{y}$</td>
<td>0.95 $L_{y}$</td>
<td>1.00 $L_{y}$</td>
</tr>
<tr>
<td>Example of combined sections in alternative to C 250x80x8 [mm]</td>
<td>210x80x8</td>
<td>190x80x8</td>
<td>150x50x8 + angle</td>
<td>130x50x8 + angle</td>
</tr>
<tr>
<td>Actual reduction in height [mm]</td>
<td>40</td>
<td>52</td>
<td>92</td>
<td>104</td>
</tr>
</tbody>
</table>

**3.9.2 Base configuration for tail lift**

A base configuration is available on EUROCARGO models (opt. 4113) for the assembly of the tail loft (also see Chapter 5.4 - Paragraph “Base configuration” (Page 29)).

The base configuration consists of the following:

- specific wiring connected to connector D of bulkhead connector and located under front grille;
- specific switch on dashboard for activating tail lifts (see Figure 26);
- connection to the instrument cluster for activation of tail lift warning lamp (see Figure 26).
Before operating the tail lift, press the switch (2) on the central module of the dashboard. The red warning light (1) on the cluster switches on to indicate that the tail lift is open and the vehicle cannot be set in motion. After completing the operation and closing the tail lift correctly, the driver must press the switch (2) again to deactivate the system and enable engine start.

### 3.9.3 VEHH pre-installation for tail lifts

To allow compliance with the VEHH standard (Association of European producers of tail lift manufacturers), a designated pre-installation is available (opt. 75182) which prevents the Bodybuilder from having to act on the electrical system.

The VEHH configuration consists of the following:

- temporary rear under-run bar. This is a simple bar with side marker lights, rear lights and a licence plate mount which the bodybuilder must remove and replace with a definitive under-run bar with its own fastening (see Figure 27);
- specific rear light wiring for connection to definitive under-run bar;
- specific wiring with 7-pin connector located on the right side member at the end of the rear overhang (see also Chapter 5.4 - “TAIL LIFT” (⇒ Page 32));
- specific switch on the dashboard for tail lift and warning light activation (as for opt. 4113).

**Note** The opt. 75182 is only available together with opt. 169 (Vehicle without rear under-run protection RUP).
3.10 INTERCHANGEABLE OUTFITS

The interchangeable outfits can be separated from the vehicle and positioned on four supports while awaiting subsequent handling.

As a rule the realization envisages the implementation of a subframe with longitudinal sections of dimensions based on Table 3.4, Alternatively there are structures that already include the connection and lifting devices.

If the concentrated loads transmitted by the lifting systems produce great strains on the vehicle chassis, provision must be made for suitable reinforcement.

To ensure proper functionality, the various conditions of the vehicle alignment must be carefully checked according to the characteristics of the suspension. Models equipped with air suspension on the rear or integral axle, are particularly suited for this type of application.

In particular cases the lifting devices, as well as the subframe, may be anchored to the connection plates between the chassis and subframe, provided that they are of suitable dimensions.

For the superstructure connections, especially when rapid closing systems are used, verify that the longitudinal and transverse thrusts which occur under dynamic conditions are adequately withstood.

The possibility of doing without a subframe or a specific sub-structure can be allowed with IVECO authorization under the following conditions:

- the interchangeable superstructure must adhere all along the chassis or at least a large surface area of the suspension connection zone;
- the connection devices, of a suitable number, must be secured on the vertical rib of the side members;
- the lifting devices must be anchored so as to transmit limited stresses to the chassis.

⚠️ The use of the vehicle without a swap body is only permitted for travelling short distances. The lack of the subframe induces the onset of additional stress on the chassis which could adversely affect its integrity. There must also be a nameplate highlighting this risk.
3.11 CONSTRUCTION OF BOX TRUCK BODIES

A structure consisting of longitudinal profiles and cross members may be used for connection to the vehicle chassis (see Figure 3.15). Dimensions as indicated in Table 3.4 may be used for longitudinal sections.

When the floor makes use of cross beams which are positioned no more than 700 mm apart and suitably connected in such a way as to create a sufficiently rigid (self-supporting) structure, it may not be necessary to use longitudinal profiles.

To ensure the stability required for the cross members and avoid stiffening the front part of the vehicle chassis excessively, consider the indications given in the previous paragraph "Box section dimensions" (Page 5).

3.12 TILT BEDS (BREAKDOWN RECOVERY)

Using a tilt bed typically subjects the chassis to considerable stress. The vehicle used should therefore be specifically indicated for this application. These vehicles are listed in Table 3.5 together with the indicative characteristics for the subframe sections necessary.

Where a very long bed is necessary, it is preferable to use a vehicle that already has a sufficiently long wheelbase rather than create a long overhang.

The subframe must be suitably sized and stiffened at the rear with boxing and diagonal crossbraces (see Figure 6 and Figure 7).

Connections to the chassis must be elastic (brackets or supports) at the front end and stiff at the rear end (cleat plates, see Figure 12) to allow the additional structure to contribute more effectively towards the rigidity of the assembly.

The rear tilt pivot must be installed on the subframe, and must be situated longitudinally as close as possible to the rear suspension mount. To prevent the risk of the tilt bed compromising vehicle stability when operating and to avoid excessively increasing the stress sustained by the chassis, the distance between the tilt pivot and the rear suspension mount must comply with the specifications given in Figure 16. Should this not be possible, the subframe profiles must be larger than normal and additional stiffening must be applied to the rear.

The position of the lift system must be defined with particular attention to protect the structural integrity of the rams and permit a precise and practically location for the mountings: it is therefore recommended that in order to reduce the extent of the localised load, the lifting device is placed forwards of the centre of gravity of the payload-flat body assembly.

The tow truck must not tow with a "forked" lifting device if the flatbed does not have a ground (counter-weight or other vehicle, in full compliance with the maximum permissible load on the rear axle) which allows the optimal distribution of the loads on the axles to be maintained and, therefore, to prevent severe damage to the rear suspensions.

The bodybuilder must equip the vehicle appropriately to ensure stability during bed tilting manoeuvres.

In the case of vehicles equipped with air suspensions, lifting with stabilisers should only be performed with the bellows inflated. This precaution is required to prevent the bellows from detaching from the corresponding plates. There must also be a nameplate highlighting this indication.
3.13 VEHICLES FOR COUNCIL, FIRE SERVICE AND SPECIAL USES

The outfitting of vehicles for municipal use (compactor trucks, road rollers; road cleaning vehicles) in many cases require:

- the realization of a particularly robust subframe towards the rear and elastic type connections to the chassis towards the front of the vehicle;
- shortening of the rear overhang of the chassis.
  When very short overhangs are necessary, the chassis may be shortened immediately downstream of the rear spring support (or after the bar coupling in the case of air suspension), thus keeping intact the connection to the chassis of the crossbar applied therein;
- the vertical placement of the exhaust, behind the cab;
- the implementation of rear suspension with greater rigidity or realized with asymmetric springs;
- a new arrangement of the rear lights.

⚠️ Do not use the reversing light switch, mounted on the gearbox, to activate functions that require increased reliability and safety levels, (e.g. engine stop during reverse, on vehicles for urban waste collection from the personnel present on the rear footboards).

3.14 FRONT INSTALLATION OF SNOW PLOUGH ATTACHMENTS

The application of a snowplough attachment (blade or ploughshare) to the front part of the vehicle must be carried out using a suitable support structure, appropriately anchored to the core of the chassis side members and in observance of the prescriptions contained in Chapter 2.2 (☞ Page 7).

⚠️ Resistant structures which make use of struts or tie rods that act on the leaf spring and/or on relative supports are strictly prohibited.

It being understood that all national requirements and specific regulations must be respected, the possibility of using the original assemblies on the front of the vehicle must be safeguarded (e.g. rescue towing device, windshield cleaning step); Otherwise the Bodybuilder must consider equivalent solutions equal within the possible technical limits.

Since in using the vehicle as a snowplough it must be ballasted and the maximum speed must be limited to 40 km/h, upon request an increase in the maximum permitted load on the axle may be granted, up to the attainment of another value approved by IVECO.

Observance of the required load must be documented and guaranteed by the company that carries out the installation.

3.15 APPLICATION OF A WINCH

The application of a winch on the vehicle can be carried out at the following points:

- on the front part of the chassis (frontal);
- on the chassis of the vehicle, behind the cab;
- between the side members of the vehicle, in a central or lateral position;
- on the rear part of the chassis.

The installation must be carried out so as not to alter the correct functioning of the vehicle’s assemblies and components, in observance of the maximum permitted axle limits and following the instructions of the winch manufacturer. The fastening of the idler members and assembly, must be carried out in observance of Chapter 2.2 (☞ Page 7), ensuring that the connection areas are not only reinforced locally (see Chapter 2.17 (☞ Page 54)), according to the pull of the winch cable and particularly its transverse component, when the traction is oblique.
The installation of a winch in the area behind the cab must allow for the insertion of an auxiliary frame, of suitable dimensions and structure (crossbars and diagonals for stiffening) for the winch capacity.

In the event of winches:

- hydraulically controlled: previously installed hydraulic pumps can be used for other services (tipping bodies, cranes, etc.);
- mechanical: for transmission of the control it is necessary to follow the indications contained in Chapter 4.1 (Page 5) and 4.2 (Page 7);
- with worm screw control: the dimensioning of the drive parts must take into account the low efficiency of controls of this type;
- electric: these are used for low power applications of brief duration, given the limited capacity of the vehicle battery and alternator.

### 3.16 CONCRETE MIXER INSTALLATION

Concrete mixer applications may only be constructed on vehicles that are suitable for this application and indicated in Table 3.15, which provides the minimum specifications of the reinforcement sections and the effective capacity of the drum. The maximum permissible weights for these vehicles may not be exceeded.

For the actual installation, besides observing the prescriptions imposed by the national Standards, the following also applies:

- The concrete mixer must be equipped with a continuous steel subframe, in order to distribute concentrated loads as much as possible. The chassis members may consist of sections which, while ensuring the same section modulus (W_s) and a moment of inertia (I) not less than the values given in Table 3.15, make it possible to lower the centre of gravity of the added structure (e.g. box sections, or sections with upper wing turned outwards, see Figure 29);

### Table 3.15 - Minimum dimensions of the subframe profile

<table>
<thead>
<tr>
<th>Models</th>
<th>Approximate capacity of the drum [m³]</th>
<th>Section modulus W_s [cm³] of the minimum reinforcement section with a yield point of the material used = 360 N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>140EK, 150EK, 160EK</td>
<td>3 – 3.5</td>
<td>83</td>
</tr>
<tr>
<td>180EK</td>
<td>4 – 5</td>
<td>92</td>
</tr>
</tbody>
</table>

**Note** For the dimensions of the profiles see Table 3.2.
1. Chassis
2. Reinforcement section with normal channel
3. Reinforcement section with upturned upper wing
4. Relative drum positions

- the subframe must be reinforced (e.g. crossbar, cross brace at rear part - see Chapter 3.2 - Paragraph "Crossbars" (☞ Page 10)) to reduce stress on the vehicle chassis caused by the forces generated during vehicle operation (due to the specific geometric configuration of the structure);
- the connections (see Chapter 3.3 (☞ Page 12)) must only involve the two chassis and be realized so as to guarantee secure anchoring. For vehicles not originally equipped with plates, the use of plates is recommended for transverse and longitudinal containment, while the use of elastic connections should be limited to the front end of the subframe (see Figures 11 and 30);

1. Subframe
2. Brackets
3. Plates

- The centre of gravity of the concrete mixing unit must be as close as possible to the front axle of the vehicle, without of course exceeding the maximum permissible load on the axle itself.
To guarantee vehicle stability (particularly when cornering and on terrain with a transverse incline), the surging of the mass inside the drum - during mixing drum operation - and the consequent transverse displacement of its centre of gravity must be taken into account.

- The additional motor for the mixing drum control requires a suitable suspension system.

Specific solutions concerning power take-offs (PTO), independent from the clutch and suitable for concrete mixer outfits, in addition to the indications for the programming of the control apparatus, are contained in Section 4 (⇒ Page 5).
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POWER TAKE-OFFS

4.1 GENERAL SPECIFICATIONS

Different types of power take-offs (PTO, Power Take Off) for motion pick-up can be mounted for operating auxiliary units. Depending on the type of use and performance required, the application can be fitted to:

- the gearbox;
- the driveline;
- the front of the engine;
- the rear 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.

When defining 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 phase (5 to 10% for mechanical transmissions, belts and gears, and higher values for the hydraulic controls).

The choice of transmission ratio for the power take-off should be made so that the absorption of power occurs in a flexible engine operating range; low speeds (below 1000 rpm) must be avoided to prevent irregular running.

The available power can be calculated in relation to the power take-off speed and the established torque.

\[
P \text{ [HP]} = \frac{M \times n \times i}{7023} 
\]

\[
P \text{ [kW]} = \frac{M \times n \times i}{9550} 
\]

\(P = \text{Available power}\)

\(M = \text{Torque permitted for the power take-off}\)

\(n = \text{Engine revolutions per minute}\)

\(i = \text{Transmission ratio} = \text{PTO output rpm} / \text{engine rpm}\)

4.1.1 Type of use

The maximum torque take-off values refer to continuous usage of up to 60 seconds.

Torque take-off values exceeding the maximum values indicated for occasional, limited usage (less than 30 s), must be approved on a case by case basis in relation to the type of application.

In the case of continuous usage exceeding 60 seconds, where the function is comparable to that of a stationary motor, the necessity of reducing torque take-off in relation to other, peripheral conditions (such as engine and transmission cooling necessities) must also be evaluated.

Note Not all types of power take-offs are suitable for continuous use, therefore the following indications must be observed (working period, breaks etc.).

⚠️ During prolonged use, the gearbox oil temperature must not exceed 110 °C and the water temperature must not exceed 100 °C.

In the case of prolonged usage which may lead to high oil temperatures, it is advisable to contact the PTO supplier to determine whether the installation of a dedicated "external oil circuit kit" is necessary.

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

In other cases, to avoid overload (e.g. hydraulic pumps, compressors) it may be necessary to include the application of devices such as clutches or safety valves.
4.1.2 PTO transmissions

In full compliance with the specifications provided by the Manufacturer of the driveline, the constant-velocity forces from the power take-off at the relevant apparatus should be carefully considered (angles, rpm, moment) during the design phase as well as the dynamic behaviour in the installation phase.

This means that:

- the dimensions should take into consideration the forces which might occur under maximum power and torque conditions;
- to ensure effective kinetic forces, the shaft ends must be at the same angle (see Figure 1), and this angle must not exceed 7°;
- solution Z is preferred to solution W due to the lower loads on the bearings of the power take-off and the equipment being driven. When it is necessary to obtain a different driveline with spatial inclinations according to angle $\phi$ (as shown in Figure 2), it is important to remember that the constant-velocity forces of the assembly can only be guaranteed if the intermediate section has forks offset by the same angle $\phi$ and if equal conditions are observed between the angles at the extremities $X_1$ and $X_2$.

For drivelines consisting of several sections, please refer to the indications provided in Chapter 2.8 (⇒ Page 37).

![Solution Z](image1)

![Solution W](image2)
4.1.3 Electrical system

On EUROCARGO Euro VI vehicles, all PTOs - including any PTOs installed after purchase - are managed solely by the EM. Therefore vehicle order shall contain related OPT 4572.

The VCM and EM electronic and electrical systems (see Figure 1 - Section 5) provide innovative methods and processes relating to the control of the PTOs, which can significantly improve safety and reliability. To activate, connect the PTO control switch to pin connector 61071.

4.1.4 Pneumatic system

See the description in Chapter 2.15 (⇒ Page 50).

4.2 PTO FROM GEARBOX

Drive may be taken from the layshaft via flanges or fittings located to the rear side or lower part of the gearbox.

Table 4.1 shows available torque levels and the ratios between output rpm and engine rpm for the different types of IVECO optional gearbox/PTO combinations.

IVECO must authorize high torque take-offs for sporadic use, according to the type of use.

The PTO must normally be used with the vehicle at a standstill and must be engaged and released with the clutch disengaged so as to avoid excessive stress on synchronisers.

When the PTO is used with the vehicle in motion, no gearshift must be carried out.

For gearboxes with a torque converter, the same power take-offs used on the manual gearboxes may be used; Note however, that when engine speed is lower than approximately 60% of the maximum value, the converter system is in the hydraulic operating phase and that during this phase, depending on the absorbed power the power take-off rpm may fluctuate even if engine rpm is constant.

4.2.1 Power take-off data from gearbox

The following table shows the possible types of PTO.

The installation of a PTO post vehicle production requires the reprogramming of gearbox electronic control unit and the Expansion Module (EM), as well as interventions on the wiring system. Therefore, before proceeding, please carefully read Chapter 4.6 “PTO Management” (⇒ Page 13).

Re-programming of the electronic control units must be carried out in accordance with the instructions in the IVECO technical manual using exclusively the diagnostic instrument (available from IVECO dealers and authorised IVECO service centres), providing the information regarding the specific PTO requirements.

<table>
<thead>
<tr>
<th>Gearbox</th>
<th>PTO type</th>
<th>Fitting position</th>
<th>Direction of rotation</th>
<th>Transmission ratios</th>
<th>Torque (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6S700</td>
<td>NL/4C</td>
<td>RH rear</td>
<td>Anticlockwise</td>
<td>0.73</td>
<td>350</td>
</tr>
<tr>
<td>6A5700</td>
<td>88Z/5</td>
<td>RH rear</td>
<td>Anticlockwise</td>
<td>0.97</td>
<td>450</td>
</tr>
<tr>
<td>6S800</td>
<td>NL/1C</td>
<td>Centre rear</td>
<td>Clockwise</td>
<td>0.57</td>
<td>600</td>
</tr>
<tr>
<td>6A5800</td>
<td>NH/4C</td>
<td>RH rear</td>
<td>Anticlockwise</td>
<td>0.67</td>
<td>350</td>
</tr>
<tr>
<td>6S1000</td>
<td>88ZI</td>
<td>RH rear</td>
<td>Anticlockwise</td>
<td>0.962</td>
<td>450</td>
</tr>
<tr>
<td>6A51000</td>
<td>NH/1C</td>
<td>Centre rear</td>
<td>Clockwise</td>
<td>0.53</td>
<td>1000</td>
</tr>
<tr>
<td>6S1005 + PTO</td>
<td>NL/10</td>
<td>Upper rear</td>
<td>Anticlockwise</td>
<td>1.70</td>
<td>320</td>
</tr>
</tbody>
</table>
### 4.3 POWER TAKE-OFF FROM TRANSFER BOX

The maximum permissible take-off torque values are given as follows:

<table>
<thead>
<tr>
<th>Gearbox</th>
<th>PTO type</th>
<th>Fitting position</th>
<th>Direction of rotation</th>
<th>Transmission ratios</th>
<th>Torque (Nm) (*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6S1005 + PTO</td>
<td>NL/10</td>
<td>Upper rear</td>
<td>Anticlockwise</td>
<td>1.19</td>
<td>480</td>
</tr>
<tr>
<td>9S-75 TO</td>
<td>NH/4C</td>
<td>RH rear</td>
<td>Anticlockwise</td>
<td>1.08</td>
<td>430</td>
</tr>
<tr>
<td></td>
<td>N75/10C</td>
<td>RH rear</td>
<td>Anticlockwise</td>
<td>1.27</td>
<td>410</td>
</tr>
<tr>
<td></td>
<td>NH/1C</td>
<td>Centre rear</td>
<td>Clockwise</td>
<td>0.85</td>
<td>600</td>
</tr>
<tr>
<td>9S-1110</td>
<td>NH/4C</td>
<td>Lower rear</td>
<td>Anticlockwise</td>
<td>1.24</td>
<td>430</td>
</tr>
<tr>
<td></td>
<td>N109/10</td>
<td>Upper rear</td>
<td>Anticlockwise</td>
<td>1.45</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>NH/1C</td>
<td>Centre rear</td>
<td>Clockwise</td>
<td>0.97</td>
<td>800</td>
</tr>
<tr>
<td>12AS-1210</td>
<td>NH4C</td>
<td>Lower rear</td>
<td>Anticlockwise</td>
<td>1.10</td>
<td>430</td>
</tr>
<tr>
<td></td>
<td>NH1C</td>
<td>Centre rear</td>
<td>Clockwise</td>
<td>1.22</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>NM AS/10C</td>
<td>Rear right</td>
<td>Anticlockwise</td>
<td>1.80</td>
<td>510</td>
</tr>
<tr>
<td>52500</td>
<td>P96A1</td>
<td>RH lateral</td>
<td>Anticlockwise</td>
<td>0.985</td>
<td>270</td>
</tr>
<tr>
<td></td>
<td>P96A2</td>
<td>RH lateral</td>
<td>Anticlockwise</td>
<td>1.264</td>
<td>250</td>
</tr>
<tr>
<td>53000</td>
<td>17A1</td>
<td>LH lateral</td>
<td>Anticlockwise</td>
<td>0.93</td>
<td>600</td>
</tr>
</tbody>
</table>

(*) Available torque with engine at 1000 rpm

(1) Sporadic operation < 1 hour of service

#### 4.2.2 Direct installation of a user (pumps, compressors, etc.) on the PTO

In the case of pumps or other equipment applied directly on the power take-off without intermediate shafts, after ensuring that the dimensions of the pump or accessory leave an adequate safety margin with the chassis and powertrain unit, it is also necessary to verify that the static and dynamic torques exerted by the mass of the pump and by the PTO are compatible with the structural characteristics of the walls of the gearbox.

