## 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Data and information contained in this publication may be outdated as a result of changes adopted by IVECO, at any time, for technical or commercial reasons or due to the need to adapt the vehicle to new legal requirements.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>
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<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>
</tr>
<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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NOTE Indicates an additional explanation for a piece of information.
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SECTION 1

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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:

- Directives for transformation and fitting of vehicles;
- technical specifications;
- truck diagrams;
- tractor 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 outfittings included in these Directives and carried out in compliance with the instructions provided do not require a 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 stabiliser bars and suspensions;
- modifications to the cab, cab mounts, locking and tilting devices;
- modifications to intake, engine exhaust and SCR components;
- applications of retarders;
- power take-off applications;
- variations in tyre measurements;
- modifications to hook organisms (hooks, fifth wheels).
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.

The Bodybuilder will be responsible for obtaining final approval from the competent authority for completed operations.

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 municipal/autonomous/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, ONU/Geneva 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 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 first-stage manufacturer, while the bodybuilder is defined as Second-stage manufacturer or that of the next stage.
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,
   - reattainment 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 GUARANTEES

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 guarantee 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 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.
1.9 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 required, is considered very important by IVECO.

1.10 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 manufacturer 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.

1.11 CHOICE OF MATERIALS TO USE: ECOLOGY - RECYCLING

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

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

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 expenses for carrying out these operations are borne by the owner of the vehicle in 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.

Delivery of the vehicle to the final customer
Before delivering the vehicle, the Bodybuilder must:

- calibrate its production (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 in the IVECO network;
- check alignment, toe-in and height of the front suspensions on the basis of IVECO reference values;
- adjust the headlamps according to the instructions provided in the "Use and Maintenance Manual";
- measure the battery voltage with a digital multimeter (2 digit decimal), keeping 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 the Customer/Dealer 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;
- on a designated plate, note down the characteristic data of the additional assemblies and the precautions to be taken when they are in operation;
- 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.

Type approval name

EUROCARGO MLC 120E 19 /P

- **EUROCARGO** – Vehicle name
- **MLC** – Cab type

<table>
<thead>
<tr>
<th>Cab Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>MLC</td>
<td>Short cab</td>
</tr>
<tr>
<td>MLL</td>
<td>Long cab</td>
</tr>
<tr>
<td>MLD</td>
<td>Double cab</td>
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</tbody>
</table>

- **120** – Gross mass - GWW Cabs (no./10 = weight in t)

<table>
<thead>
<tr>
<th>Gross Mass</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>I10</td>
<td>4x2 - 4x4 trucks</td>
</tr>
<tr>
<td>I20</td>
<td>4x2 trucks</td>
</tr>
<tr>
<td>I40</td>
<td>4x2 trucks</td>
</tr>
<tr>
<td>I50</td>
<td>4x2 - 4x4 trucks</td>
</tr>
<tr>
<td>I60</td>
<td>4x2 trucks</td>
</tr>
<tr>
<td>I80</td>
<td>4x2 trucks</td>
</tr>
<tr>
<td>I90</td>
<td>4x2 trucks</td>
</tr>
</tbody>
</table>

- **E** – Range code

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Standard chassis height</td>
</tr>
<tr>
<td>EL</td>
<td>Optimal chassis height</td>
</tr>
</tbody>
</table>

- **I9** – Engine power (no. x 10 = power in HP)
- **/ P** – Version

<table>
<thead>
<tr>
<th>Version</th>
<th>Description</th>
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<tbody>
<tr>
<td></td>
<td>Rear mechanical suspension</td>
</tr>
<tr>
<td>P</td>
<td>Rear air suspension</td>
</tr>
<tr>
<td>FP</td>
<td>Front and rear pneumatic suspensions</td>
</tr>
<tr>
<td>R</td>
<td>Towing vehicles</td>
</tr>
<tr>
<td>D</td>
<td>Dual cab (6+1) with mechanical suspension</td>
</tr>
<tr>
<td>D/P</td>
<td>Dual cab (6+1) with rear air suspension</td>
</tr>
<tr>
<td>K</td>
<td>Tipping body pre-fitting</td>
</tr>
<tr>
<td>DK</td>
<td>Twin cab with tipping body pre-fitting</td>
</tr>
</tbody>
</table>
1.14 TRADemarks and symBoles

Logos, identification tradenames 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 tradenames or logos.

IVECO reserves the right to withdrawing its tradenames and logos if the above requirements are not met.

1.15 DIMENSIONS AND GROUND

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.

Weighing of the chassis

It should be noted that variations are possible on the masses of the order of 5%.