Furthermore, 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.

The power take-offs provided by IVECO include a flange for direct mounting of pumps with UNI 4 connection, the outlet consists of a grooved shaft 21 ISO 14.

> During prolonged use, the gearbox oil temperature must not exceed 110 °C and the water temperature must not exceed 100 °C. Since not all power take-offs available on the market are suitable for continuous use, the specific requirements associated their use (work period, pauses, etc.) must be strictly adhered to.

#### Note

In the case of continuous usage which may lead to high oil temperatures, it is advisable to contact the PTO supplier to determine whether the installation of a dedicated external oil circuit kit or a supplementary lubrication pump is necessary.
### Table 4.2

<table>
<thead>
<tr>
<th>Transfer box type</th>
<th>Max. torque [Nm] demand from transfer box</th>
<th>Output type</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC 1100 (1)</td>
<td>500</td>
<td>flange ø est. 90 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 holes ø 8.1 mm</td>
</tr>
</tbody>
</table>

(1) Request optional power take-off. Installation of the PTO requires the replacement of internal components of the transfer box.

**Note** Only PTOs tested by IVECO may be installed.

### 4.4 POWER TAKE-OFF FROM DRIVELINE

Authorisation for the application of a power take-off on the driveline downstream of the gearbox is issued by IVECO after examination of the documentation presented as required.

**Note** The power take-offs on the line of the universal joint cannot be used in conjunction with EuroTronic transmissions.

In general, the following should be noted:

- The PTO engagement/disengagement must be performed with the gearbox in neutral. During engagement and disengagement the torque absorption by the Bodybuilder must be reduced to 0 Nm;
- the power take-off rpm is dependent on the gear selected;
- the power take-off must be located immediately downstream of the gearbox; for vehicles with the driveline in two or more sections, the power take-off may also be fitted at the flexible support between the first and second sections (the indications provided in Chapter 2.8 (☞ Page 37) must be observed);
- the angles of the driveline on the horizontal plane and vertical plane must be kept as close as possible to the original values;
- masses and rigidity added to the driveline must not cause any imbalance, abnormal vibrations or damage to the components of the drive transmission (from the engine to the rear axle) either during vehicle movement or during operation with the power take-off;
- the power take-off must be fixed to the chassis with its own suspension.

⚠️ The transmission is an important part for the safety of the vehicle, and as such any intervention on the transmission must only be carried out by specialist companies approved by the manufacturer.

**Note** Any intervention on the propeller shaft carried out without prior authorisation from IVECO will immediately invalidate the warranty.
4.5 POWER TAKE-OFF FROM ENGINE

In general the use of these power take-offs is planned for apparatus applications requiring a continuous power supply.

4.5.1 Torque take-off from the front of the engine

The drive take-off from the front of the crankshaft occurs, for limited torque values to be taken (e.g.: air conditioning units), by drive belt transmission; the use of coupling shafts is normally reserved for take-offs of a greater magnitude (e.g.: municipal use).

These implementations, when not originally specified, require precise modifications to the front part of the vehicle, e.g. modifications to the radiator, cab, bumpers etc.). Particular attention must therefore be paid:

- to the system comprising additional masses and relative rigidity which must be flexibly disengaged from the crankshaft with regard to the torsional and flexural effects;
- to the additional mass values and relative moments of inertia and to the distance of the centre of gravity of the masses from the centre line of the crankshaft main bearing carrier which must be kept to a minimum;
- to avoiding a reduction in the radiator cooling capacity;
- to restoring the rigidity and resistance characteristics of the modified elements (crossbar, bumper, etc.);
- to avoid exceeding, during extended use, temperatures of the engine cooling water of over 100 °C and engine oil temperature (measured on the main duct of the pressure switch area) of 120 °C. If this is not possible, additional heat exchangers are required.

Table 4.3 shows the values to which reference must be made for the take-off.

On the front of the engine there is a pulley with 2 grooves which power can be drawn.

The position of the take off and the size of the pulley are shown in the following Figures.

![Figure 3](image-url)

A  Front of the engine  I.  Pulley for drive take-off
Table 4.3 - PTO on the front of the engine

<table>
<thead>
<tr>
<th>Engine</th>
<th>$n_{\text{max}}$</th>
<th>Max. torque available [Nm]</th>
<th>Maximum moment of inertia [kgm$^2$]</th>
<th>Maximum flexural moment [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tector</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 cylinders</td>
<td>2200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 cylinders</td>
<td>2500</td>
<td>400</td>
<td>0.015</td>
<td>100</td>
</tr>
<tr>
<td>6 cylinders</td>
<td>2500</td>
<td>400</td>
<td>0.015</td>
<td>100</td>
</tr>
</tbody>
</table>

(1) Maximum moment of inertia of rigidly fixed additional masses.

(2) Maximum flexural moment due to radial forces relative to axis of first main bearing. The maximum flexural moment may be multiplied by the factor indicated in the table in relation to the angular position between the additional radial forces and the axis of the cylinders (zero is the top dead centre position with clockwise rotation).

Table 4.4

<table>
<thead>
<tr>
<th>Multiplication factor</th>
<th>Angular position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>225–15</td>
</tr>
<tr>
<td>2</td>
<td>15–60</td>
</tr>
<tr>
<td>3</td>
<td>60–105</td>
</tr>
<tr>
<td>4</td>
<td>105–65</td>
</tr>
<tr>
<td>3</td>
<td>165–210</td>
</tr>
<tr>
<td>Multiplication factor</td>
<td>Angular position</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>2</td>
<td>210–225</td>
</tr>
</tbody>
</table>

### 4.5.2 Torque take-off from the rear of the engine - Multipower PTO

Certain models with a mechanical transmission (150E to 190EL with power outputs from 280 to 320 HP and 4x4) may be equipped with the optional IVECO Multipower PTO, which is capable of handling higher torques than other PTO types. This unit is fitted on the rear part of the engine and takes drive from the flywheel and is independent of the vehicle clutch drive; it is suitable for use with the vehicle running and/or at a standstill (e.g. municipal applications, concrete mixers etc.).

Some precautions:

- the PTO must be engaged only with the engine at a standstill (the Expansion Module offers a configuration that a safety device prevents engagement with the engine running in any case);
- the unit may be disengaged with the engine running but only if the output torque is nil;
- the during engine must be started when no torque is being taken from shall be absorbed/consumed by the PTO.

**Note** To guarantee correct engagement, the static moment of connected units must not exceed 35 Nm.

The main technical and dimensional characteristics are given in Figure 5 and in Table 4.5

![Figure 5](image)

**Table 4.5 - Technical specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio revolutions - rpm</td>
<td>1.29</td>
</tr>
<tr>
<td>Max. torque available</td>
<td>900 Nm</td>
</tr>
<tr>
<td>Output flange</td>
<td>ISO 7646-120 x 8 x 10</td>
</tr>
<tr>
<td>Control</td>
<td>pneumatic</td>
</tr>
<tr>
<td>Direction of rotation</td>
<td>as engine</td>
</tr>
<tr>
<td>Weight</td>
<td>70 kg</td>
</tr>
<tr>
<td>Oil capacity</td>
<td>2 litres</td>
</tr>
</tbody>
</table>
Note  If the PTO is engaged while driving, it must be remembered that depending on the gearing ratio of the power take-off (see Table 4.5), connected pumps may reach high rotating speeds (for example: an engine speed of 1800 rpm corresponds to a pump speed of 2400 rpm).

4.6 PTO MANAGEMENT

- Interventions that are carried out which do not comply with the following indications, may cause serious damage to the on-board systems (not covered by the contractual warranty) and could compromise the safety, reliability and correct functioning of the vehicle.

The power take-offs are managed by the EM control unit (Expansion Module) located under the dashboard, in front of the passenger seat.

4.6.1 General information

The PTOs are activated by means of solenoid valves and engagement is verified by the "PTO Detection" signal.

"PTO Management" includes safety and control functions and in particular, if the engagement has occurred correctly, carries out "Intermediate speed control".

The "PTO Mode" configuration (most advanced definition) requires programming of the Expansion Module (EM) and the Vehicle Control Module (VCM). The EM is able to drive up to three PTOs and controls their activation and deactivation individually.

The following two conditions must be met to permit activation of a PTO:

1. mechanical engagement
2. recall of a "PTO mode" to be paired

These actions, can be carried out with two separate commands and in sequence, or with a single command using the PTO switches on the central island console in the cab.

- Only use the signals available on the Bodybuilder connectors (such as parking brake engaged signal, vehicle stopped signal, reverse not engaged signal) to ensure correct PTO management and prevent the risk of drive train damage.

4.6.2 Definitions

Multiplex

This term describes the set of two control units: IVECO Body Controller (IBC3) and Chassis Electronic Module (MET).

They are connected to the other electronic systems (EDC, VCM, ECAS etc.) in the vehicle.

Information and messages are exchanged by means of Bus CAN lines.
PTO switch (PTOsw x, x = 1, 2, 3)

Located in the central part of the dashboard, it is used to request an action associated with a specific PTO (e.g. - depending on EM programming - engage / disengage PTO).

Since the EM and VCM are able to control up to three PTOs, there might be up to three switches installed (from PTOsw1 to PTOsw3). Each switch is connected to connector 61071 (pins 18, 19, 20).

Connector 61071

More detailed information is given in Chapter 5.2 (⇒ Page 10).

PTO Mode x (x = 1, 2, 3)

After receipt of a request from a PTO switch via the respective input of connector 61071, a PTO mode implements a set of parameters to ensure correct PTO operation.

The PTO Mode offers the possibility of requesting physical activation of the PTO. Possible selections: Yes/No (described below).

It is possible to activate up to three PTO modes simultaneously.

4.6.3 Physical activation of the PTO

The physical PTO activation is an integral part of a PTO Mode. This includes a set of parameters for mechanical engagement of a PTO. Various parameter sets are available for the different PTOs (depending on the engine and transmission). These guarantee PTO engagement is compliant with the specific requirements.

The PTO configuration may be customised by Iveco Service upon the specific customer request.

The physical activation of the PTO is stored in the EM.

4.6.4 "Intermediate Speed Control x" mode (x = 1, 2, 3)

This mode can be requested by the EM. If request is sent the VCM activates a set of parameters that defines the engine behaviour (activation of an intermediate speed, low idle rpm, high idle rpm, accelerator deactivation etc.). This configuration is stored in the Vehicle Control Module (VCM).

Note Since the engine can only support one set of parameters at a time, a priority must be established regarding when multiple Intermediate Speed Control modes are required simultaneously: configuration PTO3 has maximum priority, configuration PTO2 has medium priority and configuration PTO1 has minimum priority.

Only management of the power take-offs through the EM control unit ensures comprehensive, reliable and safe PTO management. Only in this way is it possible to guarantee the integration with other vehicle functions.

Operating the power take-off without connection to the EM control unit may cause damage to the vehicle.

Connection to the EM control unit presupposes activation and electrical control of the power take-offs (by means of electromagnetic valves). Air-activated power take-off and/or without connection to the EM control unit are not therefore not recommended by IVECO.
4.6.5 Configurations

Depending on the planned use of the vehicle, Bodybuilders are required to contact IVECO Service in order to carry out the necessary programming of the controls involved (EM, VCM, etc.) for operation of each individual power take-off.

4.6.6 Programming EM - PTO 1, 2, 3

PTO programming includes the following function groups:

1. PTO switch function
2. PTO hardware
3. Conditions for the mechanical engagement of the PTO
4. Conditions for the mechanical activation of the PTO
5. Extended functions

Adjustments within the five function groups may be defined separately for each PTO mode x (x=1, 2, 3).

1. PTO switch function

The EM control unit controls the PTO modes and speeds by means of switches located on the dashboard and connected to the relevant pin of the connector 61071-ST14A.

Operating the switch may determine one of the following actions:

- Mechanical engagement of the PTO (in conjunction with a given PTO configuration)
- Activation of the "Intermediate speed Control" mode
- Mechanical engagement of the PTO (in conjunction with a specific PTO configuration) and activation of the "Intermediate speed control" mode after successful engagement
- No effect

Activation of a PTO by the EM is always connected to a switch operation. However, activating the switch should not necessarily lead to engagement of a PTO (see the list above).

Each switch may be allocated its own PTO configuration. If switch operation also activates "Intermediate speed control" mode, then when different switches are operated simultaneously a selection needs to be made. The following priority must be observed:

- PTO 3 configuration (PTOsw 3): maximum priority (PTOsw 1 and 2 status is ignored);
- PTO 2 configuration (PTOsw 2): medium priority (PTOsw 1 and status is ignored);
- PTO 1 configuration (PTOsw 1): minimum priority.

2. PTO Hardware

Vehicles can be fitted with up to three PTOs, each managed simultaneously as described in Chapters 4.2 (⇒ Page 7), 4.4 (⇒ Page 9) and 4.5 (⇒ Page 10).

3. Conditions for PTO engagement

The selection determines which conditions must be satisfied in order to engage the PTO mechanically (electrical activation by means of the electromagnetic valve).

During the transient phase - PTO requested but not yet engaged - PTO warning light flashes. After 20 s, PTO engagement must be requested again (deactivation and reactivation of the PTO switch).

Note  At the request of the client, an indicator light on the IC can be enabled via intervention of the service centre.
Table 4.6 - Example of configuration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating brake</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Parking brake</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Clutch status output</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Clutch Timeout</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connector ST91/92/93 3 Pin</td>
<td>Open</td>
<td>Earthed</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>40-100 °C</td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Clutch slip limit</td>
<td></td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Expansion module pressure switch (inactive)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. rpm for engagement</td>
<td>650 rpm</td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Max. rpm for engagement</td>
<td>700 rpm</td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Min. vehicle speed</td>
<td>0 km/h</td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Max. vehicle speed</td>
<td>1 km/h</td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Lowest speed engaged</td>
<td></td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Highest speed engaged</td>
<td></td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Gear in neutral</td>
<td>In neutral</td>
<td>Gear engaged</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Reverse gear</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
</tbody>
</table>

4. Conditions for mechanical deactivation of the PTO

The selection determines the conditions and the limit values which must not be exceeded or which must at least be reached.

With reference to Table 4.6, if any one condition is not observed, the PTO will be deactivated.

During the transient phase - PTO shutdown started but PTO not yet deactivated - PTO warning light flashes.

**Note** At the request of the client, an indicator light on the IC can be enabled via intervention of the service centre.

5. Extended functions

a. Timing behaviour of PTO Mode request

The EM control unit expects that certain PTO engagement conditions are met within a certain time period (standard 20 seconds) after the PTO request. Once this period has elapsed, the PTO mode request is rejected and an error is displayed.

The time interval is programmable (0–25 seconds). The PTO switch must then be cycled (switched off and on again).

b. Timing behaviour of physical PTO engagement monitoring

Establishes the interval between PTO solenoid valve activation and physical PTO engagement, being checked by PTO feedback signal. If the set interval is exceeded, the request is rejected.

c. Timing behaviour of PTO deactivation condition monitoring

If any one of the defined deactivation conditions is not met for a period exceeding a specified time period (generally 10 seconds as the default setting) during the physical engagement of a PTO, the configured actions (physical deactivation of the PTO, sending of an ISC OFF command, sending of an ISC RESUME command) are initiated. The time interval is programmable (0–10s).

d. Timing behaviour of physical PTO deactivation

Establishes the interval between PTO solenoid valve de-activation and physical PTO disengagement, being checked by PTO feedback signal.

e. Timing behaviour between clutch activation and PTO engagement
Establishes a minimum time interval within which the clutch must be operated before PTO engagement is permitted and carried out (to be used only with manual non Single_H transmission).

f. Timing behaviour of error identification
Time that elapses before an error activates Degraded Mode.

<table>
<thead>
<tr>
<th>Table 4.7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Table 4.7</strong></td>
</tr>
<tr>
<td><strong>Parameter</strong></td>
</tr>
<tr>
<td>Timeout at activation</td>
</tr>
<tr>
<td>Timeout at PTO activation conditions</td>
</tr>
<tr>
<td>Timeout at activation via switch</td>
</tr>
<tr>
<td>Timeout at PTO deactivation conditions</td>
</tr>
<tr>
<td>Timeout for error identification</td>
</tr>
</tbody>
</table>

**Note**  Where possible, all the activation and deactivation and Timeout control condition parameters must be set to enable monitoring. When a failure tolerant approach is needed the selection of "is not controlled" is to be preferred.

### 4.6.7 PTO mode 0 (driving mode)

With a speed below 25 km/h, it is possible to activate intermediate engine rpm. The intermediate rpm is set at 900 rpm and can be modified as follows:

1. activate the Resume function
2. adjust the speed to the required level using SET+ or SET-
3. activate Resume for at least 5 seconds.

The adjustment field with the gearbox in neutral is set at 100 rpm, but it can be increased up to 200 rpm. For safety reasons, it is not possible to modify the following settings:

<table>
<thead>
<tr>
<th><strong>Table 4.8</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Table 4.8</strong></td>
</tr>
<tr>
<td><strong>Button</strong></td>
</tr>
<tr>
<td>RES / OFF</td>
</tr>
<tr>
<td>SET+ / SET-</td>
</tr>
<tr>
<td>Accelerator pedal</td>
</tr>
<tr>
<td>Max. rpm possible with SET+ button or accelerator pedal</td>
</tr>
<tr>
<td>Torque delivered</td>
</tr>
</tbody>
</table>
| Conditions for deactivating intermediate engine speed function | • Operation of the brake or clutch pedal  
• C/C Off activated  
• engine brake operated  
• Intarder operated  
• PTO mode 0 deactivation speed  
• 'NEUTRAL' not selected (automatic transmissions) |
4.6.8 PTO Modes 1, 2, 3, configurable

Through IVECO Service, three different and independent PTO maps can be set. Since the engine can only operate with one PTO mode at a time, the following priorities are assigned to the modes:

- speed mode 3: maximum priority (speed modes 1 and 2 are ignored);
- speed mode 2: average priority (speed mode 1 is ignored)
- speed mode 1: minimum priority.

Note The Bodybuilder must observe this order of priority when managing the outfitting and interface outfitting. This is so as to avoid additional costs for subsequent modifications to the wiring or reprogramming.

The following table provides an overview of parameters which must be determined individually for each mode (programming by IVECO Service).

Table 4.9

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Possible values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. rpm possible with SET + button $N_{SET_{+ max}}$ (1)</td>
<td>$N_{L} - N_{max}$ (2)</td>
</tr>
<tr>
<td>Maximum rpm possible with the accelerator pedal</td>
<td>$N_{max_{accel}}$</td>
</tr>
<tr>
<td>Engine rpm increment with SET + button</td>
<td>250 rpm for each second button is pressed</td>
</tr>
<tr>
<td>Engine rpm decrement with SET - button</td>
<td>As above</td>
</tr>
<tr>
<td>Torque limiting (1)</td>
<td>See table</td>
</tr>
<tr>
<td>Overspeed regulator curve gradient</td>
<td>&quot;High Idle&quot; curve: vertical by default</td>
</tr>
<tr>
<td>Usage of CC buttons (RES / OFF / SET + / SET -)</td>
<td>Active / inactive</td>
</tr>
<tr>
<td>Storing intermediate engine speed setting</td>
<td>Fixed (EASY)/spare (driver) (6)</td>
</tr>
<tr>
<td>&quot;TIP&quot; function, for SET + / SET- buttons (4)</td>
<td>Active / inactive</td>
</tr>
<tr>
<td>PTO mode deactivated with brake or clutch (independently for each mode) (5)</td>
<td>Active / inactive</td>
</tr>
<tr>
<td>Accelerator pedal</td>
<td>Active / inactive</td>
</tr>
<tr>
<td>Recalling stored intermediate engine speed setting with RES after activation of PTO mode (1)</td>
<td>Active / inactive</td>
</tr>
<tr>
<td>Minimum rpm value settable with SET - button, $N_{SET_{- min}}$ (7)</td>
<td>$&gt; 500$ rpm</td>
</tr>
<tr>
<td>PTO mode deactivated from parking brake (6)</td>
<td>Active / inactive</td>
</tr>
<tr>
<td>Vehicle speed limit above which PTO mode is deactivated (intermediate engine speed $V_{IDLE_{max}}$)</td>
<td>between 2 Km/h and 95 Km/h (programmable)</td>
</tr>
<tr>
<td>Permissible PTO speed range (1)</td>
<td>$N_{L} - $ Max. rpm possible (1)</td>
</tr>
</tbody>
</table>

Abbreviations:

$N_{L}$ engine speed at idle
$N_{max}$ maximum engine speed
$N_{RES}$ stored intermediate engine speed, (recalled by pressing RESUME or by activating a PTO mode)
$N_{SET_{+ max}}$ maximum rpm settable with SET+ button. This value is identical in all PTO modes
$N_{SET_{- min}}$ minimum rpm value settable with SET - button
$N_{max_{accel}}$ maximum rpm possible with accelerator pedal

(1) Speed given refers to crankshaft, not PTO. The corresponding speed of the PTO must be calculated by multiplying by the gear reduction ratio of the PTO.
(2) The following rules apply for setting the intermediate engine speed value:
4.7 STANDARD CONFIGURATIONS

The following table shows the standard factory settings.

<table>
<thead>
<tr>
<th>Table 4.10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PTO Mode</strong></td>
</tr>
<tr>
<td><strong>Activation from 21-pin connector 61071</strong></td>
</tr>
<tr>
<td><strong>Max. torque</strong></td>
</tr>
<tr>
<td><strong>Maximum rpm value settable with SET + button, ( N_{\text{SET, max}} )</strong></td>
</tr>
<tr>
<td><strong>Maximum rpm value settable with SET - button, ( N_{\text{SET, min}} )</strong></td>
</tr>
<tr>
<td><strong>Overspeed regulator curve gradient</strong></td>
</tr>
<tr>
<td><strong>Accelerator pedal</strong></td>
</tr>
<tr>
<td><strong>Usage of CC buttons (RES / OFF / SET + / SET -)</strong></td>
</tr>
<tr>
<td><strong>Stored rpm value, ( N_{\text{RES}} )</strong></td>
</tr>
<tr>
<td><strong>Maximum vehicle speed above which PTO is deactivated ( v_{\text{ZEU, max}} )</strong></td>
</tr>
<tr>
<td><strong>PTO mode disabled from brake or clutch</strong></td>
</tr>
<tr>
<td><strong>Recalling stored intermediate engine speed setting with RES after activation of PTO mode</strong></td>
</tr>
<tr>
<td><strong>PTO mode deactivated from brake</strong></td>
</tr>
<tr>
<td><strong>PTO mode deactivated from engine brake</strong></td>
</tr>
</tbody>
</table>

**Note** The rpm increment/decrement with the SET + / SET - buttons is 250 rpm
4.7.1 Conditions for activating/deactivating PTO
These conditions may be modified through the IVECO Service Network.

1) No PTO installed or PTO pre-installations
Only the engine speed programming is requested by the VCM.
The switches select the three speed modes.

<table>
<thead>
<tr>
<th>PTO SW 1</th>
<th>PTO Mode 1</th>
<th>900 [tr/min]</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTO SW 2</td>
<td>PTO Mode 2</td>
<td>1100 [tr/min]</td>
</tr>
<tr>
<td>PTO SW 3</td>
<td>PTO Mode 3</td>
<td>1300 [tr/min]</td>
</tr>
</tbody>
</table>

2) Multipower PTO
Only the engine speed programming is requested by the VCM.
The switches select the three speed modes (see Table 4.11).

Activation conditions

<table>
<thead>
<tr>
<th>Engine status</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure switch</td>
<td>ST91 - pin closed</td>
</tr>
<tr>
<td>Vehicle status</td>
<td>stationary</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>&lt; 120 [°C]</td>
</tr>
</tbody>
</table>

Deactivation conditions

| Coolant temperature | > 120 [°C] |

3) PTO 1,2 manual gearbox

Activation conditions

<table>
<thead>
<tr>
<th>Engine status</th>
<th>ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coolant temperature</td>
<td>&lt; 120 [°C]</td>
</tr>
</tbody>
</table>

Deactivation conditions

<table>
<thead>
<tr>
<th>Engine status</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle speed</td>
<td>&gt; 25 [km/h]</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>&gt; 120 [°C]</td>
</tr>
</tbody>
</table>

4) PTO 1,2 automatic gearbox

Activation conditions

| Engine status     | ON (500 < rpm < 900) |

---

---
### Gearbox status
- neutral

### Vehicle status
- stationary or crawling speed \(0 < v < 2 \text{ [km/h]}\)

### Coolant temperature
- \(< 120 ^\circ\text{C}\)

#### Deactivation conditions

<table>
<thead>
<tr>
<th>Engine status</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle speed</td>
<td>(&gt; 20 \text{ [km/h]})</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>(&gt; 120 ^\circ\text{C})</td>
</tr>
</tbody>
</table>

#### 5) PTO Transfer box

##### Activation conditions

<table>
<thead>
<tr>
<th>Clutch status</th>
<th>not pressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine status</td>
<td>ON</td>
</tr>
<tr>
<td>Vehicle status</td>
<td>stationary</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>(&lt; 120 ^\circ\text{C})</td>
</tr>
</tbody>
</table>

##### Deactivation conditions

<table>
<thead>
<tr>
<th>Engine status</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coolant temperature</td>
<td>(&gt; 120 ^\circ\text{C})</td>
</tr>
</tbody>
</table>

### 4.8 PTO ADJUSTMENTS

#### 4.8.1 Modifications to the torque curve, maximum engine speed and slope of speed limiter of maximum engine speed

For mechanical power take-off protection, it is possible to limit:

1. engine torque delivery as a protection against overload;
2. engine rpm, as a protection against over-speed.

This is qualitatively shown by the diagram in Figure 6 by means of a torque/engine rpm curve (defined by 16 points), a horizontal section (representing torque limitation) and a sloping section (representing over-rev adjustment).
After setting a maximum for engine rpm and a variation mode (slope 3), we obtain a point of intersection X with the straight line of the set torque and therefore the maximum rpm compatible with this torque on the x-axis.

In other words: as the engine rpm increases, the control unit uses the lowest torque value between those on curve 1 and those on straight line 2 and then, for speeds greater than that determined by point X, causes the over-revving adjustment device to cut in and thus reduce the torque.

Please note that:

- the Bodybuilder chooses the engine speed up to which the selected torque must available according to the intended use of the PTO;
- The speed referred to is that of the crankshaft and not the PTO, for which the rpm must be calculated taking into account the reduction ratio (see Table 4.5);
• the limitations (torque, intersection point and curve gradient) may be selected independently of one another; It is, however; advisable to set a combination;
• these parameters may only be activated by IVECO.

![Graph showing Nm vs rpm]

We will take a look at the example in Figure 7:

• max. engine torque 600 Nm;
• standard power take-off operation is specified at 900 rpm;
• engine rpm must not exceed 1100 rpm;
• rpm must be calculated for all over-revving rpm regulator gradients;
• variable over-revving rpm regulator curve gradient: 0–0.2 rpm/Nm.

The corresponding power at 1100 rpm and a torque of 600 Nm gives (see equations on page 4-3):

\[ P = (600 \times 1100) / 9550 = 69 \text{ kW} = 94 \text{ HP} \]

The overrevving regulator curve (gradient) depends on the specific application.

With stationary operation, a steep overrevving rpm adjustment curve is therefore generally sufficient, while in driving mode this may give rise to rapid load changes (which could be a problem).

Therefore:

• with regulator at 0.05 rpm/Nm (curve C in figure), a torque of 600 Nm is available up to 1100 - (0.05 \times 600) = 1070 rpm;
• with regulator at 0.1 rpm/Nm (curve B), the torque is available up to 1040 rpm;
• with regulator at 0.2 rpm/Nm (curve A), the torque is available up to 980 rpm.
4.8.2 Intermediate engine speed adjustment

Maximum intermediate engine speed regulator speed setting possible with SET+ button, \(N_{\text{SET, max}}\)

The maximum possible value for the intermediate engine speed regulator (CC) settable with the SET+ button is configurable. This limit is identical for all PTO modes (driving mode 0, PTO modes 1, 2 and 3).

4.8.3 TIP function

As already seen in the Note (4) of Table 4.9, the TIP function, namely pressing and releasing the SET+/SET- button (< 1 sec.) lets the driver gradually adjust the intermediate engine speed setting or the speed control setting.

The intermediate engine speed regulator may be activated at speeds <\(V_0\) km/h (max. speed for PTO mode).

With speed > \(V_0\) km/h, the speed regulator is activated.

The variation for the intermediate speed regulator is equal to 20 rpm for each TIP, while for the speed regulator it is equal to 1 km/h for each TIP.

Pressing and holding the SET+ and SET- buttons (> 1 sec.) adjusts the intermediate engine speed setting or the speed control setting is modified in a continuous manner. The effective rpm value or speed value at the time the SET+ or SET button is released is stored as the new setting.

The TIP function for the SET+ and SET- buttons may be disabled. This configuration is applicable to all PTO modes simultaneously (PTO driving mode 0, and PTO modes 1, 2 and 3). Disabling the TIP function limits the functionality of the speed regulator. Therefore this modification should only be used after having thoroughly assessed the situation.

Note: This function is intended for setting hydraulic units.

4.8.4 Increase/decrease rpm value with SET+/SET-

Pressing and holding the SET+/SET- buttons for more than 1 sec. and disabling the “TIP” function (the “TIP” function is automatically disabled by pressing and holding the SET+/SET- buttons) modifies the setting value for the intermediate engine speed regulator, as a result, the modification rate (engine rpm increment/decrement per second). The time interval necessary for this modification is calculated with the following formula:

\[
\text{interval necessary [s]} = \frac{\text{difference in rpm per second [rpm/s]}}{\text{rpm increment per second [rpm/s/s]}}
\]

Example: the intermediate engine speed setting must be increased from 800 rpm to 1800 rpm with button SET+. The difference in rpm is 1000 rpm, therefore:

with a modification rate of 250 rpm/s, the interval necessary is \(1000/250 = 4 \text{ s}\).

4.8.5 Accelerator pedal activation/deactivation

In normal driving mode (PTO mode 0), the accelerator pedal is always enabled. In PTO modes 1, 2 and 3, the accelerator pedal may be disabled. In this mode, the PTO speed regulator function of the engine ignores the accelerator pedal. If the accelerator pedal is active in these modes, the engine speed may be increased using the pedal up to the maximum \(N_{\text{max}}\) rpm value in effect.
4.8.6 Automatic gearbox

With the automatic gearbox, engagement of the PTO is coordinated by the gearbox control unit and the Expansion Module control unit, and takes place as follows:

- PTO engagement request (the gearbox control unit verifies that the internal conditions necessary for performing the operation safely are met: engine speed <900 rpm and transmission output speed <250 rpm);
- Solenoid valve activated by the control unit to activate the PTO;
- if the PTO and parking brake are engaged simultaneously, the gearbox is automatically shifted into neutral and PTO mode 2 is activated (the relay on the relay board of the gearbox control unit on the rear cab bulkhead is powered);
- verification of safe PTO operating conditions (transmission output speed <300 rpm).

Before activating the PTO, the transmission control unit verifies a number of different parameters (engine speed <900 rpm and transmission output speed <250 rpm). If all the necessary internal gearbox conditions are met, the automatic gearbox control unit automatically engages the PTO. Any limitations applicable for the active PTO mode (final speed, maximum torque etc.) are also valid during the entire engagement process.

4.9 EM (EXPANSION MODULE)

The optional 4572, EM (Expansion Module) is available for the EUROCARGO Euro VI; Furthermore, option 0384 offers a CANopen interface for Bodybuilders.

The EM control unit can be used for electronic management of the PTO and for special applications indicated in Standard EN1501 for waste collection vehicles (optional 6821); alternatively, the EM provides a CANopen interface with special gateway for Bodybuilder, in accordance with standard CiA 413 Truck Gateway.

The wiring diagram for the Expansion Module hardware is shown in Figure 8, and the block diagram of the hardware structure is shown in Figure 9.
1. PTO switch
2. EM control unit
3. Instrument panel
4. PTO solenoid valve control
5. PTO Pressure switch resp. Bodybuilder PTO engagement consent
6. PTO return signal
7. Total/rear PTO
8. Lateral PTO
To ensure activation of the PTO activation and the display on the instrument cluster, the connections on ST91, ST92 and ST93 must be used as shown in Tables 4.12 and 4.13 which are taken from Tables 5.4, 5.14, 5.15 and 5.16 in Section 5. Furthermore the conditions already set originally are described in Chapter 4.7 (⇒ Page 19).

4.9.1 Connections

Table 4.12 - PTO mode request

<table>
<thead>
<tr>
<th>PTO</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Connector 61071 - pin 18</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Connector 61071 - pin 19</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Connector 61071 - pin 20</td>
<td></td>
</tr>
</tbody>
</table>

To carry out request, close the pins on ground of pin 17.

Table 4.13 - IN / OUT: ST91, ST92, ST93

<table>
<thead>
<tr>
<th>Pin</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PTO feedback</td>
<td>PTO actuator (solenoid valve control)</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Pressure switch (PTO Multipower) or consent to PTO engagement external Bodybuilder</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Ground</td>
</tr>
</tbody>
</table>
SECTION 5

ELECTRONIC SUB-SYSTEMS
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<td></td>
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<td>FROM THE &quot;COWL&quot; VEHICLE</td>
<td></td>
</tr>
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<td>5.11.1</td>
<td>Radar sensor</td>
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<td>LDWS (Lane Departure Warning System)</td>
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EUROCARGO Euro VI - Step D – BODYBUILDER INSTRUCTIONS
ELECTRONIC SUB-SYSTEMS

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ELECTRONIC SUB-SYSTEMS

It is strictly PROHIBITED to carry out connections to connectors other than those intended by IVECO and to make any changes to the original electrical system.

5.1 ELECTRONIC SYSTEMS

An innovative electronic system, called Hi-MUX, checks and controls the vehicle subsystems.

For a better understanding of this system, the location (see Figure 1) and the functions of the main control units installed on the vehicle are indicated below.

⚠️ It is not permitted to connect devices or electrical circuits directly to the control units. Only the connectors or special interfaces listed in Chapter 5.2 may be used.
5.1.1 Location of control units

1. EBS Electronic Brake System
2. VCM Vehicle Control Module
3. ECAS Electronic Control Air Suspension
4. EM Expansion Module
5. Central locking
6. IBC3 IVECO Body Controller
7. IC Instrument Cluster
8. Chassis Electronic Module MET
9. Automatic transmission control unit
10. Airbag ECU
11. DDM Drive Door Module
12. EDC Engine Diesel Control
13. Steering Shaft ECU
15. LDWS Lane Departure Warning System
16. PDM Passenger Door Module
17. UTP Unified Telematic Platform
5.1.2 IVECO Body Controller (IBC3)

The Body Controller is the central control unit for the vehicle, and, together with the MET control unit, constitutes the Easy Mux system.

The two control units communicate with each other through the CAN line to process the signals (input and output), crucial for the interaction between the vehicle’s individual systems.

The Body Controller is located in the cab, below the dashboard in front of the passenger seat. The fuses and relays and also housed here.

5.1.3 Bulkhead connector (for wiring passage)

The subsystems fitted on the chassis are connected to the control units in the cab via the "bulkhead connector" which is the interface for the electric connectors.

The bulkhead connector is located under the hood.
5.1.4 Chassis Electronic Module (MET)

The Electronic Chassis Module (MET) transmits and receives information to and from all the components and sensors located on the chassis (e.g. lighting devices, brake system sensors, differential lock sensors, etc.) Information is transmitted via the Body Controller to the respective recipient vehicle systems. The MET is situated inside the left-hand chassis side member, behind the battery housing.
5.1.5 Expansion Module (EM)

The EM (Expansion Module) control unit, located in the cab control unit compartment (passenger side), controls the power take-offs and makes it possible to carry out complex applications such as:

- control of the transmission (gearbox) from external sources (TC1 message);
- control of the engine from external sources such as engine speed requests and limits, vehicle speed limit, start up and engine stop;
- safety rules for waste collection applications;
- optimisation of the brake system for waste collection applications;
- control of additional lights;
- interface with CAN_open network.
For an in-depth analysis of the EM functions, please contact the IVECO Customer Centre.

### 5.2 BODYBUILDER CONNECTORS

Connectors **61071, 72071 and 61069** are included in the standard vehicle configuration.

Optional connectors are: **72070, 72072A, 72072B, 72072C, 72072D, 72074, ST91, ST92, ST93**.

Each is described below depending on its location (see Paragraphs "Connectors in Cab" (Page 11), "Connectors on chassis" (Page 23) and "Arrangement of side marker lights (Side Marker Lamps)" (Page 54).

To interface with the equipment installed, the Bodybuilder must have the corresponding opposite male or female connector and use contacts made with reference to the following diagrams:

**Table 5.1 - Connectors 61071, 72071, 72070, 72074, 72072A, 72072C**

<table>
<thead>
<tr>
<th>Cable section</th>
<th>Contact code</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.35 mm²</td>
<td>41200694 EZ</td>
</tr>
<tr>
<td>0.5 mm² - 1.0 mm²</td>
<td>41200695 EZ</td>
</tr>
<tr>
<td>1.0 mm² - 2.5 mm²</td>
<td>41200696 EZ</td>
</tr>
<tr>
<td>2.5 mm² - 4.0 mm²</td>
<td>41200697 EZ</td>
</tr>
</tbody>
</table>

**Table 5.2 - Connector 72072B**

<table>
<thead>
<tr>
<th>Cable section</th>
<th>Contact code</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.35 mm² - 0.5 mm²</td>
<td>500314820 EZ</td>
</tr>
<tr>
<td>0.75 mm² - 1.5 mm²</td>
<td>500314821 EZ</td>
</tr>
</tbody>
</table>
Table 5.3 - Connectors ST91, ST92, ST93, 61069

<table>
<thead>
<tr>
<th>Cable section</th>
<th>Contact code</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.35 mm² - 0.5 mm²</td>
<td>9845 7375 EZ</td>
</tr>
<tr>
<td>0.75 mm² - 1.5 mm²</td>
<td>9843 5370 EZ</td>
</tr>
</tbody>
</table>

5.2.1 Connectors in cab

The following connectors are located inside the cab (see Figure 6):

- 61071 (standard connector for bodybuilder)
- 72071 (standard connector for bodybuilder)
- 72074 (Automatic Transmission)
- 72070 (FMS)
- 72072A (EM)
- 72072B (EM)
- 72072C (EM)

These connectors are housed under the dashboard, some on the driver’s side and some on the passenger side. Connector 72070 (FMS - Fleet Management System) is housed in one of the DIN format compartments situated on the cross member above the windscreen on the driver’s side.

![Figure 6]
a) Standard connector 61071: 21 pin, brown

A. 41200685 Counterpart to be coupled
B. 504163549 Existing part on the vehicle

Table 5.4 - Basic functions of connector 61071

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Engine Start</td>
<td>8892</td>
<td>10 mA</td>
<td>VCM X3-27</td>
<td>Ground = start engine (signal must be permanently active till engine starter runs) Open wire = no action</td>
</tr>
<tr>
<td>2</td>
<td>Engine stop</td>
<td>0151</td>
<td>10 mA</td>
<td>VCM X3-26</td>
<td>Ground = stop engine (short activation sufficient to stop engine); Open wire = no action</td>
</tr>
<tr>
<td>3</td>
<td>Service brake</td>
<td>1165</td>
<td>200 mA</td>
<td>VCM X1-13</td>
<td>0 V = service brake not pressed +24 V = service brake pressed</td>
</tr>
<tr>
<td>4</td>
<td>Vehicle standstill</td>
<td>5515</td>
<td>200 mA</td>
<td>IBC3 E-15</td>
<td>0 V = vehicle standstill +24 V = vehicle moving</td>
</tr>
<tr>
<td>5</td>
<td>Parking brake</td>
<td>6656</td>
<td>200 mA</td>
<td>VCM X1-10</td>
<td>0 V = not engaged +24V = engaged</td>
</tr>
<tr>
<td>6</td>
<td>Not connected</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Vehicle speed</td>
<td>5540</td>
<td>10 mA</td>
<td>40011-B7</td>
<td>Pulse signal (1)</td>
</tr>
<tr>
<td>8</td>
<td>Engine status</td>
<td>7778</td>
<td>200 mA</td>
<td>IBC3 E-14</td>
<td>Engine status output 0 V = engine stopped &lt; 100 rpm +24 V = engine running &gt; 400 rpm</td>
</tr>
<tr>
<td>9</td>
<td>Gearbox neutral</td>
<td>8050</td>
<td>200 mA</td>
<td>VCM X1-07 EM X1-07</td>
<td>0 V = neutral not engaged +24 V = neutral engaged Input driven by EM when installed Else input driven by VCM</td>
</tr>
<tr>
<td>10</td>
<td>Reverse gear</td>
<td>2268</td>
<td>200 mA</td>
<td>IBC3 E-16</td>
<td>0 V = reverse gear not engaged +24 V = reverse gear engaged</td>
</tr>
<tr>
<td>11</td>
<td>K15</td>
<td>8871</td>
<td>5 A</td>
<td>IBC3 B-01</td>
<td>K15 (after fuse)</td>
</tr>
<tr>
<td>12</td>
<td>CC Set+</td>
<td>8156</td>
<td>10 mA</td>
<td>VCM X3-33</td>
<td>Input signal (2) Open wire = Set+ not activated Ground = Set+ activated</td>
</tr>
<tr>
<td>13</td>
<td>CC Set-</td>
<td>8157</td>
<td>10 mA</td>
<td>VCM X3-32</td>
<td>Input signal (2) Open wire = Set - not activated Ground = Set - activated</td>
</tr>
<tr>
<td>14</td>
<td>Reserved</td>
<td>8154</td>
<td>10 mA</td>
<td>VCM X3-30</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5.5 - Tachograph B7 Signal

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage $U_{\text{low}}$</td>
<td></td>
<td>5,5</td>
<td>1,5</td>
<td>V</td>
<td>$1 = 1 \text{ mA}$</td>
</tr>
<tr>
<td>Voltage $U_{\text{high}}$</td>
<td></td>
<td></td>
<td></td>
<td>V</td>
<td>$1 = -1 \text{ mA}$</td>
</tr>
<tr>
<td>Frequency</td>
<td></td>
<td></td>
<td>&lt;1,6</td>
<td>kHz</td>
<td></td>
</tr>
<tr>
<td>Pulse duration</td>
<td>0,64</td>
<td>2</td>
<td>4</td>
<td>ms</td>
<td>Square wave</td>
</tr>
</tbody>
</table>

The Tachograph B7 output provides the speed pulse according to ISO16844-2.
Speed pulse output signal (terminal B7) form + the timing diagram of the speed pulse output versus the motion sensor speed signal (terminal B3) mounted on gearbox resp. transfer box.

a. max. delay 40 μs ± jitter 10 μs

(2) Input monitored only when 61071/pin 16 CC Driver/Bodybuilder is connected to ground, otherwise input is ignored.