For this reason, before carrying out the fitting, it is a good idea to determine the mass of the cab vehicle and its distribution on the axles.

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 rear-view mirrors, normally set for widths of 2550 mm, is also suitable for special superstructures, 2600 mm wide (e.g. mini-vans).

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

To determine the position of the centre of gravity of the superstructure and the payload, you can proceed according to the examples given below.

On the technical documentation for each model (cab version diagram), you can see the positions allowed by the vehicle in the standard version. The masses and the positioning of the individual components of the vehicle are shown on the chassis and weight allocation diagram.
Example to determine the placement of the centre of gravity of the payload plus superstructure (Vehicle with 2 axles; vehicles with 3 axles having equal loads on two rear axles)

\[
\begin{align*}
W &= \text{Payload plus superstructure} \\
W_1 &= \text{Measurement of payload on front axle} \\
W_2 &= \text{Measurement of payload on rear axle (or tandem)} \\
L_1 &= \text{Distance of centre of gravity from the centre line of the rear axle (or tandem centre line)} \\
L &= \text{Actual wheelbase}
\end{align*}
\]

**Note** For vehicles with three or more axes, with variable ratio of the distribution of the masses on the two rear axles depending on the load, the “virtual” value of the wheelbase and the centre line between the axes must be determined for the respective load condition realized, using the instructions on the vehicle cab diagram.

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.
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:

- fixed loads,
- mobile loads;
- loads that result in increased aerodynamic actions.

a) Fixed loads

\[
H_v = \text{Vehicle centre of gravity height (loaded)}
\]

\[
H_s = \text{Height of payload centre of gravity from the ground}
\]

\[
H_t = \text{Complete full-load vehicle centre of gravity height}
\]

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

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

Control at full load

- \( H_v \): Vehicle centre of gravity height (loaded)
- \( H_s \): Height of payload centre of gravity from the ground
- \( H_t \): Complete full-load vehicle centre of gravity height
- \( W_v \): Vehicle tare weight
- \( W_s \): Payload
- \( W_t \): Complete vehicle ground at full load
For any inspections with the vehicle set up without payload you can proceed similarly, assuming $W_s$ is only the tare weight of the superstructure (considering for $H_v$ 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 111, 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.

implementation of stabiliser bars

The use of additional or reinforced anti-roll bars, spring reinforcements or rubber spring parts, helps to compensate if the payload has a high centre of gravity. However, it should be noted that 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).

Respect of the permitted masses

All the limits shown on IVECO documentation must be respected. It is particularly important to evaluate the maximum ground on the front axle in any load condition, in order to ensure the necessary steering features in all road surface conditions.

Special attention must therefore be paid to vehicles with concentrated load on the rear overhang (e.g.: cranes, tail lifts, central axle trailers) and vehicles with a short wheelbase and high centre of gravity height (e.g. silo vehicles, concrete mixers).
Note In the positioning of the auxiliary bodies and superstructure, a proper load distribution in the transverse direction must be ensured. A variation on the nominal load may be permitted for each wheel (50% load on the corresponding axle) of ± 4% (e.g.: load allowed on the axle 10,000 kg; allowed for each wheel side from 4,800 to 5,200 kg) in compliance with what is permitted by the tyres, without affecting the braking and driving stability characteristics 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 realized in observance of the admissible axle loads, the minimum required load on the front axle, the length limits, positioning of the tow hook and under-run protection, provided for by the various Standards.

Variations on 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 the necessary indications may be provided.

1.16 INSTRUCTIONS FOR PROPER FUNCTIONING OF THE VEHICLE PARTS 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; in Figure 1-6 are shown the longitudinal space 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.
- in outfittings which include the tipping of the side boards, consider the size of the most protruding parts of the vehicle, in order to avoid limitations to tipping or damage to the parts. These dimensions are indicated on the Bodybuilders diagrams and are available from 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 outfittings (campers, mobile shops, vans) sufficient ventilation of the brakes and sufficient aeration of the battery case must be guaranteed by means of openings or windows in the panelling 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.
Distance from the exhaust system

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

Bear in mind 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 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 GENERAL REGULATION FOR THE 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, when pipes must be inevitably installed near the engine, exhaust system, catalytic converter or turbocharger, suitable insulating shields or protective plates must be provided.