(3) If the intermediate speed control is inactive, the CC Resume function is activated
If the intermediate speed control is active, the CC OFF function is activated
The function switches between CC OFF and CC Resume at each subsequent activation

(4) Cyclic passage between the int. inputs PTO_x must be not faster than 500ms. Switching faster may ignore the request. Input will activate physical PTO - when configured - and VCM intermediate Speed Control Mode 1,2,3 On contemporaneous activations of PTO 1,2,3 inputs the VCM intermediate Speed Control Mode is assigned by means of prioritization: PTO_3 - highest priority, PTO_2 - medium priority, PTO_1 - lowest priority

**WARNING:** The Deactivation of a physical PTO is only allowed in load-free conditions. Therefore the deactivation of a physical stationary/non stationary PTO device during driving operation and/or with a gear engaged is not permitted as in such a case the connection to the PTO is not load-free. If the PTO is deactivated, this may result in malfunctions and the PTO and/or gearbox may be damaged.

(5) Up to 10 A can be used in combination with the chassis connector GA 72072D / Pin 1

**Specification 01 - Vehicles with ECAS system (Electronically Controlled Air Suspension)**

> **During working operations using stabilisers, the air springs on vehicles equipped with air suspensions must be discharged.**

**Note** On the rear axle with air suspensions, it is recommended that there is a residual pressure of no more than 0.5 bar to prevent dislodging of the air bellow rubber from the piston.
b) Standard connector 72071: 9 pin, yellow

![Image of connector 72071]

A. 41200681 Counterpart to be coupled
B. 504163547 Existing part on the vehicle

### Table 5.6 - Basic functions of connector 72071

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>cable code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2nd speed-limiter</td>
<td>8223</td>
<td>10 mA</td>
<td>VCM X3-13</td>
<td>2nd speed limiter activation&lt;br&gt;Open wire = not activated&lt;br&gt;+24V = engaged</td>
</tr>
<tr>
<td>2</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Clutch status</td>
<td>9963</td>
<td>200 mA</td>
<td>VCM X1-12</td>
<td>Open circuit = clutch not activated&lt;br&gt;Connected to ground = clutch activated</td>
</tr>
<tr>
<td>4</td>
<td>PTS</td>
<td>5542</td>
<td>200 mA</td>
<td>VCM X1-14</td>
<td>PTS = Programmable Threshold Speed (1)&lt;br&gt;Programmable threshold (rpm or vehicle speed)&lt;br&gt;+24 V = limit exceeded&lt;br&gt;0 V = limit not exceeded</td>
</tr>
<tr>
<td>5</td>
<td>Emergency lights</td>
<td>1113</td>
<td>10 mA</td>
<td>IBC3 E-04</td>
<td>Input signal (2)&lt;br&gt;Connected to ground = on&lt;br&gt;Open circuit = off</td>
</tr>
<tr>
<td>6</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Engine speed signal</td>
<td>5587</td>
<td>10 mA</td>
<td>ECM 1-34</td>
<td>Pulse signal</td>
</tr>
<tr>
<td>9</td>
<td>External lights</td>
<td>3333</td>
<td>5 A</td>
<td>IBC3 E-24</td>
<td>0 V = lights off&lt;br&gt;+24 V = lights on (parking, low and high beam)</td>
</tr>
</tbody>
</table>

(1) VCM default vehicle speed is 6 km/h
The value cannot be modified in Service Network with E.A.S.Y. when the following options are present:

- OPT 06821 (EN1501)
- Certain Refurbishing Near Market requests for RCV (plz contact IVECO Bodybuilders market responsible)

(2) The emergency lights are only supported during the KIS ON phase.

### Table 5.7 - Engine speed signal

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage ( U_{\text{min}} )</td>
<td>0</td>
<td></td>
<td>1.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Voltage ( U_{\text{neg}} )</td>
<td>( U_{\text{min}} - 2 )</td>
<td>( U_{\text{neg}} )</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Duty cycle</td>
<td>50</td>
<td></td>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Pulse duration</td>
<td>0.64</td>
<td>2</td>
<td>4</td>
<td>ms</td>
<td></td>
</tr>
</tbody>
</table>

The engine speed signal provides six pulses for each revolution of the camshaft, i.e. three pulses for each revolution of the crankshaft (see Figure 10).
A. Top Dead Centre
b. Complete crankshaft rotation (360°)
c. Complete camshaft rotation (360°)

When the signal is not available, contact the IVECO Assistance Service.

c) Optional connector 72070: 12 pin, green

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground</td>
<td>0001</td>
<td>5 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Voltage reducer</td>
<td>7770</td>
<td></td>
<td>Pin 4 voltage reducer</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>CAN H</td>
<td></td>
<td></td>
<td>Tachograph C5</td>
<td>FMS CAN H</td>
</tr>
<tr>
<td>7</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>CAN L</td>
<td></td>
<td></td>
<td>Tachograph C7</td>
<td>FMS CAN L</td>
</tr>
<tr>
<td>10</td>
<td>K15</td>
<td>8879</td>
<td></td>
<td>Radio A4</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>K15</td>
<td>8879</td>
<td></td>
<td>Radio A4</td>
<td></td>
</tr>
</tbody>
</table>

A.41 200682 Counterpart to be coupled
B. 99478888 Existing part on the vehicle
<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>K30</td>
<td>7772</td>
<td></td>
<td>IBC3 B-9</td>
<td></td>
</tr>
</tbody>
</table>

FMS CAN line is enabled with opt. 14569.
For further information please see Chapter 5.3 (→ Page 28)

d) Optional connector 72072A: 6 pin, blue

A. 41040341 Counterpart to be coupled
B. 41200680 Existing part on the vehicle

Only available with OPT 4572 (EM-light) or OPT 0384 (EM-full) installed.

**Table 5.9 - Basic functions of connector 72072A**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>cable code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 2   | Request gearbox in neutral Gearbox activation | 6983       | 500 mA    | EM X4-05     | Only with automatic gearbox
Indicated that Driver requested Neutral gear & Neutral gear being physically engaged
Ground = ON
Open circuit = OFF |
| 3   | Bodybuilder Enable                 | 0991       | Load between 10 mA and 1 A (1) | EM X3-17 | It must be activated by the Bodybuilder when the outfitting is in operation. Otherwise some functions not supported:
- Neutral shift for automatic gearboxes
- Safe State activation by BB EMCY (ST148/2)
- CANOpen controls under Firewall monitoring
Ground = active, low side switch |
| 4   | Vehicle CAN fully operational signal | 9089       | 10 A (2)  | Relay wiring: Activated via EM X4-04 and VCM X1-07 | Allows Bodybuilder the supervision of "Vehicle CAN fully operational" information (3)
+24 V = ON, vehicle CAN systems are operational
Ground = OFF at least one system is not operational |
| 5   | Reserved                            |            |           |              |                                                                         |
| 6   | Reserved                            |            |           |              |                                                                         |

(1) During the K15 OFF phase, the input will not be activated so as to avoid an increase in the sleep current of the.
(2) Up to 10 A can be used in combination with CA cab connector 72072C / Pin 1
(3) Allows the Bodybuilder to check the "Vehicle with CAN fully operational" information. It shows at the same time:
• IVN (In Vehicle Network) communication w/o timeouts and
  Bodybuilder interface application running

**Note**  The output signal is filtered every second to prevent temporary interference. Output remains off for ~5 sec after the phase K15 ON. The Bodybuilder must check this delay at each cycle, otherwise wiring problems cannot be safely identified.

The IVN CAN communication of following systems are monitored via Timeout detection:

• Vehicle Control module
• Brake system
• ECAS (when installed)
• Automatic gearbox (when installed)
• Body Controller System
• Tachograph

Detailed information for each system is available via CANopen – see EMCY 0x1014 object.

e) Optional connector 72072B: 20 pin, black

![Connector Diagram]

A. 500314809 Existing part on the vehicle
B. 500314816 Counterpart to be coupled

Only available with OPT 0384 (EM-full) installed.

**Table 5.10 - Basic functions of connector 72072B**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Cable Code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Request gearbox in neutral signal</td>
<td>0992</td>
<td>10 mA (1)</td>
<td>EM X3-18</td>
<td>Only supported with OPT 6821 and ZF AutoGbox (EMOS or ET). Only with Bodybuilder enable (72072A - pin 3) activated. Signal change required, no later than 1 second after K15 ON Ground = active, low side switch</td>
</tr>
<tr>
<td>2</td>
<td>Bodybuilder Emergency Signal</td>
<td>0993</td>
<td>10 mA (1)</td>
<td>EM X3-19</td>
<td>Input to activate the Vehicle StoppedState values, only with Bodybuilder Enable (72072A/pin 2) also activated List of configurable signals (2) Ground = active, low side switch</td>
</tr>
<tr>
<td>3</td>
<td>External stop brake request (ENI501)</td>
<td>0994</td>
<td>10 mA (1)</td>
<td>EM X3-20</td>
<td>Only supported with opt 6821 (1) Input to activate the Stopping brake (V&lt;2km/h) Ground = active, low side switch</td>
</tr>
<tr>
<td>4</td>
<td>Stop brake signal return (ENI501)</td>
<td>0995</td>
<td>10 mA</td>
<td>EM X3-21</td>
<td>reserved for IVECO exclusively Only supported with OPT 6821 Input to monitor the stop brake pressure Ground = active, low side switch</td>
</tr>
<tr>
<td>Pin</td>
<td>Description</td>
<td>cable code</td>
<td>Max. Load</td>
<td>Connected to</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----</td>
<td>-------------</td>
<td>------------</td>
<td>-----------</td>
<td>--------------</td>
<td>---------</td>
</tr>
<tr>
<td>5</td>
<td>Stepper swt req. (EN1501)</td>
<td>0996</td>
<td>10 mA (v)</td>
<td>EM X4-06</td>
<td>Only supported with opt 6821 (v) Input to activate the Refuse stepper switch Ground = active, low side switch <strong>n.a. when ABS-HSA (OPT 14861) installed</strong></td>
</tr>
<tr>
<td>6</td>
<td>LMM (Light Management Module) Right turn indicator</td>
<td>6985</td>
<td>1.5 A</td>
<td>EM X1-03</td>
<td>Right turn signal light 0V = not engaged +24V = engaged</td>
</tr>
<tr>
<td>7</td>
<td>LMM (Light Management Module) Left turn indicator</td>
<td>6986</td>
<td>1.5 A</td>
<td>EM X1-08</td>
<td>Left turn signal light 0V = not engaged +24V = engaged</td>
</tr>
<tr>
<td>8</td>
<td>Warning sound indicator (EN1501)</td>
<td>6987</td>
<td>1 A</td>
<td>EM X4-01</td>
<td><strong>reserved for IVECO exclusively</strong> Only supported with OPT 6821 Output EN1501 Warning sound indicator 0V = not engaged +24V = engaged</td>
</tr>
<tr>
<td>9</td>
<td>Keep EM alive</td>
<td>6988</td>
<td>1 A</td>
<td>EM X4-02</td>
<td>0V = not engaged +24V = engaged</td>
</tr>
<tr>
<td>10</td>
<td>Brake diagnostics lamp (EN1501)</td>
<td>6989</td>
<td>1 A</td>
<td>EM X4-03</td>
<td><strong>reserved for IVECO exclusively</strong> Only supported with OPT 6821 Output EN1501 Reverse protections Brake active 0V = not engaged +24V = engaged after K15 active for 2 sec (w/o brake activated) <strong>n.a. when ABS-HSA (OPT 14861) installed</strong></td>
</tr>
<tr>
<td>11</td>
<td>Brake engaged (EN1501)</td>
<td>6990</td>
<td>1 A</td>
<td>EM X4-21</td>
<td><strong>reserved for IVECO exclusively</strong> Only supported with OPT 6821 Output EN1501 Solenoid Brake 0V = not engaged +24V = engaged</td>
</tr>
<tr>
<td>12</td>
<td>Gearbox in neutral request (EN1501)</td>
<td>6991</td>
<td>1 A</td>
<td>EM X4-22</td>
<td>Only supported with OPT 6821 and ZF AutoQbox (EMOS or ET) Contact IVECO for further details 0V = not engaged +24V = engaged</td>
</tr>
<tr>
<td>13</td>
<td>Chassis ready (acc. EN1501)</td>
<td>6992</td>
<td>1 A</td>
<td>EM X4-23</td>
<td>Indicates Chassis Information ready (acc. EN1501) for adjustment contact IVECO CS organisation 0 V = Off: Frame not ready +24 V = On - Frame ready</td>
</tr>
<tr>
<td>14</td>
<td>Accelerator pedal idle switch</td>
<td>6993</td>
<td>1 A</td>
<td>EM X4-31</td>
<td>Indicates that Accelerator pedal idle switch 0 V = OFF - low idle switch not active + 24 V = ON - low idle switch active</td>
</tr>
<tr>
<td>15</td>
<td>Signal indicating &quot;at least&quot; one PTO is engaged</td>
<td>6994</td>
<td>1 A</td>
<td>EM X4-32</td>
<td>Indicates at least one PTO is engaged Signal based on PTO feedback signal/s 0 V = OFF - no PTO engaged + 24 V = ON - at least one PTO engaged</td>
</tr>
<tr>
<td>16</td>
<td>Bodybuilder fluid level</td>
<td>5981</td>
<td>0-32 V, 0-500 Ohm (v)</td>
<td>EM X4-14</td>
<td>Analog input for IC display (instrument panel) of the &quot;outfitting fluid level&quot; information with CANopen enabled</td>
</tr>
<tr>
<td>17</td>
<td>Bodybuilder pressure</td>
<td>5982</td>
<td>0-32 V, 0-500 Ohm (v)</td>
<td>EM X4-15</td>
<td>Analog input for IC display (instrument panel) of the &quot;outfitting pressure&quot; information with CANopen enabled</td>
</tr>
</tbody>
</table>
EUROCARGO Euro VI - Step D – BODYBUILDER INSTRUCTIONS

ELECTRONIC SUB-SYSTEMS

5.2 BODYBUILDER CONNECTORS

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>cable code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Bodybuilder Thermal Temperature</td>
<td>5983</td>
<td>0-32 V, 0-500 Ohm (f)</td>
<td>EM X4-29</td>
<td>Analog input for IC display (instrument panel) of the &quot;outfitting temperature&quot; information with CANopen enabled</td>
</tr>
<tr>
<td>19</td>
<td>ReGen inhibit</td>
<td>5991</td>
<td>0-2000 Hz (f)</td>
<td>EM X4-16</td>
<td>reserved for IVECO exclusively used by IVECO for Cummins application</td>
</tr>
<tr>
<td>20</td>
<td>ReGen force</td>
<td>5992</td>
<td>0-2000 Hz (f)</td>
<td>EM X4-38</td>
<td>reserved for IVECO exclusively used by IVECO for Cummins application</td>
</tr>
</tbody>
</table>

(1) During the K15 OFF phase, the input will not be activated, so as to avoid an increase in the sleep current.

(2) Requirements for Functional Safety

In case of an emergency inside the Bodybuilder application, IVECO offers the activation of the Bodybuilder Emergency input. When input activated the vehicle enters - depending on configuration - autonomously in a Vehicle Stopped State. IVECO offers a set of pre-configured Stopped State settings to satisfy Bodybuilders application specific needs; for details please contact IVECO.

- This feature is only available when the Bodybuilder application is in operation and not during normal vehicle driving. Therefore, the Bodybuilder enable input (ST 72072A, pin 3) will be simultaneously switched to ground; otherwise no other action will be initiated.
- Please note that the Vehicle Stopped State values are transmitted via CAN to the other vehicle subsystems. Therefore, this feature requires that the "Vehicle CAN fully operational" output is active.
- When the "Vehicle CAN fully operational" output is not active then the Bodybuilder application does not have to implement actions (or rather reactions) which rely on the EM nor on the entire IVECO Bodybuilder interface functioning properly (as for instance the CANopen gateway). The Bodybuilder is responsible for initiating measures that make sure that the Safe State of its application is entered autonomously.
- When the application specifies that the Bodybuilder also requests a recovery strategy while the "Vehicle in full CAN option" output is passive, contact IVECO if support is requested to complete the design specifications of this recovery strategy.
- All the signals listed below are transmitted as one entire package - it is not possible to exclude any of them.
- The values of the "Vehicle Stopped State" signals are transmitted immediately after activation of Bodybuilder Emergency and shall remain active until:
  - K15 is switched off
  - the CANopen NMT "Start Node" command is received or
  - the CANopen NMT "Start all Nodes" command is received
  - the CANopen NMT "Start via HW input" command is configured and the signal is reactivated

Note: During this "Stopped State" phase the affected CANopen signals received on BB-CAN are ignored.

(3) The stopping brake can only be activated with vehicle speed less than 2 km/h. On EBS vehicles a new Stopping Brake request is serviced only when engine is running. When Stopping brake being active the engine could be stopped and Stopping brake remains engaged.

The Stopping brake is only supported during K15 ON phase, switching off K15 disable the function on ABS vehicles. On vehicles with EBS brake system the Bodybuilder automatically deactivates the stop brake request when K15 is switched off.

(4) The "Compactor footboard switch" input and the CANopen 0x6148 object activate the following actions on the actuated footboard switch (as described in Standard Fpr EN 15011:2010 of 2010-02, Chapter 5.1.1.3.3.1 - Directives for man-riding footboards):

- speed limiting
- in the case of reverse gear engaged (rear-loading compactor), protection by:
  - Brakes activation
  - torque limit set to 0% (only low idle governor) if reversing
  - inhibiting reverse gear on automatic gearboxes when this is engaged, only when the Bodybuilder Enable input (72072A/03) is connected to ground by the Bodybuilder
f) Optional connector 72072C: 9 pin, yellow

![Connector Diagram]

A.41200681 Counterpart to be coupled  
B. 504163547 Existing part on the vehicle

Only available with OPT 0384 (EM-full) installed.

Table 5.11 - Basic functions of connector 72072C

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>K30</td>
<td>7796</td>
<td>10 A (1)</td>
<td>K30</td>
<td>Protected by fuse 10 A</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
<td>0000</td>
<td></td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CO (CANopen) operational</td>
<td>0975</td>
<td>0.5 A</td>
<td>EM X4-28</td>
<td>LSO (Low Side Output), activated in the case of CO initiated (typically ~3 seconds after K15 ON) for adjustment contact IVECO CS Open circuit = CANopen not operational 0 V = CANopen operational</td>
</tr>
<tr>
<td>4</td>
<td>Bodybuilder CAN</td>
<td>CAN H</td>
<td>EM X4-17</td>
<td></td>
<td>CANopen Truckgateway, see CIA 413</td>
</tr>
<tr>
<td>5</td>
<td>CAN Gnd</td>
<td>0999</td>
<td>EM X4-09</td>
<td></td>
<td>HF Ground (High Frequency), capacitive coupled</td>
</tr>
<tr>
<td>6</td>
<td>Bodybuilder CAN</td>
<td>CAN L</td>
<td>EM X4-19</td>
<td></td>
<td>CANopen Truckgateway, see CIA 413</td>
</tr>
<tr>
<td>7</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) 10 A can be used in combination with "Vehicle CAN fully operational" signal, connector 72072A pin 4

g) Optional connector 72074: 12 pin, black

![Connector Diagram]

A.500314807 Counterpart to be coupled  
B. 500314814 Existing part on the vehicle
Table 5.12 - Basic functions of connector 72074 (automatic gearbox)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>cable code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Neutral indicator for Extra PTO</td>
<td>0147</td>
<td>500 mA</td>
<td>ALL 45</td>
<td>Gearbox in neutral. Ground for neutral engaged. This output function is activated by the TCM when Neutral is attained and a programmable combination of engine speed and transmission output speed has been detected.</td>
</tr>
<tr>
<td>2</td>
<td>Multi-state switch</td>
<td>4123</td>
<td>15 mA</td>
<td>ALL 23</td>
<td>Limitation 1st gear and inhibition reverse gear. Open wire = function active +24V = function not engaged Ground = function active This function is normally enabled with an operator-controlled momentary switch. When the function is enabled, the transmission is limited to operation in Neutral only and in the reduced forward gear range (6) (which can be selected)<em>. Operator requests to upshift beyond the maximum</em> gear range or to shift into Reverse are ignored by the TCM. If the function is enabled with Reverse selected on the shift selector, the transmission will shift to Neutral. If the function is enabled in a forward drive range higher than the maximum specified gear range*, the TCM will invoke preselect downshifts until the specified gear range is attained. The function is disabled when the enabling switch is released.</td>
</tr>
<tr>
<td>3</td>
<td>Gear range inhibition</td>
<td>0259</td>
<td></td>
<td>ALL 42</td>
<td>For special applications - Input from PTO switch. Open wire = inactive +24V = active Ground = inactive Enabling this function alerts the TCM that PTO operation has been requested by the operator. When the input function is enabled, the TCM disrupts the &quot;modulated main pressure&quot; feature in the gearbox, resulting in transmission operation at full main pressure. When the function is enabled and all of the following conditions exist, the TCM activates Output Function G (PTO Enable Output). Required operating conditions for enabling of this function are: ⚫ accelerator position is &quot;low&quot; ⚫ engine speed and output speed are within Customer Modifiable Constant limits.</td>
</tr>
<tr>
<td>4</td>
<td>PTO active</td>
<td>8131</td>
<td>15 mA</td>
<td>ALL 43</td>
<td>For special applications - 24 V output to activate the PTO. This output function is activated when use of the PTO has been requested and all operating conditions required to enable the PTO have been satisfied.</td>
</tr>
<tr>
<td>5</td>
<td>PTO control</td>
<td>8333</td>
<td>500 mA</td>
<td>ALL 30</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>PTO 2 control</td>
<td>6164</td>
<td></td>
<td>ALL 50</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Relay control</td>
<td>5146</td>
<td></td>
<td>ALL 2</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>&quot;Pump Pack&quot; activation signal (only with Allison 3000 gearbox)</td>
<td>5145</td>
<td></td>
<td>ALL 17</td>
<td></td>
</tr>
</tbody>
</table>
## 5.2 BODYBUILDER CONNECTORS

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>cable code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Automatic neutral signal</td>
<td>0258</td>
<td>5 mA</td>
<td>ALL 1</td>
<td>For special applications - Logic mode &quot;and&quot; mode with pin 8 Open wire = function inactive +24 V = function inactive Value close to digital ground = function active The TCM determines this function enable request to be valid only after receiving two separate input signals. When properly integrated into the vehicle system, the enabled function automatically commands the gearbox to shift to Neutral when an additional vehicle brake is engaged.</td>
</tr>
<tr>
<td>10</td>
<td>Digital ground</td>
<td>0000</td>
<td></td>
<td>ALL 3</td>
<td>It must be used as return for &quot;closed on digital ground&quot; inputs. Do not connect to the battery negative or to other grounds.</td>
</tr>
<tr>
<td>11</td>
<td>Range indicator</td>
<td>0103</td>
<td>500 mA</td>
<td>ALL 13</td>
<td>Gearbox: ground for neutral not engaged This output function is activated by the TCM when the specified gear (or gears) is being commanded by the TCM</td>
</tr>
<tr>
<td>12</td>
<td>Gearbox speed indicator output</td>
<td>8039</td>
<td>15 mA</td>
<td>ALL 5</td>
<td></td>
</tr>
</tbody>
</table>

Contact Customer Service for any modifications.

### 5.2.2 Connectors on the chassis

The following connectors (all black) are located on the frame:

- 61069 (SML) - see Paragraph "Installation of lateral side lights (Side Marker Lamps)" (● Page 54)
- 72072D (EM)
- ST91 (PTO 1)
- ST92 (PTO 2)
- ST93 (PTO 3)
a) Optional connector 72072D: 7 pin, black

![Diagram of connector 72072D]

A.504111928 Counterpart to be coupled  
B. 41118387 Existing part on the vehicle

Only available with OPT 0384 (EM-full) installed.

**Table 5.13 - Basic functions of connector 72072D**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>K30</td>
<td>7795</td>
<td>10 A</td>
<td>K30</td>
<td>Protected by fuse 10A (1)</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
<td>0000</td>
<td></td>
<td>Ground</td>
<td></td>
</tr>
</tbody>
</table>
| 3   | CO enable (CANopen)    | 0975      | 0.5 A     | EM X4-28     | LSO (Low Side Output), activated in the case of CO initiation (typically ~3 seconds after K15 ON) for adjustment contact IVECO C5  
Open circuit = CANopen not operational  
0 V = CANopen operational                                         |
| 4   | Bodybuilder CAN        | CAN H     |           | EM X4-17     | CANopen Truckgateway, see CIA 413                                       |
| 5   | CAN line Ground        | 0999      |           | EM X4-09     | HF Ground (High Frequency), capacitive coupled                           |
| 6   | Bodybuilder CAN        | CAN L     |           | EM X4-19     | CANopen Truckgateway, see CIA 413                                       |
| 7   | Reserved               |           |           |              |                                                                         |

(1) 10 A can be used in combination with K30 on the connector 61071 pin 21

b) Optional connectors ST91, ST92, ST93: 4 pin, black

![Diagram of connectors ST91, ST92, ST93]

A.98435337 Counterpart to be coupled  
B. 98435341 Existing part on the vehicle

Only available with OPT 4572 (EM-light) or OPT 0384 (EM-full) installed.
Table 5.14 - Basic functions of connector ST91

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PTO1 feedback signal</td>
<td>6131</td>
<td>10 mA (1)</td>
<td>EM X3-08</td>
<td>Connect to ground to read the PTO1 feedback</td>
</tr>
<tr>
<td>2</td>
<td>PTO1 activation via the electromagnetic valve</td>
<td>9131</td>
<td>1.5 A</td>
<td>EM X1-01</td>
<td>OFF = 0V = valve not activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ON = +24V = valve activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Max load in Lite = 2.0 A</td>
</tr>
<tr>
<td>3</td>
<td>PTO1 pressure switch</td>
<td>0391</td>
<td>10 mA (1)</td>
<td>EM X3-11</td>
<td>Connected to ground if active</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td></td>
<td>Ground</td>
<td></td>
</tr>
</tbody>
</table>

(1) During the K15 OFF phase, the input will not be activated so as to avoid an increase in the sleep current

Table 5.15 - Basic functions of connector ST92

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PTO2 feedback signal</td>
<td>6132</td>
<td>10 mA (1)</td>
<td>EM X3-09</td>
<td>Connect to ground to read the PTO2 feedback</td>
</tr>
<tr>
<td>2</td>
<td>PTO2 activation via electromagnetic valve</td>
<td>9132</td>
<td>1.5 A</td>
<td>EM X1-04</td>
<td>OFF = 0V = valve not activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ON = +24V = valve activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Max load in Lite = 2.0 A</td>
</tr>
<tr>
<td>3</td>
<td>PTO2 pressure switch</td>
<td>0392</td>
<td>10 mA (1)</td>
<td>EM X3-12</td>
<td>Connected to ground if active</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td></td>
<td>Ground</td>
<td></td>
</tr>
</tbody>
</table>

(1) During the K15 OFF phase, the input will not be activated so as to avoid an increase in the sleep current

Table 5.16 - Basic functions of connector ST93

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PTO3 feedback signal</td>
<td>6133</td>
<td>10 mA (1)</td>
<td>EM X3-10</td>
<td>Connect to ground to read the PTO3 feedback</td>
</tr>
<tr>
<td>2</td>
<td>PTO3 activation via electromagnetic valve</td>
<td>9123</td>
<td>1.5 A</td>
<td>EM X1-06</td>
<td>OFF = 0V = valve not activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ON = +24V = valve activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Max load in Lite = 2.0 A</td>
</tr>
<tr>
<td>3</td>
<td>PTO3 pressure switch</td>
<td>0393</td>
<td>10 mA (1)</td>
<td>EM X3-16</td>
<td>Connected to ground if active</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td></td>
<td>Ground</td>
<td></td>
</tr>
</tbody>
</table>

(1) During the K15 OFF phase, the input will not be activated so as to avoid an increase in the sleep current

5.2.3 Trailer connectors

If an adjustment of the tow vehicle with continuous braking is necessary, use two 7-pin connectors (72000 and 72001) or alternatively a single 15 pin connector ISO (72010) on the last crossbeam of the chassis.

If the trailer is designed for a 12 Volt supply, an optional connector with 13 pins (72016) must be used.
a) 7-pin trailer connector

![Image of 7-pin trailer connector]

Table 5.17 - Basic functions of the 7 pin connector (72000) for the trailer

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire Code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground</td>
<td>0000</td>
<td>11 A</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Daylight running lights/right trailer clearance light</td>
<td>3331</td>
<td>6 A</td>
<td>MET-A06</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Left trailer indicator</td>
<td>1180</td>
<td>6 A</td>
<td>MET-C04</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Trailer stop lights</td>
<td>1179</td>
<td>6 A</td>
<td>MET-A02</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Right trailer indicator</td>
<td>1185</td>
<td>6 A</td>
<td>MET-B03</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Daylight running lights/left trailer clearance light</td>
<td>3332</td>
<td>6 A</td>
<td>MET-A07</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Spare</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.18 - Basic functions of the 7 pin connector (72001) for the trailer

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire Code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground</td>
<td>0000</td>
<td>11 A</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Power supply +15 for trailer</td>
<td>8869</td>
<td>11 A</td>
<td>MET-C01</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Trailer reverse light</td>
<td>2226</td>
<td>6 A</td>
<td>IBC3-A09</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Spare</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Spare</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Spare</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Trailer rear fog light</td>
<td>2283</td>
<td>6 A</td>
<td>MET-B1</td>
<td></td>
</tr>
</tbody>
</table>
B) 15-pin trailer connector

Table 5.19 - Basic functions of the 15 pin connector (72010) for the trailer

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Left trailer indicator</td>
<td>1180</td>
<td>6 A</td>
<td>MET-C04</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Right trailer indicator</td>
<td>1185</td>
<td>6 A</td>
<td>MET-B03</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Trailer rear fog light</td>
<td>2283</td>
<td>6 A</td>
<td>MET-B01</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td>11 A</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Daylight running lights/left trailer</td>
<td>3332</td>
<td>6 A</td>
<td>MET-A07</td>
<td></td>
</tr>
<tr>
<td></td>
<td>clearance light</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Daylight running lights/right trailer</td>
<td>3331</td>
<td>6 A</td>
<td>MET-A08</td>
<td></td>
</tr>
<tr>
<td></td>
<td>clearance light</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Trailer stop lights</td>
<td>1179</td>
<td>6 A</td>
<td>MET-A02</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Trailer reverse light</td>
<td>2226</td>
<td>6 A</td>
<td>IBC3-A09</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Spare</td>
<td></td>
<td></td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>10</td>
<td>Spare</td>
<td></td>
<td></td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>11</td>
<td>Spare</td>
<td></td>
<td></td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>12</td>
<td>Spare</td>
<td></td>
<td></td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>13</td>
<td>Spare</td>
<td></td>
<td></td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>14</td>
<td>Spare</td>
<td></td>
<td></td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>15</td>
<td>Spare</td>
<td></td>
<td></td>
<td></td>
<td>–</td>
</tr>
</tbody>
</table>

Table 5.20 - Basic functions of connector (72016) to 13 pin for trailer powered at 12 Volt

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Left trailer indicator</td>
<td>1180</td>
<td>6 A</td>
<td>MET-C04</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Trailer rear fog light</td>
<td>2283</td>
<td>6 A</td>
<td>MET-B01</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ground</td>
<td>0000</td>
<td>11 A</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Right trailer indicator</td>
<td>1185</td>
<td>6 A</td>
<td>MET-B03</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Daylight running lights/right trailer</td>
<td>3331</td>
<td>6 A</td>
<td>MET-A07</td>
<td></td>
</tr>
<tr>
<td></td>
<td>clearance light</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Trailer stop lights</td>
<td>1117</td>
<td>6 A</td>
<td>MET-A02</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5.21 - Characteristics of the CAN line

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical level</td>
<td>Unshielded twisted pair cable compliant with ISO std. 11898 (SAE J1929/11).</td>
</tr>
<tr>
<td></td>
<td>Termination of internal bus to cable with 120 Ω resistor.</td>
</tr>
<tr>
<td>Application level</td>
<td>Messages and parameters compliant with SAE J1939/71.</td>
</tr>
</tbody>
</table>

The information that can be retrieved contains the message "FMS Standard Interface" and identifies the version that is supported. This message is not present if you have installed an interface that does not support this standard.
The telematic devices connected to the FMS connector, wanting to use the Remote Tachograph Download Data functionality must be set to use the "source address" F0; if you do not operate in this way, on the message "error 13", relative to problems on the CAN network, could appear on the tachograph.

5.4 CONFIGURATIONS FOR TAIL LIFTS

5.4.1 Base configuration

Vehicles with base configuration (opt. 4113) are equipped with specific wiring between the instrument cluster and the bulkhead connector and a switch on the dashboard. Pressing the switch closes the electrical circuit connected to the tail lift. At the same time, an indicator lamp illuminates on the instrument panel and the engine cannot be started up until the switch is pressed again (see Chapter 3.9 - Paragraph "Base configuration for tail lifts" (☞ Page 39)).

To complete the electrical wiring to the tail lift, refer to the diagram in Figure 21.

The tail lift anchoring kit (option 6229), should preferably be used together with this configuration.
25550 Contactor for preventing start-up with tail lift engaged
25551 Contactor for tail lift indicator lamp inserted
50003 Electronic instrument panel for instrument and warning lights display
52219 Switch for activating tail lift
52502 Key-controlled switch for services with start-up
70000 Fuse holder 6
86116 Body Computer multiplex control unit
86132 VCM (Vehicle Control Module) control unit
5.4.2 Base configuration with second ECAS remote control (opt. 4115)

Vehicles with air suspension (FP and /FP) may be equipped with an ECAS remote control unit in addition to the remote control unit provided as standard. This option (opt. 4115, for use solely together with opt. 4113 described previously) consists of specific wiring and a supplementary remote control unit which may be connected in the vicinity of the tail lift.

When the switch to activate the rear lift is pressed, the standard remote control unit is disabled and the supplementary unit only is enabled. The original state is restored when the switch is pressed again.

25546 ECAS contactor from box (power supply)  
25547 ECAS contactor from box (mass)  
25548 ECAS contactor from box (clock)  
25549 ECAS contactor from box (data)  
85160 Chassis settings adjuster  
86023 Vehicle raising-lowering control unit
5.4.3 VEHH pre-installation (opt. 75182)

To allow compliance with the standard established by the VEHH (Association of European producers of tail lift manufacturers), opt. 75182 is available (see Chapter 3.9 - "VEHH pre-installation for tail lifts" (Page 40)).

Refer to the following diagrams for the VEHH configuration without and with ECAS.

a) VEHH tail lift without ECAS

25550 Contactor for preventing start-up with tail lift engaged
25571 Contactor for VEHH tail lift control
50003 Electronic instrument panel for instrument and warning lights display
52219 Switch for activating tail lift
52502 Key-controlled switch for services with start-up
70000 Fuse holder 6
86116 Body Computer multiplex control unit
86132 VCM (Vehicle Control Module) control unit
b) VEHH tail lift with ECAS

25550 Contactor for preventing start-up with tail lift engaged
25551 Relay for tail lift indicator lamp
25571 Contactor for VEHH tail lift control
25573 ECAS control switch with VEHH tail lift engaged
50003 Electronic instrument panel for instrument and warning lights display

52219 Switch for activating tail lift
52502 Key-controlled switch for services with start-up
70000 Fuse holder 6
B6116 Body Computer multiplex control unit
B6132 VCM (Vehicle Control Module) control unit

Figure 24
5.5 OPERATOR’S FOOTBOARD

For refuse collection vehicle, the standard EN 1501 imposes safety requirements of the operation and protection from accidents (e.g. locking in the load compartment or accidental fall of the containers off the vehicle, retracting of the vehicle, etc.).

Therefore, if the outfitting includes an external footboard for an operator to ride on, which can only be activated when the operator is present, the electrical system must be pre-configured according to the following diagrams.

a) vehicles with automatic or mechanical gearbox

---

22050  Bell (EN1501 in operation)
25139  Maintenance control switch EN1501
53620  Switch (parking brake engaged)
58740  Parking brake engaged signal warning light
61011  Container for a 3 A diode
70000  Fuse holder 6

72071  Cab 9-pole connector for bodybuilders
72072  DMI/EM control unit interfacing connector
78065  Solenoid valve EN1501 (parking brake activation)
86126  EM (Expansion Module) control unit
86132  VCM (Vehicle Control Module) control unit
A  Footboard switch (bodybuilder supply)
b) vehicles with automated gearbox 6AS or 12AS

With this type of vehicle, the following operations must be carried out on the electrical system:

- Cut the connection between the VCM control unit (1) and button "N" (2)
- Add a relay (3)
- Insert the relay contact in series between the VCM control unit and button "N"

![Electrical Circuit Diagram]

Figure 26

<table>
<thead>
<tr>
<th>Num</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VCM control unit</td>
</tr>
<tr>
<td>2</td>
<td>Button &quot;N&quot;</td>
</tr>
<tr>
<td>3</td>
<td>Relay to be added</td>
</tr>
<tr>
<td>4</td>
<td>Connector ST72072A</td>
</tr>
<tr>
<td>5</td>
<td>Connector ST72072B</td>
</tr>
<tr>
<td>6</td>
<td>EM (Expansion Module) control unit</td>
</tr>
</tbody>
</table>

5.6 ELECTRICAL CIRCUIT MODIFICATIONS

- **CAN line wires and electric/electronic devices must not be modified.**
- **Any modifications on the electrical system will reduce quality and safety characteristics.**
- **Bodybuilders must use genuine IVECO spare parts if changes to the electrical system are inevitable.**
5.6 ELECTRICAL CIRCUIT MODIFICATIONS

5.6.1 General information
The instructions provided in Chapter 2.1 - Paragraph "Special precautions" (⇒ Page 5) also refer to Multiplex system wiring.
The connectors and the respective terminals cannot be modified. Avoid connecting and disconnecting the chassis control unit connectors for more than three times to prevent damaging the gel which ensures tightness of the connections.

5.6.2 Length of wiring
The CAN line and the electrical wires form a single wiring, therefore it is not possible to replace only the CAN line or the electric cables where the electrical system consists of both.
When repositioning the Hi-MUX system electronic control units, it may be necessary to modify the wire length.
1. If the length is excessive, some bends are possible (avoid the coils, the cause of undesirable electromagnetic effects), unless the rigidity prevents it shorter length wiring needs to be adopted;
2. If the length is insufficient, it must be replaced.

Note  For any exception to mounting instructions, IVECO's written authorisation is necessary.
Lack of observance of above described prescriptions involves guarantee lapse.

5.6.3 Disconnecting the electronic control units
Follow the instructions below carefully before disconnecting an electronic control unit:
- turn the ignition key to OFF and remove it;
- switch off the additional heaters and wait for the end of the cooling down cycle (the warning light of the corresponding key will go out);
- open the DGC (Main Current Switch, see Chapter 5.8 (⇒ Page 48));
- isolate the battery by disconnecting the battery cables: disconnect the negative terminal first followed by the positive terminal;
- disconnect the control unit.

5.6.4 Repositioning the electronic control units
IVECO recommends avoiding modifications which entail the repositioning of the electronic control units. However, if repositioning is unavoidable, follow the instructions below:
- the electronic control units must be positioned on the chassis or in the cab and secured with a fastening similar to the original one (i.e. bracket);
- in order to avoid any malfunctions the electronic control units must not be turned in relation to the chassis and must maintain the original orientation (e.g. to avoid water ingress);
- electronic control units must not be fitted on the subframe;
- the cover must always be refitted;
- avoid subjecting electronic control units to knocks from debris and stones from the road when travelling.