### 1.18 CONVENTIONS

In these Guidelines the following conventions are adopted:

- **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 GENERAL CHASSIS MODIFICATION STANDARDS

Keep in mind that:

- **weldings on the supporting structures of the chassis are absolutely forbidden** (except as prescribed in Paragraph "Weldings" (☞ Page 8) and in Chapters 2.4 (☞ Page 14), and 2.5 (☞ Page 17));
- **no holes may be drilled into the side members** (with exception to what is stated in Paragraphs "Weldings" (☞ Page 8) and "3.3 Choosing the type of connection" (☞ Page 11));
- 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 re-used, 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.

Preventive measures

▶ **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.

Braking and electrical systems

For additional details on the braking and electrical systems see Chapters 2.15 (➤ Page 48) and 5.7.

Characteristics of the material used in chassis modifications

For chassis modifications on the vehicle (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 2.1 - Material to be used in chassis modifications**

<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>Fe E420</td>
<td>530</td>
<td>420</td>
<td>21%</td>
</tr>
<tr>
<td>S420MC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QStE420TM</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2.2 - Chassis side members sections**

<table>
<thead>
<tr>
<th>Model</th>
<th>A x B [mm]</th>
<th>Wheelbase [mm]</th>
<th>Thickness t [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3105 3330 3690 4185 4455 4590 4815 5175 5670 6210 6570</td>
<td></td>
</tr>
<tr>
<td>110EL, 120EL</td>
<td>195.5x65</td>
<td>5 5 5 6 6</td>
<td>- 6 - - - -</td>
</tr>
<tr>
<td>120E, 140E</td>
<td>240x70</td>
<td>5 - 5 5 6 -</td>
<td>6 6.7 6.7 - 6.7</td>
</tr>
<tr>
<td>150E, 160E</td>
<td>240x70</td>
<td>5 - 6 6 6 -</td>
<td>6.7 6.7 6.7 - 7.7</td>
</tr>
<tr>
<td>150EH, 170EH</td>
<td>262.5x80</td>
<td>6 - 6 7.7 -</td>
<td>7.7 7.7 7.7 - -</td>
</tr>
<tr>
<td>180E, 190EL</td>
<td>262.5x80</td>
<td>- - 6 7.7 -</td>
<td>7.7 7.7 7.7 7.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>A x B [mm]</th>
<th>Wheelbase [mm]</th>
<th>Thickness t [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3240 3690 3915 4150</td>
<td></td>
</tr>
<tr>
<td>110EW</td>
<td>240x70</td>
<td>6 6 6</td>
<td>6 6</td>
</tr>
<tr>
<td>150EW</td>
<td>6 6 6</td>
<td>6 6</td>
<td></td>
</tr>
</tbody>
</table>
Stresses on the chassis

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

**Note**  Static stress $\sigma$ allowed on 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.

**Hole position and size**

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-url)
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.

Welds

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 involved in the side member modification, as hereafter specified (see). Figure 3.

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 earth; 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 earth 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.
2.3 RUST AND PAINT PROTECTION

- 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 12)).

Sealing holes by welding

When making new holes, if they are too close to the existing holes (see Figure 2), the existing holes can be welded closed. 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.

### Original vehicle parts

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)

<table>
<thead>
<tr>
<th>Class</th>
<th>Part requirements</th>
<th>Examples of parts involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Parts in direct contact with atmospheric agents</td>
<td>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.</td>
</tr>
<tr>
<td>B</td>
<td>Parts in direct contact with atmospheric agents that mainly have structural characteristics, in clear sight</td>
<td>Chassis and relative parts, including its fasteners Parts below the radiator grille (class B) External cab ramps</td>
</tr>
<tr>
<td>B2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>Only for rear axles and front axles</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Parts in direct contact with atmospheric agents, not in clear view</td>
<td>Engine and relative parts</td>
</tr>
<tr>
<td>D</td>
<td>Parts not in direct contact with atmospheric agents</td>
<td>Pedals - Seat coverings - Fastening elements - etc., mounted inside the cab</td>
</tr>
</tbody>
</table>

#### 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>Stainless steel (1)</td>
<td>18-0506</td>
<td>A - B1 - B2 - C - D</td>
</tr>
<tr>
<td>Geomet (2)</td>
<td>GEO 321-8</td>
<td>18-1101</td>
</tr>
<tr>
<td></td>
<td>GEO 500-8</td>
<td>yes -</td>
</tr>
</tbody>
</table>

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

(1) Stainless steel (2) Geomet
### Rust and Paint Protection

#### Type of protection
- **GEO 321-8 PM**
- **GEO 321-8 PML**
- **GEO 321-8 PL**
- **GEO 500-8 PL**
- **GEO 321-5**
- **GEO 500-5**
- **GEO 321-5 PM**
- **GEO 321-5 PML**
- **GEO 321-5 PL**
- **GEO 500-5 PL**