IVECO cannot be liable for system malfunctioning if the instructions contained in this chapter are not followed.
5.7 ELECTRICAL SYSTEM: OPERATIONS

5.7.1 General information

Vehicles are set to function normally with a 24 V electrical system.

The chassis represents the grounding (it acts as a current return conductor between the components located on it and the battery power source/alternator) and it is connected to the negative pole of the battery and components, if an isolated return is not provided for this.

When installing additional equipment or additional circuits, the following indications must be taken into account and, depending on the complexity of the operation, there must be proper documentation (e.g. wiring diagram) to match that of the vehicle.

The use of cables and connections with colours/codes identical to those used on the original vehicle makes installation correct and facilitates any repair work.

Note For more detailed information regarding the electrical system of the vehicle, please refer to the specific Repair Manual, print 603.95.624 (EUROCARGO 6-10 t Euro 6) and print 603.95.633 (EUROCARGO 12-18 t Euro 6).

These are available through the Assistance Network and can also be requested from sales bodies.

5.7.2 Precautionary measures when working on the system

Operations which do not comply with the indications specified by IVECO may cause damage to on-board systems (control units, wiring, sensors, etc.), and affect the correct operation of the vehicle and driving safety; they can also cause significant damage (e.g. short circuits with fire and destruction of the vehicle) which is not covered by warranty.

Before removing any electrical/electronic equipment, disconnect in sequence the ground cable from the battery negative pole and then the positive cable.

To prevent damage to the vehicle's electrical system, follow the following instructions:

- The cables must have suitable sectioning for the type of load and the position of the load in the vehicle.
- The power cables (+ direct) must be:
  - individually intubated in conduits of suitable diameter and not together with other cables for signal and negative;
  - placed at least 100 mm (reference value = 150 mm) from high heat sources (turbine, engine, exhaust manifold, etc.);
  - placed at least 50 mm from containers of chemical agents (batteries, etc.);
  - placed at least 50 mm from moving parts.
- The path of the cables must be defined with brackets and clamps dedicated and reconciled, to avoid hanging parts and to be able to restore the same installation after repairs or interventions.
- The passage of cables through holes and on the edges of metal sheets must be protected by cable gaskets in addition to the corrugated tube.
  It is not possible to specially drill the chassis to allow the cables path.
- The corrugated tubing must protect the entire cable and be connected (with heat shrinking or taping) to the rubber caps on the terminals.
- All the positive terminals and cable terminals must be protected by rubber caps (for hermetic in areas exposed to weathering or with possible stagnation of water).

Use fuses with the necessary rating for the specific function, and do not under any circumstances use higher rating fuses.

Restore the original condition of the wiring (paths, protections, strips) completely avoiding the cable to come in contact with metallic surfaces that can impact the integrity.
5.7.3  Precautionary measures when working on the chassis

For work on the chassis, to protect the electrical system, its equipment and ground connections, respect the precautions shown in Chapter 2.1 - Paragraph "Special Precautions" (⇒ Page 5) and Chapter 2.3 - Paragraph "Welding" (⇒ Page 9).

If required by the application of additional appliances, diodes must be fitted to protect against any inductive current peaks.

The ground signal from the analogue sensors must only be wired on the specific receiver; additional ground connections may distort the output signal from this sensor.

The cable bundles for low signal intensity electronic components must be arranged parallel to the reference metal plane, namely adherent to the chassis / cab structure, in order to minimise parasitic capacities; space the path of the cable bundle added to the existing one as much as possible.

The added systems must be connected to the ground of the system with the utmost care (see Paragraph "Ground points" (⇒ Page 38)); the related wiring harnesses should not be coupled to the electronic circuits that already exist on the vehicle in order to avoid electromagnetic interference.

Ensure that the wiring of the electronic devices (length, type of conductor, position, strips, cable shielding connection, etc.) comply with indications provided by IVECO.

Carefully restore the original system after any operations.

- Carefully restore the original system after any operations.

- If removing or replacing the KITAS pulse sender on the gearbox, realignment/recalibration must be performed at the DTCO by the IVECO assistance service.

5.7.4  Ground points

The original earth connections of the vehicle should never be altered; in cases where these connections must be moved or new connections added, use the holes present on the chassis to the extent possible, taking care to:

- mechanically remove - either by filing and/or with a suitable chemical based solution - the paint on both the chassis and terminal side, thus creating a contact surface free of indentations and edges;
- paint the area between the terminal and metal surface with a suitable high conductivity paint
- connect to earth within 5 minutes after application of the paint.

As regards the signal related ground connections (e.g. sensors or low-absorption devices), do not use the standardized points Under no circumstances use standardized points for engine ground connection and chassis ground connection.

Additional signal grounds must be positioned at different points from the power ground.
1. **Ground connections:** (A) connection is correct; (B) connection is incorrect

2. Correct cable fastening to the ground point using: (A) screw, (B) cable terminal, (C) washer, (D) nut

3. Cable connected to ground

---

**Figure 27**

**Figure 28**

- **MC1** Cab interior left side ground
- **MM1** Left chassis side member ground
- **MM2** Front right side member frame ground
- **MM3** Cab interior right side ground
- **MM4** Cab interior right side ground
- **MM5** Cab interior left side ground
- **MM6** Roof panel ground

- **MM9** Front left chassis side member ground
- **MM10** Rear left chassis side member ground
- **MM13** Rear right chassis side member ground
- **MT1** Front left chassis side member ground
- **MT2** Left chassis side member ground
- **T1/T2** Attachment points for the cab/chassis equipotentiality braided cable
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 a "star" formation (Figure 29), while tightening must be done in an orderly and adequate manner.

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

- electronic control units must be connected to the system ground when equipped with metal housings
- the negative cables of the electronic control units are to be connected to a system ground point, connected to the negative terminal of the battery;
- the analogue grounds (sensors), while not being connected to the system ground/negative terminal of the battery, are to have good conductivity. Consequently, particular care should be given to terminal parasitic resistances: oxidation, scratches, etc.;
- the metal braid of the shielded circuits must be in electrical contact only at the control unit side to which the signal is to be sent
- In the case of junction connectors (Figure 30), the unshielded section d, near the connectors must be as short as possible;
- The cables must be routed in such a way as to be parallel to the reference plane, as close as possible to the chassis/body.

*STELLA* connections of various negatives with the system ground

Shielding by means of a metal braid of a cable leading to an electronic component
5.7.5 Electromagnetic compatibility

It is recommended 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 primary secondary functions (not impacting on direct vehicle control), for frequencies varying from 20 MHz to 2 GHz.

The maximum excursion allowed for transition voltage with equipment powered by 24 V is +80 V measured on the terminals of the artificial network (L.I.S.N.) if tested on the bench. Alternatively, if tested on the vehicle, the excursion must be read at the most accessible point near to the conflicting device.

**Note** Devices powered at 24 V must:
- be immune to interferences such as -600 V negative spikes, +100 V positive spikes, bursts of ±200 V;
- operate correctly during the phase when voltage drops to 8 V for 40 ms and to 0 V for 2 ms;
- resist the load dump phenomena up to 58 V.

The maximum radiated emission levels measured at the bench and the levels of conducted emissions generated by devices and also by 24 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>Type of detector</th>
<th>Frequency range and limits acceptable in dBµV/m</th>
<th>Unit of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiated</td>
<td>Aerial at a distance of 1 metre</td>
<td>Broad-band</td>
<td>almost peak</td>
<td>150-300 kHz</td>
<td>0.53-2 MHz</td>
</tr>
<tr>
<td>Radiated</td>
<td>Broad-band</td>
<td>peak</td>
<td>63</td>
<td>54</td>
<td>35</td>
</tr>
<tr>
<td>Radiated</td>
<td>Narrow-band</td>
<td>peak</td>
<td>41</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>Conduit USN 50.0 5 µH 0.11 µF</td>
<td>Broad-band</td>
<td>almost peak</td>
<td>80</td>
<td>66</td>
<td>52</td>
</tr>
<tr>
<td>Conduit</td>
<td>Broad-band</td>
<td>peak</td>
<td>93</td>
<td>79</td>
<td>65</td>
</tr>
<tr>
<td>Conduit</td>
<td>Narrow-band</td>
<td>peak</td>
<td>70</td>
<td>50</td>
<td>45</td>
</tr>
</tbody>
</table>

Use electrical/electronic equipment in compliance with the UNECE directive on electromagnetic compatibility.

Only components with certified approval and with mark "e" are allowed; the "CE" marking is not sufficient.

By way of example, the mark prescribed by the current UNECE 10R3 on electromagnetic compatibility in the automotive field is shown below:

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The values in the table are only to be considered respected if the device comes form "IVECO Spare Parts" or it has been certified as per the international standards ISO, CISPR, VDE etc. Whenever equipment is used which runs on mains power (220 V AC) for its primary or secondary source of power, it must be checked to ensure that its characteristics are in line with IEC regulations.

5.7.6 Receiver-transmission systems

The most frequent applications include:

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

⚠️ If devices are fitted which could interact with the electronic systems already present (retarders, additional heaters, power take-offs, air conditioners, automatic gearboxes, telematics and speed limiters) contact IVECO to optimize the application.

a) General indications

1. The equipment must be approved according to the law and be of a fixed nature (not potable). The use of non approved transmitters or supplementary amplifiers could seriously impede the correct functioning of the electrical/electronic devices normally supplied, with negative effects for the safety of the vehicle and/or the driver.

2. The system already provided on the vehicle must be used to power the transmitters and they must be connected to terminal K30 of the connector ST40 (and K15 where necessary) via a supplementary fuse. Any additional power lines must be created respecting the correct sizing of cables and protection.

3. The coaxial antenna cable must be positioned taking care to:
   - use a low loss, top quality product with the same impedance as the transmitter and the antenna (see Figure 33);
   - in order to avoid interference and malfunctioning, create a path (the shortest possible) which maintains a suitable distance (min. 50 mm) from pre-existing cabling or from other cables (radio, amplifiers and other electronic equipment), keeping the minimum distance from the metal structure of the cab and using existing holes in the sheet metal;
   - do not shorten or lengthen; avoid unnecessary tangles, tension, folds and crushing.

4. Outside the cab, the antenna must be installed on the vehicle on a metal base with a wide surface; it must also be fitted as vertically as possible with the connection cable pointing downwards and, in any case, following the manufacturer’s fitting instructions and warnings (see Figure 32). Installation on the centre of the roof is to be considered the best by far, as the grounding is proportional in all directions. The equipment and two-way radios inside the passenger compartment should be placed in the slot of the crossbar fitted above the windscreen on the driver’s side.

5. The quality of the antenna, the mounting position and a perfect connection to the vehicle structure (ground) are factors of fundamental importance to guarantee the best performance of the transmitter equipment.
1. Antenna support
2. Gasket
3. Fixed joint cover

4. Fastening screw M6x8.5 (tighten to a tightening torque of 2 Nm)
5. Antenna
6. Roof panel
7. Antenna extension cable

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

Power for the equipment, when the voltage required is different to that for the system, must be obtained using a suitable DC/DC 12-24V converter if not already provided. The power cables must be as short as possible, avoiding any twists (coils) and maintaining the minimum distance from the reference plane.

Some specific instructions are given below for each type of equipment.
b) Amateur equipment for CB (27 MHz) and 2m band (144 MHz)

The transmitter part must be installed in a separate area from the vehicle's electrical components; in the case of a pulse transmission system, it must be at a distance of at least 1 meter away from other devices.

- The ROS value (Stationary Wave Ratio) must be as close as possible to the unit (the recommended value is 1.5), while the maximum acceptable value must never be greater than 2.
- The ANTENNA GAIN values must be as high as possible and guarantee a sufficient level of spatial uniformity, characterised by deviations in relation to the average value to the order of 1.5 dB in the typical CB band (26.965-27.405 MHz).
- The IRRADIATED FIELD in cab value must be as low as possible, and however < 1 V/m.

In any case, limits set by the applicable European Directive must never be exceeded.

To determine whether the system is functioning well and to check that the antenna is calibrated, it is suggested that the following information is taken into account:

1. if the ROS (Stationary Wave Ratio) is higher on the lower channels than on the higher ones, the antenna should be lengthened;
2. if the ROS (Stationary Wave Ratio) is higher on the higher channels than on the lower ones, the antenna should be shortened;

After having calibrated the antenna, it is advisable to re-check the ROS (Stationary Wave Ratio) value on all the channels.

c) Equipment for GSM/PCS/UMTS cellular phones and TETRA/TETRAPOL

Install the transmitting part in a flat, dry area, separate from the electronic components of the vehicle, away from humidity and vibrations. In the case of a pulse transmission system, it must be at a distance of at least 1 meter away from other devices.

- The ROS value (Stationary Wave Ratio) must be as close as possible to the unit (the recommended value is 1.5), while the maximum acceptable value must never be greater than 2.
- The ANTENNA GAIN values must be as high as possible and guarantee a sufficient level of spatial uniformity, characterised by deviations in relation to the average value to the order of 1.5 dB in the 380-460 MHz band and 870-960 MHz and 2 dB in the 1710-2000 MHz band.
- The IRRADIATED FIELD in cab value must be as low as possible, and however < 1 V/m.

In any case, limits set by the applicable European Directive must never be exceeded.

An optimum position for the antenna would be the front of the cab roof, at a distance of not less than 30 cm from other antennas.

d) GPS receiver and satellite navigation units

Install the transmitting part in a flat, dry area, separate from the electronic components of the vehicle, away from humidity and vibrations. In the case of a pulse transmission system, it must be at a distance of at least 1 meter away from other devices.

The GPS antenna must be installed so as to have the maximum visibility possible of the sky.

In fact, as the signals received from the satellite are at very low power (approximately 13.66 dBm), almost any obstacle can influence the quality and performance of the receiver.

The following should therefore be guaranteed:

- an absolute minimum angle of vision of the sky of 90°;
- a distance no less than 30 cm from any other antenna;
- a horizontal position and never underneath any metal which makes up part of the cab structure.

Moreover:

- the ROS value (Stationary Wave Ratio) must be as close as possible to the unit (the recommended value is 1.5), while the maximum must never be greater than 2 in the GPS frequency range (1575.42 ± 1.023 MHz).
• the ANTENNA GAIN values must be as high as possible and guarantee a sufficient level of spatial uniformity, characterised by deviations in relation to the average value to the order of 1.5 dB in the 1575.42 ± 1.023 MHz band.

5.8 ADDITIONAL EQUIPMENT

The vehicle system is set up to supply the necessary power to the equipment provided, for each of which, as part of their function, the specific protection is assured as well as the correct dimensioning of cables.

The installation of additional equipment must include suitable protections and should not overload the vehicle system.

The connection of the added users to ground must be made with an adequately sectioned cable, as short as possible and made to allow for any movements of the added equipment with respect to the chassis of the vehicle.

Having the need for higher capacity batteries, due to added loads, it is appropriate to request the optional with increased batteries and alternators.

In any case, when increasing battery capacity, it is advisable not to exceed 20-30% of the maximum values provided as optional by IVECO, so as not to damage some of the components (e.g. starter motor). When higher capacities are necessary, use additional batteries, making the necessary provisions for recharging as indicated below.

5.8.1 Additional batteries

The installation of additional electrical equipment or high absorption equipment (e.g. engines operated frequently or used for long periods with thermal motor off, as in the case of tail lifts), could require power that the basic vehicle system cannot provide. In these cases, additional batteries of suitable capacity must be adopted.

The insertion of additional batteries in the vehicle circuit should include an adequate recharge system, using an alternator with more power or adopting and additional alternator with a separate recharge system, integrated with that of the vehicle. In this case it is necessary to provide additional batteries with a capacity equal to those originally fitted (170 Ah / opt. 220 Ah) for correct charging of all the batteries.

In case of installation of additional batteries, it is possible to use:

1. recombination batteries (AGM or gel);
2. traditional batteries.

In both cases it is necessary to adequately separate the batteries from the environment of the vehicle occupants by means of an appropriate container that ensures sealing in case of:

• emission of vapours (for example, in the event of a fault in the alternator voltage regulator);
• explosion of the battery;
• Leakage of liquid electrolyte, even in case of tilting.

If type 1 batteries are used, it is necessary to place a breather towards the outside of the housing compartment.

If type 2 batteries are used, it is necessary to use batteries equipped with:

• cover with a system that emits gas towards the outside, equipped with a tube for spraying acid spray outwards;
• flame arrestor system by means of porous pad.

It is also necessary to ensure that the evacuation of gas is located far from possible spark trigger points, from mechanical/electric/electronic parts, placing the exhaust outlet so as to avoid generating vacuum inside the battery housing compartment.

▶ Ground connection of the additional battery must be made using a cable (the shortest possible) of adequate section.
1. Standard batteries
2. Additional batteries
3. Alternator with built-in regulator
4. Starter motor
5. Ignition switch
6. Contactor switches
7. IVECO Body Controller
8. Instrument panel

> All the lines downstream of all batteries are to be adequately protected, under any fault condition. Failure to ensure adequate protection may pose a fire hazard and a danger to persons.

5.8.2 Additional alternators

The installation of additional batteries involves the verification of the ability of the alternator to charge. If the results of this verification are negative, an alternator with more power must be used, or an additional alternator must be adopted; in this case, connection must be made as indicated in the following Figure.
The installation of additional equipment must include suitable protections and should not overload the vehicle system. The additional alternators must be the type with Zener diode rectifiers to avoid damaging electric/electronic equipment due to accidental battery disengagement. Each alternator must also have a light or LED indicating low battery charge. The additional alternator must have electrical features identical to those of the standard alternator and the cables must be correctly sized.

If you need to modify the system in a way other than described in this manual (for example, adding batteries in parallel), it is necessary to share the operation with IVECO.

### 5.8.3 Additional electrical units

Particular attention must be paid when installing cooling units that use a second alternator, mounted on the engine (additional generator), as a power source.

These generators provide, depending on the number of turns, a voltage of the order of 270–540 V which goes through the wiring to the cooling unit installed on the vehicle.

There is a clear danger of any crosstalk (electromagnetic interference between adjacent cables) that can be generated between the aforementioned cable and the wiring already present on the vehicle.

In these cases it is necessary to use cables with high insulation, adopting a preferential path, though not in the vicinity of the standard vehicle wiring.

For these units, respect the electromagnetic emissions levels mentioned above.

In case of a standard alternator malfunction (e.g., low voltage, no signal) on the control panel, an error message will be reported.

A possible additional alternator cannot be connected to the Multiplex and therefore in case of malfunction, the Multiplex is not able to detect which alternator is not operating properly.
5.9 CURRENT DRAWS

5.9.1 General information

The current draw is related to the battery capacity.

If the engine is stopped the current draw from the battery reduces the capacity to restart the engine.

Note If the battery is charged less than 50% the engine start may be seriously compromised.

For the correct operation of the vehicle it is important to ensure that:

• with engine stopped, the supply is limited to 10% of the nominal battery capacity;
• with the engine running, the supply of another 20% of the nominal battery capacity is possible.

In the following the detail:

Table 5.23 - Maximum samples permitted with engine not running

<table>
<thead>
<tr>
<th>battery capacity [Ah]</th>
<th>supply for 1 continuous hour [A]</th>
<th>supply for 2 continuous hours [A]</th>
<th>supply for 5 continuous hours [A]</th>
<th>supply for 10 continuous hours [A]</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>9.9</td>
<td>5.0</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>143</td>
<td>12.9</td>
<td>6.4</td>
<td>2.6</td>
<td>1.3</td>
</tr>
<tr>
<td>170</td>
<td>15.3</td>
<td>7.7</td>
<td>3.1</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Battery level status

It is approximately derivable by the following table, where there is a direct link "open circuit voltage of the battery ↔ level":

Table 5.24

<table>
<thead>
<tr>
<th>battery voltage [V]</th>
<th>charge level</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;12.2</td>
<td>&lt;50%</td>
</tr>
<tr>
<td>12.3</td>
<td>50%</td>
</tr>
<tr>
<td>12.4</td>
<td>65%</td>
</tr>
<tr>
<td>12.5</td>
<td>75%</td>
</tr>
<tr>
<td>&gt; 12.6</td>
<td>&gt;90%</td>
</tr>
</tbody>
</table>

Note To check the level it is necessary to accurately measure the voltage with the battery terminals disconnected and possibly at least one hour after turning off the engine.

The loss of capacity due to a current draw when the motor is stopped must be recovered in the shortest possible time.

To this effect, it is considered that, in case of a vehicle with standard equipment, without additional electrical loads, with 70 A alternator and 110 Ah battery, circulating with typical urban mission, the capacity is recovered as follows:

Table 5.25

<table>
<thead>
<tr>
<th>outgoing charge level [%]</th>
<th>working hours [h]</th>
<th>recovered capacity [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>28</td>
</tr>
<tr>
<td>75</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>16</td>
</tr>
</tbody>
</table>
The table does not take into account the drawing of the auxiliaries additions to the electrical system which, by taking a current depending on the user, removes current in order to charge the battery.

It is reasonable to estimate that according to the table below, relating to important characteristics of the joining between alternator and vehicular mission, it is necessary to ensure a current margin equal to:

- 20% of the battery capacity for missions from 1 to 3 hours
- 15% of the battery capacity for missions from 3 to 5 hours
- 10% of the battery capacity for missions from to 5 hours

This means that a long mission allows to recharge slower and therefore a greater margin for auxiliaries, while short missions require higher current charging or lower auxiliary loads.

### Table 5.26

<table>
<thead>
<tr>
<th></th>
<th>Engine / Mission</th>
<th>4 cylinders / Door To Door</th>
<th>4 cylinders / Urban Distribution</th>
<th>6 cylinders / One Day Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternators</td>
<td>Bosch 70 A</td>
<td>Bosch 90 A</td>
<td>Bosch 70 A</td>
<td>Bosch 90 A</td>
</tr>
<tr>
<td>Total available potential (80 °C) [A]</td>
<td>55</td>
<td>71</td>
<td>16</td>
<td>58</td>
</tr>
<tr>
<td>Potential for recharge and opt (without vehicle consumption) [A]</td>
<td>41</td>
<td>56</td>
<td>15</td>
<td>42</td>
</tr>
<tr>
<td>Max supply at idle speed (80 °C) [A]</td>
<td>47</td>
<td>58</td>
<td>11</td>
<td>40</td>
</tr>
</tbody>
</table>

**Total available potential:** is the hourly current that the alternator can provide if always used at maximum current available to the relative rotating speeds (that is the sum of the max. currents on the mission in an hour)

**Potential for recharge and optional:** is the available potential from which was removed the actual vehicular consumption

**Available potential at idle mode:** is the maximum available current at idle speed

**Example 1**

Vehicle with 143 Ah battery and 70 A alternator, "Door To Door" missions lower at three hours of engine running:

- the available potential is ~55 A and the available potential for recharge and optional is ~41 A
- with engine running for at least 3 hours requires the 20% of 143 = ~28 A for the recharge
- the maximum continuous permit for the optional is given with 41 – 28 = 13 A

**Example 2**

Vehicle with 170 Ah battery and 70 A alternator, "Urban Distribution" missions of approximately four hours of engine running

- the available potential is ~60 A and the available potential for recharge and optional is ~42 A
- with engine running for at least 4 hours requires the 15% of 170 = ~26 A for the recharge
- the maximum continuous permit for the optional is given with 42 – 26 = 16 A

For the vehicle use and absorption with engine stopped higher than the recommended ones, it is necessary to have extra batteries. The high electric load supply (e.g. tail lifts), when the use is frequently (greater than 10 drives a day), requires the use of batteries with min. capacity of 143 Ah and an increased alternator of 90 A.
5.9.2 Current draw points

On EUROCARGO it is not possible to connect additional electrical systems directly to the positive battery pole, as this pole is engaged by cables going to the fuse box.

It is also not possible to draw current from the bulkhead connector, from the lateral lights systems and from the additional fuse box (points A-A highlighted in figure 36).

**Note**  The fuse holder, placed on the side of the battery casing, must not be changed or moved.

The current draw is possible from:

a) connector block;
b) connector 61071;
c) main current switch;
d) main current contactor (if fitted).

**a) Connector block**

![Diagram of connector block]

1. **Cable box**
2. **Additional fuse box**

![Diagram of the fuse box with labeled ports]

**Figure 36**

**A. Current draw points not to be used**

1. **M1. Power supply outlet for starter motor**
2. **M2. Power supply outlet DGC / TGC / Batt.**

**Figure 37**
M3. Fuse box power supply outlet
M4. Outlet at Grid Heater relay
M5. Bodybuilder power supply outlet

The current draw can be performed with the specific terminal M5 specially crafted in the terminal board.

b) 21-pin connector 61071 (brown)
From the 21-pin connector 61071, placed in the electric control unit compartment (under the panel on the passenger side), it is possible to draw current from the pins 11 and 21.

Such current draw is protected by two fuses:

<table>
<thead>
<tr>
<th>FUSE</th>
<th>MAXIMUM LOAD</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>F9</td>
<td>6 A</td>
<td>K30 (pin 21)</td>
</tr>
<tr>
<td>F15</td>
<td>6 A</td>
<td>K15 (pin 11)</td>
</tr>
</tbody>
</table>

For further information please see Chapter 5.2 (⇒ Page 10).

c) Main current switch (DGC)
It is generally located on the battery casing and functions automatically. It is a two-pole switch that disconnects the battery from the chassis, allowing the operation of the tachograph, body computer, cooling unit, bed module and instrument panel.
For special modifications (for example, transport of fuel, transport of dangerous substances), it may be necessary to use a safety switch which completely isolates the batteries and the alternator from the rest of the system.

**Note** Parallel connection is permitted with the output of the switch, provided that the current draw does not exceed 150 A, suitable fuses are used and the necessary precautions are taken. If other draws are in progress, an additional strong one may generate difficulties.
Specific solutions must be authorised by IVECO.

d) Main current contactor (TGC optional)
When the vehicle is equipped with the TGC optional, the draw may be made on the appropriate pin.
In this case you need to remove the protective plastic from the free pin and connect the draw terminal directly to the threaded screw (positive pole), locking it with a suitable nut; the chassis constitutes the return.
To make two or more current draws, interpose a suitable spacer between the draw terminals.
Always protect the cables with a special corrugated pipe and always replace the protective plastic.

**Note** Before drawing any current, read Chapter 5.2 carefully. The drawn current may not exceed the maximum load value as indicated in the Chapter.
5.9.3 Maxifuses and Megafuses
At IVECO Parts there are five fuse holder kids available, to protect high absorption draws. Their positioning must be always performed as close as possible to the draw terminal on the batteries.

![Figure 38](image)

A. Maxifuse
B. Battery case
C. Megafuse

Table 5.28 - Maxifuse

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Reference number of IVECO electrical kit accessories</th>
<th>Fusebox body design number</th>
<th>Cable cross-section</th>
</tr>
</thead>
<tbody>
<tr>
<td>KIT 40 A</td>
<td>4104 0110 KZ</td>
<td>500317518</td>
<td>10 mm²</td>
</tr>
<tr>
<td>KIT 60 A</td>
<td>4104 0111 KZ</td>
<td>500317518</td>
<td>10 mm²</td>
</tr>
</tbody>
</table>

Table 5.29 - Megafuse

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Reference number of IVECO electrical kit accessories</th>
<th>Fusebox body design number</th>
<th>Cable cross-section</th>
</tr>
</thead>
<tbody>
<tr>
<td>KIT 100 A</td>
<td>4104 0112 KZ</td>
<td>500315861</td>
<td>25 mm²</td>
</tr>
<tr>
<td>KIT 125 A</td>
<td>4104 0113 KZ</td>
<td>500315861</td>
<td>35 mm²</td>
</tr>
<tr>
<td>KIT 150 A</td>
<td>4104 0114 KZ</td>
<td>500315861</td>
<td>50 mm²</td>
</tr>
</tbody>
</table>

The fuse must be fastened to the chassis with a tightening torque of 2 ± 0.2 Nm.

5.9.4 Voltage reducer
The electrical system of the vehicle is prepared for the power supply of 12 V devices. In the cab there is a connection with a voltage reducer (from 24 V a 12 V).
Do not power the unit directly by taking 12 V voltage from a single battery.

⚠️ The voltage reducer is arranged for a maximum current absorption of 20 A at a temperature of 30°C (measured in the device compartment on the upper cross member). Therefore, it must not be used if other devices indicate higher absorption.
5.10 MISCELLANEOUS

5.10.1 Additional circuits

> It is strictly PROHIBITED to carry out connections to connectors other than those intended by IVECO.

They must be separated and protected from the vehicle main circuit by means of a specific fuse.

The cables used must be 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 through flexible conduits in the case of a plurality of functions (the use of polyamide type 6 plastic is recommended) 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 passage of these cables through structural components (crossbars, profiles, etc.) must be executed using suitable cable glands or protections; they must be secured separately with insulated cable clamps (e.g. nylon) and at suitable intervals (approx. 200 mm). Do not make any holes in the chassis and/or bodywork for the passage of cables.

In case of external panels, use a specific sealant both on the cable and on the panel to prevent water, dust and fumes from infiltrating.

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 which 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>
<thead>
<tr>
<th>Table 5.23 - Use of cables and fuses according to the current drawn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. continuous current (A)</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>0 – 4</td>
</tr>
<tr>
<td>4 – 8</td>
</tr>
<tr>
<td>8 – 16</td>
</tr>
<tr>
<td>16 – 25</td>
</tr>
<tr>
<td>25 – 33</td>
</tr>
<tr>
<td>33 – 40</td>
</tr>
<tr>
<td>40 – 60</td>
</tr>
<tr>
<td>60 – 80</td>
</tr>
<tr>
<td>80 – 100</td>
</tr>
<tr>
<td>100 – 140</td>
</tr>
</tbody>
</table>

(1) For uses of more than 30 seconds.

(2) Depending on the position and therefore the temperature that may be reached in the housing, choose fuses that can be loaded 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.
- It is necessary to avoid coupling with the signal transmission cables (e.g. ABS), for which preferential routing has been provided in order to meet electromagnetic requirements (EMI).
  It should be noted that when grouping several cables together, in order to compensate for lower heat dispersal capacity, the current intensity must be reduced with respect to the nominal value of a single cable.
- In vehicles with frequent engine start-ups, with limited current drawn and engine rotations (e.g. vehicles with refrigeration chambers), provide for periodic battery charging to maintain efficiency.
- 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.
- In the event that a component has to be installed just next to the route of a cable belonging to the original system, make sure that its remains integral and avoid any cuts.

Any damage caused by failure to comply with procedure is not covered by warranty.

5.10.2 Interventions for modifying wheelbase and overhang

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

5.10.3 Installation of lateral side lights (Side Marker Lamps)

EC regulations require that vehicles are provided with side and clearance lights when the total length exceeds 6 m.

The installation of the lateral lights must be performed on the additional structures (containers, vans, etc.), while the electric power supply must be obtained by the specific 61069 connector on the chassis (see Figure 39) is requested.

Note  It is not possible to draw current from side marker lights.
Table 5.31 - Basic functions of connector 61069

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground</td>
<td>0000</td>
<td>10 A</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Side lights left sides</td>
<td>3332</td>
<td>5 A</td>
<td>MET P-A07</td>
<td>+24V = Daylight running lights on signal, when: (1) K15 OFF and parking lights on K15 ON and parking/high beam/low beam lights on</td>
</tr>
<tr>
<td>3</td>
<td>Side lights right sides</td>
<td>3331</td>
<td>5 A</td>
<td>MET P-A08</td>
<td>+24V = Daylight running lights on signal, when: (2) K15 OFF and parking lights on K15 ON and parking/high beam/low beam lights on</td>
</tr>
<tr>
<td>4</td>
<td>K15</td>
<td>8869</td>
<td>10 A</td>
<td>MET P-C01</td>
<td>K15</td>
</tr>
</tbody>
</table>

(1) If the maximum current is exceeded:

- the output signal is deactivated
- an MUX 0x26D55 FMI 0x06 error is generated
- The interior lights of the vehicle, the left side lights and the rear right lights switch off

The error and the output signal are reset at the next K15 cycle.

If this is not acceptable, the Bodybuilder must limit the maximum current, for example with the addition of a fuse on the Bodybuilder wiring.

(2) If the maximum current is exceeded:

- the output signal is deactivated
- an MUX 0x26D51 FMI 0x06 error is generated
- The interior lights of the vehicle, all the side lights and both rear lights switch off (the rear fog light can be activated)
5.10.4 OBD socket
When creating a specific cab interior, for example Camper or Bus versions, the OBD socket (On Board Diagnosis, code 72069) must be kept in or close to the position established for trucks.
This position corresponds to the dashboard centre distance, below the air vent on the passenger side and behind trim panel.
The need to ensure maximum accessibility and appropriate information in this regard must be highlighted.

5.11 SPECIFICATIONS FOR VERSIONS DERIVED FROM THE "COWL" VEHICLE

When creating a specific cab interior, for example Camper or Bus versions, the OBD socket (On Board Diagnosis, code 72069) must be kept in or close to the position established for trucks.
This position corresponds to the dashboard centre distance, below the air vent on the passenger side and behind trim panel.
The need to ensure maximum accessibility and appropriate information in this regard must be highlighted.

Electronic safety devices

Note: It is recommended that the following information is integrated with information provided in the Use and Maintenance in terms of the detail of the features of the systems described, the operating modes and restrictions.

5.11.1 Radar sensor
The radar sensor is installed in the centre of the front bumper of the vehicle. It takes various measurements and integrates the data with the following safety systems of the vehicle:

- AEBs emergency braking (Advanced Emergency Braking System)
- ACC speed control system (Adaptive Cruise Control)

The main function of the radar sensor is to perform ensure constant monitoring of the following:

- the distance from vehicles in front, according to the value set by the driver
- detection of obstacles on the road to allow activation of a gradual alarm, partial braking or complete braking

The device is not anticipated for 4x4 vehicles.

Since the device carries out essential processing procedures for safety, installation and calibration procedures are needed which can only be performed by IVECO during the first equipment: Post-sales installation is not permitted.

For compliance with the operating conditions specified in planning and design, the need to not modify the following must be highlighted:

- orientation of the radar;
- inclination of the radar equal to ±3° on the horizontal reference plane with the vehicle outfitted;
- the area in front of the output cone of the radio waves, which must be free of any obstacles;
- the material the shape and the dimensions of the protective cover, which must be without exception those provided (see the diagrams in Figure 41 and Figure 42);
• the integrity of the protection cover (no painting, tape, etc.).

Please note that:

a) after any interventions on the engine concerning or involving the bumper, the radar sensor must be repositioned based on the following indications:

<table>
<thead>
<tr>
<th>Axles</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min [mm]</td>
</tr>
<tr>
<td>Z (distance from the ground)</td>
<td>+ 330</td>
</tr>
<tr>
<td>X (distance from the front axle)</td>
<td>+ 1000</td>
</tr>
<tr>
<td>Y (distance from the centreline of the vehicle)</td>
<td>- 10</td>
</tr>
</tbody>
</table>

b) the vehicle fastening system significantly affects the vibrational behaviour of the radar sensor; therefore the following must be observed

**Specification ISO 16750-3:2012 (Resistance to mechanical stresses)**

![Graph showing PSD vs frequency]

- standard random test profile
- additional profile in case of $f_0 < 30$ Hz

<table>
<thead>
<tr>
<th>Table 5.33</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency [Hz]</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>30</td>
</tr>
</tbody>
</table>
The vibrations must remain within half of the maximum PSD value (Power Spectral Density) indicated in figure 40.

Since the PSD is considered up to 2,000 Hz, a sampling frequency of at least 5,000 Hz is required (please note that due to the "roll-off" of the anti-"aliasing" filter, sometimes higher sampling frequencies are appropriate, such as 10 kHz with 3 kHz anti-"aliasing" filter).

The accelerations must be verified with the accelerometers positioned close to the fastening points of the radar sensor.

c) The output cone of the radio waves may be altered:

- any obstacle on the bumpers in the area in front of the radar;

**Note** The possibility of applying a snow plough blades must be evaluated on the basis of the country in which the vehicle is to be used.

- by damage to the radar fastening bracket or damage behind the tubular cross beam (for example, impacts, collisions);
- by poor refitting of the bumpers after they have been removed or replaced;
- by excessive vibrations of the bumpers, if a bumper other than standard bumpers are used.

Below are the diagrams relating to the only positions that the radar protection cover can have on the bumper when the outfitting is complete.

These diagrams refer to the plastic cover, the only one which is provided for a cowl vehicle.

---

**Table:**

<table>
<thead>
<tr>
<th>Frequency [Hz]</th>
<th>PSD (Power Spectral Density) [(ms²)/Hz]</th>
</tr>
</thead>
<tbody>
<tr>
<td>180</td>
<td>1</td>
</tr>
<tr>
<td>2000</td>
<td>1</td>
</tr>
</tbody>
</table>

Average acceleration value = 57.9 m/s²
⚠️ The dimensions must be strictly observed.

⚠️ After having positioned the radar, the system must always be recalibrated; this operation can only be carried out by the IVECO Service Network.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Cable colour code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power supply +15</td>
<td>8879</td>
</tr>
<tr>
<td>2</td>
<td>Power supply +15</td>
<td>8879</td>
</tr>
<tr>
<td>3</td>
<td>Spare</td>
<td>–</td>
</tr>
<tr>
<td>4</td>
<td>can h line</td>
<td>Gn</td>
</tr>
<tr>
<td>5</td>
<td>Spare</td>
<td>–</td>
</tr>
<tr>
<td>6</td>
<td>Spare</td>
<td>–</td>
</tr>
<tr>
<td>7</td>
<td>can l line</td>
<td>Wh</td>
</tr>
<tr>
<td>8</td>
<td>Ground</td>
<td>0000</td>
</tr>
</tbody>
</table>

Table 5.34 - ACC / AEBS radar control unit pinout
5.11.2 LDWS (Lane Departure Warning System)

The lane departure warning system (LDWS) monitors the position of the vehicle in relation to the road markings and, if there is an involuntary deviation from the theoretical direction, is able to activate a specific acoustic signal.

The system uses the images from a camera/sensor positioned at the centre of the dashboard and affixed on the inside of the windscreen (see Figure 47).

The acoustic signal may be emitted by the cluster (basic version) or from the speaker on the side of the lane which has been exceeded (optional version).

In the case of cowl vehicles:

- The camera and the speakers are supplied loose, in a dedicated kit;
- The installation of a radio in "aftermarket" requires connection of the "mute" function port to the camera as indicated in the diagram in Figure 48;
- Installation of a 12 V radio requires a 24 V adjustment device for the camera;
- Programming, calibration and camera test, as well as the programming of the acoustic signal can only be carried out by the IVECO Assistance Service.

**Note** If the windscreen is replaced, calibration of the camera and verification of all system operating parameters must be carried out once again (this can only be done by the IVECO Assistance Service and requires payment).

a) Positioning the camera

- The inclination of the camera, set by the operating specifications, must be strictly observed, even in the case of outfittings which include a windscreen with an inclination which is different from normal production.

For correct operation ("artificial view"), the camera must be positioned on the windscreen so that:

- The vertical axis is on the centre line of the vehicle, with a tolerance of ± 10 mm;
- the lens is at a height "z" from the ground (Fig. 44) established during design and planning (1810 - 1850 - 1900 - 2010 - 2050 - 2290 mm), with a possible tolerance of +/- 50 mm.

The selected installation height must be used when programming the camera.

If the camera is to be positioned at a different height from the previous one, approval must be provided by IVECO and specific programming must be carried out.
the rotation angles around the reference axis (see Figure 45) have the following values:

- compared to axis x: \(-1^\circ \leq \text{roll angle} \leq 1^\circ\),
- compared to axis y: \(-1^\circ \leq \text{pitch angle} \leq 1^\circ\),
- compared to axis z: \(-1^\circ \leq \text{yaw angle} \leq 1^\circ\).

In particular, with regards to the pitch angle, it should be noted that:

- The ECU of the LDWS device (1) must be installed complete with the "bracket" (2), the front side of which is tilted 14° from the vertical.

1. LDWS device electronic control unit
2. Bracket (P/N: 5802187075)

- The presence of the bracket means that the inclination of the windscreen (α) in relation to the horizontal is between 71° and 80°.
- If, due to the cab construction, the inclination of the windscreen exceeds 80°, a spacer must be placed between the bracket and the windscreen, the shape of which must allow the pitch angle of the camera to be kept within the limits indicated above (from -8.5° to 0.5°) and, therefore, the β angle to remain between 10° and 19°.
A. Windscreen inclination (α) less than 73°
B. Windscreen inclination (α) between 73° and 77°
C. Windscreen inclination (α) greater than 77°

1. Bracket
2. Windscreen
3. Spacer

b) Precautions
To prevent condensation on the camera lens, there must be sufficient air circulation in the space between the lens and the windscreen. The mount provided by IVECO includes ventilation channels which are lapped by a flow of air from the base of the windscreen: These channels must never be blocked.

c) Pinout

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Cable colour code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power supply +15</td>
<td>8879</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
<td>0000</td>
</tr>
<tr>
<td>3</td>
<td>Power supply +15</td>
<td>8879</td>
</tr>
<tr>
<td>4</td>
<td>CAN line H - VDB</td>
<td>White</td>
</tr>
<tr>
<td>5</td>
<td>CAN line L - VDB</td>
<td>Green</td>
</tr>
<tr>
<td>6</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Table 5.35 - LDWS pinout
## 5.11 Specifications for versions derived from the "cowl" vehicle

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Cable colour code</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>8</td>
<td>Signal from the switch for the deactivation of the LDWS system</td>
<td>8896</td>
</tr>
<tr>
<td>9</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>10</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>11</td>
<td>Deactivated LDWS system signalling warning light negative</td>
<td>6700</td>
</tr>
<tr>
<td>12</td>
<td>&quot;Mute&quot; signal from the LDWS control unit to radio</td>
<td>1632</td>
</tr>
<tr>
<td>13</td>
<td>Positive for left speaker</td>
<td>1286</td>
</tr>
<tr>
<td>14</td>
<td>Negative for left speaker</td>
<td>1288</td>
</tr>
<tr>
<td>15</td>
<td>Positive for right speaker</td>
<td>1284</td>
</tr>
<tr>
<td>16</td>
<td>Negative for right speaker</td>
<td>1283</td>
</tr>
</tbody>
</table>
SECTION 6

ADBLUE AND
SCRT SYSTEM
Contents

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ADBLUE AND SCRT SYSTEM (only diesel versions)

6.1 GENERAL INFORMATION

To comply with Euro VI requirements on engine gas emissions, IVECO has developed the "Hi-SCR" system (High-efficiency Selective Catalytic Reduction), consisting of the combined action of a diesel particulate filter (DPF) and post-treatment of exhaust gases (SCR). This post-treatment requires the use of an additive, commercially known as AdBlue (urea solution+water).