#### Classes
- **A**
- **B - B1 - B2**
- **C**
- **D**

<table>
<thead>
<tr>
<th>Cycle phase description</th>
<th>Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>MECHANICAL SURFACE CLEANING (1)</td>
<td>A</td>
</tr>
<tr>
<td>Sand/shot blasting</td>
<td>–</td>
</tr>
<tr>
<td>Brushing</td>
<td>yes (*)</td>
</tr>
<tr>
<td>Sandpapering</td>
<td>yes (*)</td>
</tr>
<tr>
<td>PRE-TREATMENT</td>
<td>–</td>
</tr>
<tr>
<td>Iron phosphating (only for non-precoated ferrous materials)</td>
<td>–</td>
</tr>
<tr>
<td>Zinc phosphating (*)</td>
<td>yes</td>
</tr>
<tr>
<td>CATAPHORETIC PAINTING</td>
<td>–</td>
</tr>
<tr>
<td>High thickness (30-40 μm)</td>
<td>yes (*)</td>
</tr>
<tr>
<td>Medium thickness (20-30 μm)</td>
<td>yes (*)</td>
</tr>
<tr>
<td>Acrylic finishing (&gt;35 μm)</td>
<td>–</td>
</tr>
<tr>
<td>RUST PREVENTER</td>
<td>–</td>
</tr>
<tr>
<td>Bi-component (30-40 μm)</td>
<td>–</td>
</tr>
<tr>
<td>Single-component (30-40 μm)</td>
<td>–</td>
</tr>
<tr>
<td>ANTIROCK PRIMER</td>
<td>–</td>
</tr>
<tr>
<td>Single (130 °C) or bicomponent (30-40 μm)</td>
<td>yes</td>
</tr>
<tr>
<td>Powders (40-110 μm)</td>
<td>yes</td>
</tr>
<tr>
<td>VARNISH</td>
<td>–</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 2.6 - Painted parts - IVECO Standard 18 - 1600 (Prospectus III)

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

Cycle phase description | Classes | A | B | B1 | B2 | C | D
--- | --- | --- | --- | --- | --- | --- | ---
VARnish | Low temperature single-component (30-40 μm) | – | – | yes | – | yes (*) | yes (*)

(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) Only parts to mount on the engine.
(9) Alternative products and cycles for the same phase under the condition of comparability with the part to treat.
(**) Specific phosphates must be used for zinc coated or aluminium sheets.

### 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 used powder varnish directly after degreasing has been performed.

Lightweight alloy, copper and brass parts must be protected.

<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) (*)</td>
</tr>
<tr>
<td>Varnish</td>
<td>Bi-component (30-40 μm) (*)</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>–</td>
</tr>
<tr>
<td>Zinc coating <em>(1)</em></td>
<td>–</td>
</tr>
</tbody>
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*(1) Free from hexavalent chromium

### 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;
- drive 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;
- complete diesel filter base (only versions with diesel);
- 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 painting is complete and before oven drying (max. temperature 80 °C), the parts that risk heat damage must either be removed or protected.
2.4 WHEELBASE MODIFICATION

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; because this allows the use of original drive shafts and pre-defined crossbar positions and existing "datasets" for EVSC and AEBS (see Section 5 - Chapter 5.8 - Paragraph "Safety electronical devices"). Nevertheless, IVECO must issue its authorisation for wheelbases below the minimum or maximum approved standard sizes on the market.

Authorisation

Wheelbase variation in the 4x2 versions is allowed without IVECO authorisation only when:

a) for extensions

- another one of the lengths available in production for the vehicle model is to be created;
- the thickness of the side member to be extended does not differ from that of the standard side members taken as reference, or differs (downwards) by just one "step" (see Table 2.2);
- number, type and position of the crossbars, the existing circuits and systems on the series chassis corresponding to this length are replicated.

b) for shortenings

- another one of the lengths available in production for the vehicle model is to be created;
- number, type and position of the crossbars, the existing circuits and systems on the series chassis corresponding to this length are replicated.

For the 4x4 versions, variation in the wheelbase is only allowed 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 directives, taking into account the suitable adjustments and adaptations, as well as all required precautions (e.g.: check whether the ECUs must be reparameterized, exhaust pipe adjusted, observance of minimum tare weight on the rear axle, etc.) provided for on the corresponding original wheelbases.

Effects on steering

Generally speaking, extending the wheelbase will have a negative effect on steering.