6.2 THE NITROGEN OXIDE CATALYTIC REDUCTION PRINCIPLE

The additive AdBlue, is sent from a dedicated tank by means of a SM (Supply Module) to a DM (Dosing Module) which injects AdBlue into the exhaust pipe. The mixture of exhaust gas and additive is then fed to the catalytic converter and chemically transforms NO\textsubscript{x} into nitrogen and water, harmless to the environment.

![Diagram of AdBlue and SCR system]

1. Diesel Oxidation Catalyst
2. Diesel Particulate Filter
3. Selective Catalytic Reduction
4. Clean Up Catalyst
5. Dosing Module
6. Temperature sensors
7. DPF \textit{Δp} sensors
8. NO\textsubscript{x} sensors
9. PM sensor
10. Mixer

**DOC** (Diesel Oxidation Catalyst): to oxidise the exhaust gas components through the use of oxygen.
**DPF** (Diesel Particulate Filter): to eliminate the particulate before the SCR through passive regeneration.
**SCR** (Selective Catalytic Reduction): to reduce the NO\textsubscript{x} through the injection of AdBlue.
**CUC** (Clean Up Catalyst): to eliminate the ammonia residue (NH\textsubscript{3}) so as to satisfy legal requirements.
6.3 INSTRUCTIONS

The materials and layouts of normal IVECO production are specifically approved; all other circumstances of variation must be specifically authorized.

If changes are made to the chassis which also involve the AdBlue system, the following criteria must be observed:

- all post-treatment components must be installed under extremely clean conditions;
- the protection caps of the SM, DM and the AdBlue pipe bundle may only be removed just before assembly;
- the SM and DM fittings must be handled with care;
- the SM and DM fastening screws must be tightened to the torque specified in the relevant assembly diagrams;
- the seal of the DM flange on the ATS side must be replaced each time the DM is disassembled (the seal may only be used once);
- the "after-run" phase must not be interrupted using the battery manual switch or the ADR switch (the AdBlue pipes must always be emptied to prevent any crystallization or damage from freezing);

6.3.1 AdBlue tank

50, 60, 80 and 145 litres tanks are available depending on the required capacity.

Since the AdBlue solution may be corrosive for ferrous steels, any specifically shaped tanks must be made out of polyethylene or stainless steel (code 1.4571 - 1.4541 - 1.4112 - 1.4310 - standard DIN 17440).

At the end of any operations which involve the AdBlue tank, make sure that:

- the tank ventilation pipe is not closed;
- AdBlue is present in 10% of the volume;
- the AdBlue does not exceed the maximum volume indicated by the level sensor, even if additional volume is anticipated due to the expansion of the solution in the case of freezing.

6.4 MOVING ADBLUE SYSTEM COMPONENTS

In order to comply with Euro VI requirements, the positioning of the main components of the AdBlue system has been optimised.
1. Pumping module (SM)
2. Dosing module (DM)

A. Water inlet/outlet fittings
B. AdBlue intake and return coupling
C. AdBlue pressure line fitting to DM
D. AdBlue delivery union
E. Electrical connector

In particular, the SM (Pumping Module) and the DM (Dosing Module) have been inserted into the AdBlue tank and silencer respectively (see figure 2), giving benefits in terms of space and reduced length of pipes (better pressure stability).
6.4 MOVING ADBLUE SYSTEM COMPONENTS

Figure 3 shows the essential distances which define the standard position of the aforementioned components. With optional 75435, these can be fitted in a rear position during vehicle production.

**Note**  All modifications must be authorised by IVECO.

### 6.4.1 Moving the tank

- **vertically:**

  The AdBlue tank can be moved provided that the new height of the SM module, to which it is secured, continues to comply with the conditions outlined in Figure 4.

  The position of the DM module is subject to that of the silencer/muffler assembly.

- **horizontally:**

  The AdBlue tank can be moved provided that the pipe between the SM and DM does not exceed 3000 mm in length.
1. AdBlue tank
2. Pumping module (SM)
3. Dosing module (DM)
4. Siphon

A < 1000 mm
B < 1000 mm
C > 0
S ≥ 10 mm

**Note** The dimension (A) is to be considered as fixed as the SM is integrated into the AdBlue tank.

In the diagram shown in the Figure 6, it can be seen that the pipes provide an adequate siphoning system in order to prevent any damage due to possible AdBlue freezing.

The siphon should have an internal collection volume of 12 cm³ and is to be located below the reference distance of the DM (for example S = 10 mm).

**Note** After moving the AdBlue tank, contact the IVECO Service Network for the management software update of the relative system.

### 6.4.2 Moving the muffler

- **vertically:**

  Height increases of up to 100 mm are permitted compared to the original installation distance.

  Since sufficient air circulation around the muffler must be ensured, there must be a distance of at least 80 mm between its upper surface and the superstructure.

- **horizontally:**

  Retractions are permitted which do not involve changes in the original trend of the exhaust gas temperature in the pipes connecting to the engine.

  The subsequent lengthening of this pipe must be carried out at the centre so as not to change the position of the sensors.
The new pipe must be installed so that between each end there is no loss of gas temperature greater than 15 °C (relating to ambient \( T = 25 \) °C, engine speed = 1200 rpm and engine with full load). There must also be suitable cladding since the better the insulation, the greater possibility there is for repositioning of the muffler.

![Diagram](image)

**Figure 5**

1. material in HTS fibre glass
2. ceramic fibre
3. external covering
4. total thickness of insulating material [mm]

Figure 5 shows the structure of the material to be used for insulation. The essential features of this are:

- stability at temperature: 550 °C
- heat conductivity at 500 °C: 0.125 W/mK

### 6.4.3 Interventions on cables and pipes

**a) Electrical cables**

- It is only possible to lengthen cables relating to the temperature sensors, AdBlue heater and AdBlue level
- it is forbidden to alter the length of the NOx sensor cables. If it is in no way possible to leave these cables unchanged, IVECO must be contacted and the indications provided must be followed.

**b) AdBlue pipes and heating water pipes**

the adoption of flexible materials allows not only interventions for lengthening or shortening but also interventions for bending.

**Note**  
*In order to limit the loss of load, only one lengthened stretch is allowed per pipe.*

**Note**  
The pipes may be modified using specific equipment and couplings; to select and obtain these parts, contact the IVECO Assistance Service.
To change the length of the pipes (PA NS6 or EPDM NS4 for AdBlue and PA NS 10 corrugated or smooth for coolant):

- ensure that the fittings indicated in Figure 6 are available;
- mark the delivery and return pipes before separating them to ensure there is no confusion during subsequent reassembly;
- cut the pipes with the appropriate pipe cutting clippers in order to ensure an accurate cutting area;
-insert the aforementioned fittings in the sections obtained from the cut, using the designated tools indicated in Figure 7.

⚠️ It is compulsory to work in a completely dust-free environment to prevent dust from reaching the injectors and subsequently clogging them.

---

**Figure 6**

1. T fitting for water pipes
2. Female fitting for water pipes
3. Fitting NS6 for AdBlue pipes
4. Fitting NS10 for water pipes
5. Fitting NS4 for AdBlue pipes

---

**Figure 7**

- a. Supports for fittings NS6 for AdBlue pipes
- b. Supports for fittings NS10 for water pipes
- c. Tool for inserting the T fitting
- d. Tool for inserting the female fittings
APPENDIX A

CNG -
NATURAL POWER
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CNG - NATURAL POWER

A.1 GENERAL INFORMATION

Note  The instructions provided in this Appendix do not exclude the need to also refer to those of the "Use and Maintenance Manual" and the "Services Manual".
Any additional information must be requested from the IVECO Assistance Service.

Natural gas is a mixture consisting mainly of methane (main component), ethane, propane, carbon dioxide and nitrogen.
To be used as fuel for vehicles, this mixture is compressed, hence the name CNG (Compressed Natural Gas / operating pressure up to 200 bar).
This version differs from the diesel version in terms of the specific solutions applied to the engine, particularly for the electronic management and the presence of the cylinders.
The increased level of technical complexity must therefore be taken into consideration when studying the conversion to be made to the vehicle and when implementing the relevant changes.

Note  Interventions on the engine power supply system which:
  a) use components other than original parts (even if type-approved as Separate Technical Unit) or
  b) modify the original architecture (movements or addition to cylinders, changes to the retainer types, etc.)
require prior approval from IVECO and require type approval of the vehicle to be repeated in compliance with Regulation ECE R110.
All the subsequent activities (planning, tests, documentation etc.) are charged fully to the Bodybuilder.

A.2 SAFETY REGULATIONS

Please carefully read the same chapter in the Use and Maintenance Manual provided with the vehicle.

A.3 MAIN COMPONENTS

A.3.1 Ventilation valve

Downstream of the CNG cylinder units, there is a manual cock for maintenance operations if partial or full emptying of the high pressure system section is required.

A.3.2 Shut-off valve

Upstream of the pressure gauge some versions have a manual valve which must be closed before carrying out any kind of maintenance operation on the components downstream.
A.3.3 Safety solenoid valve (CNG)

Each cylinder is fitted with a valve assembly consisting of the following devices:

- Manual closure for maintenance and shut-off;
- One-way solenoid valve served by the ignition key which interrupts the flow entering the cylinder; so the load must be carried out with non-powered valves;
- the flow relief valve intervenes in the event of a sudden change in pressure, significantly limiting the outward flow of gas from the cylinders (for example if a pipe breaks);
- the fusible plug (T-PRD) which in the event of a fire melts at 110 ± 10 °C and allows the gas to exit directly into the external environment, preventing the cylinder from exploding;
- the safety valve to control the pressure (P-PRD), with an opening threshold of 340 bar.

Note Safety valves are not interchangeable and the respective orientation must not be modified.

A.4 REQUIREMENTS

A.4.1 General requirements

Note If extending or shortening the wheelbase length from a type-approved length to a type-approved length, authorisation from IVECO is not necessary if the gas system remains unchanged in terms of layout and position on the chassis.

If changing the configuration or layout, authorisation is required even if one of the possible type-approved alternatives is to be used. The modifications must only be made by specialised personnel, working in authorised and certified workshops.

- Before any intervention, fully discharge the gas present in the pipes. This is possible by implementing the "Partial emptying" procedure (see Chapter A.5).
- Parts must be kept perfectly clean, and care must be taken to ensure that no sediment or foreign bodies can enter during handling operations.
- Pay particular attention to the direction of installation of all electrical connections.

Note All threaded connections must be tightened to the correct torque for special components for the first equipment: the values can be found in the Service Manual.

Note Washers, conical washers, self-locking nuts and gaskets are of the special type and contribute to the tightening efficiency via a deformation; therefore, before reassembly, these parts must be replaced.

- Regardless of the reason for the disassembly, the power fuel system components (in particular, the valves on the cylinders) must be replaced.
After any intervention on the high pressure section of the CNG system, a TEST must be carried out to ensure there are no GAS LEAKS at 200 bar. The test can only be carried out at a Centre specifically enabled for this task. A Test Certificate is issued following a positive result.

Check if local Regulations and the competent Authorities allow vehicles running on CNG to be parked in closed areas (for example, workshops) and that these areas are certified and authorised.

A.4.2 Special requirements

a) Repainting the outfitted chassis

Note As well as the indications provided in Chapter 2.3 PROTECTION AGAINST RUST AND PAINTING (⇒ Page 11) and especially page 13 of that Chapter, please note that it is also necessary to follow the indications provided by Regulation ECE R110 and any additional regulations of the individual country/market.

The following must be protected from paint:

- the stainless steel pipes of the gas supply system
- the pipe connection fittings
- the hose from the pressure reducer to the rail on the engine
- the solenoid valves and the relative coils on the gas cylinders
- the gas system pressure reducer
- the identification plates

Note The CNG tanks must be emptied; they must also be cleaned with nitrogen if the temperature in the painting booth exceeds 40 °C (maximum permitted temperature 60 °C).

b) Protection against high temperatures

Use suitable heat guard screens if high temperatures are anticipated (> 70 °C) with the subsequent risk for pipes, electrical cables, synthetic materials, etc.

If the vehicle conversion vehicle requires the engine exhaust gas pipe to be positioned vertically behind the cab, consideration must be given to the fact that the temperatures of the gas may exceed 800 °C and therefore this pipe must be kept at a distance of at least 50 mm from the ECU control units.
A. Contact temperatures
B. Air temperatures

- The distance between the exhaust pipe and front wheel arches must always be greater than 30 mm.

c) Cylinders
Always keep a safe distance between the outfitting and the solenoid valves to allow the solenoid valves to open/close correctly and to allow for maintenance operations to be carried out: the minimum recommended distance is 200 mm.

- The gas tank must be at a minimum height of 200 mm from the ground to ensure compliance with Regulation ECE R110.
Use suitable heat guard screens if high temperatures are anticipated (> 70 °C) with the subsequent risk for pipes, electrical cables, synthetic materials, etc.

The breather valves are essential for the safe operation of the system and therefore must always be accessible. Please read the Use and Maintenance Manual carefully for all indications in this regard.

d) ATS system (After Treatment System)
The insulators and the heat shields must remain in their original position. Any modification must receive prior authorisation from IVECO.

e) Gas pipes
Any modification of the pipes must be compliant with Standard ECE R110 and all the components must be type-approved according to ECE R110.

Lengthening the pipes may have a negative impact on performance due to reduced injection pressure.
Do not reposition components of the gas system such as the regulator, sensor or filter without having received explicit authorisation and approval from IVECO.

- For reasons of safety, both when outfitting and during maintenance, it is strictly prohibited to use the gas pipes as a support for other pipes.
- In some situations of limited space, it is permitted to secure some electric cables (using collars) to the gas pipes, provided they serve only as a guide and not as a support.
- During these operations, pay careful attention to ensure that the pipes are not damaged in the process and remain free of any scratches, markings or deformation. Protect the pipes if necessary.
- When a gas pipe passes through the chassis side member, make sure that the rubber bulkhead connector is not dislodged in any way and is perfectly coaxial with the hole on the chassis.

It is strictly prohibited to modify the diameter of the gas pipes.

B.5 EMPTYING THE GAS CIRCUIT

Note Contact the IVECO Service Network before carrying out any intervention.

Before any welding operations on the vehicle or maintenance operations on the engine, the fuel system must be fully "ventilated", i.e., it must be emptied of gas.

It is usually sufficient to partially empty the circuit, namely, empty only the pipes; however, to operate in conditions of greater safety, it is recommended that the entire system is emptied, including the cylinders.
The emptying operations must be carried out while the engine is OFF and in an environment with suitable air exchange (a forced air exchange is preferable).

To limit the release of uncombusted gas as much as possible, keep the engine running until the pressure of the gas drops to the minimum value of 20 bar.

Note Consumption of the gas at a residual pressure of 20 bar is a procedure which is less harmful to the environment than releasing the gas directly into the atmosphere.

1. Guard
2. Cylinder shut-off and safety solenoid valve
3. Ventilation valve
4. Filler neck on ventilation valve
5. Pressure gauge
A. 5.1 Partial emptying

This operation only guarantees ventilation of the system downstream of the gas cylinders.

- Prepare a rubber hose which is compatible with the gas and is of a suitable diameter for coupling with the filler (4, Figure 1) on the ventilation valve (3, Figure 1).
- Leave one end of the rubber hose at least 5 m from the cylinders and from any possible sources of flame; position the other end close to the ventilation valve.
- Cut off power supply by turning off the main current contactor.
- Disconnect the battery cables and electrically ground the vehicle.
- Check that all the cocks of the solenoid valves (2, Figure 1) on the cylinders are closed.
- Introduce the hose (compatible with the gas) on the ventilation valve filler (4, Figure 1) leaving the other end of the pipe at a distance of at least 5 metres from the cylinders and possible sources of flame.
- Slowly open the ventilation valve (3, Figure 1) to prevent the sudden decompression of the gas and the corresponding effects (freezing).
- After a few minutes, check that the pressure in the system is null.

A.5.2 Emptying fully

After partially emptying the circuit, emptying fully involves ventilating the cylinders by extracting the mobile equipment of each shut-off valve as described below.

Before performing this operation:

- Perform the partial emptying operations described in the previous paragraph.
- Remove the guard (1, Figure 1) from each cylinder assembly.
- Close the ventilation valve (3, Figure 1).
- Check that all the cocks of the solenoid valves (2, Figure 1) on the cylinders are closed.

- Disconnect the electrical connection from the coil.
- Unscrew the external nut of the coil (1) with the corresponding O-Ring (2).
- Using a screwdriver (1), immobilise the threaded pin (4). Using a wrench (2), remove the nut (3) to secure the coil (5).
- Remove the coil (5) from the shaft (6).

- Extract the spring washer.

⚠️ There is a small amount of highly pressurised gas in the valve. In order to lower the pressure slowly, unscrew the ring nut (2) of the coil shaft (1).

- If there is no pressure, fully remove the coil shaft (1) with the corresponding O-Ring.
• Remove the piston (3) with the shutter (4) and the spring (2) from the coil shaft (1).
• Screw the empty coil shaft back in with its O-Ring and tighten the ring nut.
• Repeat the previous operations for all the shut-off valves of the cylinders.
• Partially open the cocks of the solenoid valves (2) on the cylinders (see Figure 1).

⚠️ This allows the pressurised gas to enter the pipes which were previously emptied: take maximum care.

• Slowly open the ventilation valve (3, Figure 1).

After emptying, ensure that the engine cannot be started.

### A.5.3 Restore the fittings after having disconnected / replaced a pipe

• Check intactness of unions and ferrules.
• Insert the end of the pipe into the union seat. To avoid pre-tensioning, always check the alignment of the end of the pipe with the union.
• Fit and manually screw in the nut of the union until the two sealing caps are packed. Mark the position of the nut with respect to the union body in this point.
• Tighten with the wrenches, turning the nut by half turn. This wedges the second ferrule under the first one, tensioning the sealing assembly.
• Fit the securing brackets, making sure not to stress the pipe.

⚠️ Before restoring system operation, the HYDRAULIC SEAL TEST must be carried out at a specialised Centre.
A.6 BODYBUILDER CONNECTORS

Note  The basic functions of the Bodybuilder connectors are the same as those described in Section 5 - Chapter 5.2 (Page 10) for vehicles with diesel engines.

A.7 POWER TAKE-OFF MANAGEMENT

A.7.1 Installation of the power take-off (PTO)

The PTOs available for diesel engines are also suitable for CNG engines, with the exception of the Multipower PTO on the fly-wheel.

However, while it is possible to take torque from the driveline and the front part of the engine, take off from the gearbox is more appropriate and for this, the indications provided in Chapter 4.2 (Page 7) are valid.

Take into account that the PTO models for CNG tested by IVECO are those indicated in the following table.

Table A.1 - PTO on gearbox tested by IVECO

<table>
<thead>
<tr>
<th>Gearbox</th>
<th>PTO type (opt. no.)</th>
<th>Fitting position</th>
<th>Direction of rotation</th>
<th>Transmission ratios</th>
<th>TORQUE (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9S 75 TO</td>
<td>5047</td>
<td>Rear right</td>
<td>Anticlockwise</td>
<td>0.92</td>
<td>410</td>
</tr>
<tr>
<td></td>
<td>5205</td>
<td>Central rear</td>
<td>Clockwise</td>
<td>0.62</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>5210</td>
<td>Lower rear</td>
<td>Anticlockwise</td>
<td>0.79</td>
<td>430</td>
</tr>
<tr>
<td>S2500</td>
<td>14978</td>
<td>Left side</td>
<td>Anticlockwise</td>
<td>0.82</td>
<td>270</td>
</tr>
<tr>
<td>S3000</td>
<td>14979</td>
<td>Left side</td>
<td>Anticlockwise</td>
<td>0.93</td>
<td>600</td>
</tr>
</tbody>
</table>