When required by legislation, do not exceed the limits prescribed for the path, steering wheel force and the relative time of ability to negotiate curves (e.g. Regulation ECE or EC Directive in force).

Table 2.9 lists the maximum wheelbase elongation values allowed for the vehicle with series steering, maximum load and tyres. Longer wheelbases require approval and technical solutions must be adopted to improve steering, such as reduction of maximum load on the front axle or the implementation of a caster trail with a restricted set of values.

The installation of an additional pump must also be authorised, while successive installations require the participation of the specialised Company.
### Effects on braking

Generally speaking, shortening the wheelbase will have a negative effect on braking. Contact the IVECO Department - Homologation & Technical Application to find out at what conditions (brake cylinders, minimum tare, theoretically admissible loads, tyres, height of centre of gravity) transformation can be allowed.

- Modifications to the wheelbase 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 teleservices.

- The possible wheelbases are between 2690 mm and 7100 mm; lengths which are greater or lesser than this are not covered by the necessary “datasets” and therefore cannot be authorised.

### Intervention procedure

Proceed as follows to obtain good results:

- Position the vehicle so that the chassis is perfectly horizontal, use appropriate trestles;
- Detach the drive 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 8])) 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 8]);
- 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 8]).
Additional information

- Protect the surfaces against oxidation as in Paragraph "Added or modified parts" (Page 12).
- Restore the braking and electrical systems as according to Chapters 2.15 (Page 48) and 5.7.
- Follow the instructions in Chapter 2.8 (Page 36) for interventions on the transmission.

Checking chassis stress

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 counter-frame 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 or 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.

Cross members

The need to apply one or more crossbars is subject to the amount of elongation, the positioning of the gearbox, 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.

Gearbox modifications

See Chapter 2.8 (Page 36) for checks of modifications allowed.

Figure 6
2.5 REAR OVERHANG MODIFICATION

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 drawbar shall be attached, it is necessary to leave sufficient space (approx. 350 mm) between the rear crossbar and that nearest, for any drawbar 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.

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”.

Chassis Shortening
The last crossbar must be moved forward when shortening the rear overhang of the chassis.

When the rear crossbar is too close to another crossbar, the latter can be eliminated if it plays no role in suspension support.

Elongation
The possible solutions on the basis of the extensions 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 the gusset plate is carried out with welding, the gusset plate can be connected to the reinforcement using welding (see Figure 7).

The solution for extensions 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

General information

The application of a tow hook is possible without authorization:

- on vehicles with the specifically prescribed crossbar (opt. 6151) 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 (centre 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 centre axle trailers" ( ➤ Page 21).

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 (UN-ECE 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.
2.6 INSTALLING THE TOW HOOK

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.

1. Free field for towing hooks
2. Free field for coupling hooks according to standard DIN 74058 ESC-152
Towing 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:

\[ D = \frac{9.81 (T \cdot R)}{(T + R)} \]

- \( D \) = representative value of drawbar class [kN]
- \( T \) = maximum mass of the tractor [t]
- \( R \) = maximum mass of trailer with mobile vertical drawbar [t]

Drawbar coupling for centre axle trailers

Centre 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 drawbars, the rigid drawbar acts on the drawbar 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 2.10).

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 trailers with a central axle, the following formulas are valid:

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

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

- \( D_c \) = representative value of drawbar class. This is defined as the determination of the theoretical reference value for horizontal load between tractor and trailer
- \( g \) = acceleration of gravity [m/s²]
- \( T \) = maximum weight of tractor
- \( R \) = maximum weight of trailer when fully laden
- \( S \) = 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. \( S \) must be \( \leq 0.1 \times R \leq 1000 \) kg of the trailer [kg]
- \( C \) = 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 \( C = R - S \)
- \( V \) = value of the intensity of the theoretical dynamic vertical force between the vehicle and the trailer
- \( a \) = vertical acceleration in the area of the drawbar coupling/hook. In function of the rear tractor suspension, use the following values:
  - \( a = 1.8 \text{ m/s}^2 \) of air suspensions
  - \( a = 2.4 \text{ m/s}^2 \) for other types of suspensions
2.6 Installing the Tow Hook

- \( X \) = length of the load bed [m]. (see Figure 10)

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

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

If you wish to use the tow with a vehicle not originally designed (and in compliance with the limits established by IVECO for each model), only original rear crossbars which have already been hole punched 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 of the subframe which are larger in size than those normally provided (and indicated in Table 2.10).

**Table 2.10 - 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>
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*Figure 10: Length of the trailer load bed (X), Theoretical drawbar length (L)*
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Section modulus Wₜ [cm²] for longitudinal sections of the subframe with yield point of the material equal to 360 N/mm².
### 2.6 Installing the Tow Hook

**Table:**

<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>
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<td>1650</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

**Section modulus Wz [cm²] for longitudinal sections of the subframe with yield point of the material equal to 360 N/mm²**
### INSTALLING THE TOW HOOK

To tow centre-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 (Figure 11).

![Figure 11](image_url)

**Lu =** Rear overhang  
**Lv =** Length of the reinforcement parts placed in front of the centre line of the rear axle  
**Lh =** Length of the reinforcement parts placed behind the centre line of the rear axle

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

Use sections with a greater section modulus if the superstructure requires it. Check from time to time the need to install a suitable towing crossbeam and a suitable hook.

**Note** See Table 3.2 (profile dimensions).
Table 2.11 - Solutions with combined reinforcement sections

<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 $R_{0.2}$ (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>$L_v$ (see figure 2.11)</td>
<td>0.5 $L_U$</td>
<td>0.5 $L_U$</td>
<td>0.8 $L_U$</td>
<td>0.85 $L_U$</td>
</tr>
<tr>
<td>$L_{iv}$ (see figure 2.11)</td>
<td>0.6 $L_U$</td>
<td>0.6 $L_U$</td>
<td>0.95 $L_U$</td>
<td>1.0 $L_U$</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. Normal boxed profiles
2. Gradual passage from the boxed section to the open section
3. Special combined sections (connecting bracket chassis/subframe with thickness equal to section of 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), presents difficulties (e.g. presence of suspension supports, or of the coupling brackets of the air spring) and the recess to be created could excessively reduce the resistance capacity of the section, the solution must be submitted for approval with the proposed reinforcements.
Rear crossbar in lowered position

When the drawbar coupling must be lowered from its original position, IVECO may issue an authorisation to lower the original drawbar or install an additional drawbar, 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.

1. Original rear cross member.
2. Additional strap
3. M14 threaded hole - 10.9 (1/10 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 11). 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 lowering 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.
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 13 shows an example of a lowered supplementary crossbar.

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.

1. Original rear cross member.
2. Connecting plate or angle
3. Coupling plate
4. Connecting plate
5. C-profile (same dimensions as chassis)
6. Space for rear spring retainer
Tow beam in a lowered and forward position (close coupling) for centre axle trailers

Vehicles that, to tow centre 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 drawbar 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).

Standard crossbar 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;
- 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 INSTALLING THE TOW HOOK

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).

Increase of tow 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 14), or installation of a reinforced crossbar when available, or adjustments to the braking system.

The drawbar 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.

Plates

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

▶ Installation of an additional axle has major repercussions on the brake system, pneumatic system, wiring and the Multiplex interconnection system: therefore approval by IVECO is necessary. The operation must be carried out in compliance with the instructions in Chapter 5 “Special instructions for electronic subsystems”.

▶ 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 teleservices.

General information

On some models of the EuroCargo range, it may be possible to apply an additional axle and consequently 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.

In this context due to the GVW increase, this includes the need to verify, the adequacy of the FUP (Front Underrun Protection) and RUP (Rear Underrun Protection) type to the new situation and their possible replacement (see Chapters 2.20 (⇒ Page 56) and 2.24 (⇒ Page 59)).

Any application diagrams sent to IVECO - Technical Application to be examined and authorised must show indications regarding connection of the axle to the chassis, as well as information on reinforcement 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.

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

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).

**Note**  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.

### 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 17). This still requires the need for reinforcement as indicated in the Paragraph "Reinforcements on the chassis" (⇒ Page 31).
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 provided in the Paragraph "Shortening" (➠ Page 17) in order to respect the technically permissible load.

Special attention must be paid to avoiding possible interference between the added axle and the drive shaft.
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.

Suspension

The construction quality of all the components must be ensured (axle, suspension, brake assemblies, systems etc.) in order to guarantee the driving safety and the correct functioning of the vehicle.

Particular attention must be paid to the realization of the suspension, given its importance in the vehicle's road handling.

The type of suspension to be realized may be mechanical leaf spring, air spring or mixed; its execution must not compromise the vehicle’s handling or its components in terms of driving stability, comfort, cornering performance and transmission working angle (with the relative space restrictions in the event of an additional intermediate axle).

Implementation of a compensated type suspension is recommended (particularly for off-road vehicles), both total and partial, to maintain constant the load distribution on two rear axles and to ensure that both axles are in condition to react to static and dynamic loads established in the original design, and in conditions imposed by the relevant Standards (e.g. difference in axle levels).

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 suspension

Interventions are generally not allowed on this type of suspension.

Exception is made for outfits 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.

Stabiliser 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.

Attachments to the chassis

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 crossbars 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.
Brake 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 parting brake on the added axle as well.

Keeping in mind the different gross vehicle mass 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 5.5.

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:

- 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 laws allow the use of the lifting device even in normal driving conditions, as long as the max approved load set for the engine axle and the allowed speed limit are not exceeded.

In this case it is a good idea to remember the indications in Chapter 1.15 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 GEARBOX MODIFICATION

Gearbox adjustment, following wheelbase modification, must be performed using the gearbox diagram 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.

Contact the IVECO Technical Application for any difficulties; and send them a diagram with the length and tilt of the new transmission for a constant-velocity check.

The technical specifications in the gearbox Manufacturer manual must be used for correct production and installation of the sections.

![Diagram of gearbox modification](image)

**Figure 20**

Maximum allowed angularity

\[ \beta = \sqrt{\beta_1^2 + \beta_2^2 + \beta_3^2} \leq 3^\circ \]

\( \beta \cdot n < 20,000 \) 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 scope of these instructions is to safeguard proper operation of the gearbox, limit sound level and avoid stress transmitted by the drive assembly. In no way does this relieve the Outfitter of any work related liabilities.

### Lengths allowed

1. The maximum possible operating lengths, both for "LG" sliding sections as well as for "LZ" intermediate ones (see Figure 21), may be determined based on the outer diameter of the vehicle's existing pipe and on the maximum number of operating revs. (see formula and Table 2.12).

   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 2.12) in relation to the length required and the maximum number of engine rpm.
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 LZ.

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

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

<table>
<thead>
<tr>
<th>Engine</th>
<th>Power [hp - kW]</th>
<th>( n_{\text{MAX}} ) [rpm]</th>
<th>Gearbox</th>
<th>( i_G )</th>
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<tbody>
<tr>
<td>F4AEE681E</td>
<td>182 - 134</td>
<td>2700</td>
<td>65 700</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>95 75</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>0.73</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>65 800</td>
<td>0.78</td>
</tr>
<tr>
<td>F4AEE681G</td>
<td>217 - 160</td>
<td>2700</td>
<td>65 700</td>
<td>0.79</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>95 75</td>
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<td>65 800</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>65 1005 + PTO (*)</td>
<td>0.74</td>
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<tr>
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<td>2700</td>
<td>65 700</td>
<td>0.79</td>
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<tr>
<td></td>
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<td></td>
<td>95 75</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>65 800</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>65 1005 + PTO (*)</td>
<td>0.78</td>
</tr>
<tr>
<td>F4AEE681A</td>
<td>275 - 202</td>
<td>2500</td>
<td>65 1000</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>95 1110</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>65 1005 + PTO (*)</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>53000</td>
<td>0.73</td>
</tr>
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</table>
**Note**: Following the modification, the axle shaft crosspiece forks must not be turned from their original position.

### Pipe thickness

Pipe thickness depends on the torque that the original shaft must transmit, as well as on the specifications of the transmission line (engine torque, power train ratio, drive axle loads).

If using a pipe with a greater diameter than the original, thickness should in theory be reduced until it reaches the same torsional capacity; 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 to case basis in relation to the dimensions of the driver shaft (e.g. cardan joint size), in concert with the drive 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 2.13 - 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></td>
<td></td>
<td>2500</td>
<td>2700</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2060</td>
<td>1960</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2170</td>
<td>2100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2420</td>
<td>2350</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2420</td>
<td>2360</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.

**Positioning the sections**

The transmissions that comprise several sections, each axle must be of approximately the same length. In general, between an intermediate shaft and sliding shaft (see Figure 22) the difference in length must not be greater than 600 mm and this difference must not be greater than 400 mm between two intermediate shafts. As regards sliding shafts, there must be a minimum margin of 25 mm between minimum operating length and maximum sealing length; on opening, a covering must be guaranteed between the shaft and the sleeve of approx. twice the diameter of the spline shaft.

1. Drive shaft, clutch, gearbox
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 rear 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 axle casing axis when in static load are all aligned with the same tilt.
1. Drive shaft, clutch, gearbox
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 flexible supports must be done using support plates with a thickness of at least 5 mm (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 gearboxes; 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.
For every transformation of the transmission, of any of its parts, a thorough dynamic balancing must be performed on each section modified.

Given that the transmission is an important part of the vehicle in terms on safety, we strongly recommend that all modifications made to it stand up to maximum safety standards. Therefore, all modifications should be made only by highly specialised Companies that are qualified by the transmission Manufacturer.

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 counter-pressure values.

<table>
<thead>
<tr>
<th>Engine</th>
<th>Engine code</th>
<th>Exhaust counter-pressure [kPa]</th>
<th>Intake vacuum [kPa]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro III</td>
<td>F4AEE68IE</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>F4AEE68IG</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>F4AEE68IB</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>F4AEE68IA</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Euro V</td>
<td>F4AE348IA</td>
<td>18</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>F4AE368IB</td>
<td>28</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>F4AE368ID</td>
<td>28</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>F4AE368IE</td>
<td>28</td>
<td>6.5</td>
</tr>
</tbody>
</table>

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.
The holes that must be made in the box part of the van must have an area of about twice that of the cross-section of the pipe upstream of the filter; these openings (e.g. grille holes) must have minimal dimensions to prevent possible clogging.
The following are not allowed:

- alterations or replacement of the original air filter with one of lower capacity;
- modifications to the silencer body;
- 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).
Engine exhaust

The performance of any non-original exhaust pipe must be as regular as possible. To satisfy this condition, it must:

- bend with angles not exceeding 90° and with radius of 2.5 times the external diameter;
- not have through-sections which are smaller than the original ones;
- guarantee that the inside of the pipe is free from welding burrs or edges, if there are any connections.

It is also necessary to maintain the appropriate distances between the exhaust pipe and the other parts including the electrical systems, the plastic pipes, the spare wheel (minimum 150 mm), the plastic fuel tank (minimum 100 mm), respectively. Lower values (e.g. 80 mm), are admissible by adopting suitable metal guards, while further reductions will require the use of heat insulation or plastic pipes to be replaced with steel ones.

**Note** It is not permitted to modify the silencer body or to carry out any interventions on equipment (e.g. injection pump, control valve, injectors) that could compromise the correct operation of the engine and affect exhaust gas emissions.

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:
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), 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 (only diesel versions)
As regards these heaters and for direct cab installation, be particularly cautious with the exhausts (to avoid combustion gasses from being trapped in the vehicle) and correct distribution of hot air (in order to avoid direct flow).

### 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 5.7 - Paragraph "Additional equipment") 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** 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 CO\textsubscript{2} 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

General information

All interventions on the steering cab 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 variation of cab weight, it is necessary to consider the position of the load in order to respect division of allowed 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.

Each structural modification must bear protection against corrosion (see Chapter 2.3 (➡ Page 10)).

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.S. 18-1317 class ZNT/F/10/2S or I.S. 18-1318 class ZNT/10/2S); 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.

Work on the roof

Installations and modifications performed to create specific outfittings must be done with care in order to protect the resistance and maintain cab functionality and protections intact.

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.

Spoiler or top-sleeper installation

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.
Realization of sleeper cabs

IVECO can authorize 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 body builder.

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

1. 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.

2. for the tipping it might be necessary to install a cylinder of higher capacity (with adequate supports) or an extra cylinder, verifying compliance with the minimum distances to the nearly arranged 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.

3. 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, a movable bonnet, hatches or panels need to be provided for the inspection and maintenance of the underlying parts.

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.

Protection of 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 Body builder 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 mounting additional seats (e.g. in a cat. N1 van) are only allowed on vehicles already fitted at origin with supplementary fittings and already provided with alternative type approval.

Any other solution is implemented under to total responsibility of the body builder 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 tyre holder modification;
- may affect distance from 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 approved counterparts (see Chapter 2.20 (Page 56));
- requires the need to check compliance of the limit transverse contour allowed in relation to the various standards.

Prescriptions
Note  Replacing tyres with others of different external diameter affects vehicle performance (e.g.: 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.
In addition, tighten the wheel studs at the tightening torque according to the IVECO standard (see the following Table).

Table 2.15 - Wheel tightening torque according to IVECO STD 17-9219

<table>
<thead>
<tr>
<th>COD</th>
<th>CONNECTING ELEMENTS</th>
<th>THREAD</th>
<th>CLASS</th>
<th>MIN</th>
<th>MAX</th>
<th>FEATURES “S” (*)</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</td>
<td>“S”</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>640</td>
<td>“S”</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</td>
<td>“S”</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

General information

No changes are allowed to the regulating unit, distributor, brake cylinders, valves, etc., 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 national standards provide it, the vehicle must be presented to the competent authority for inspection.
In the case of displacement of control valves, dryer, etc., restore the same type of installation originally provided, ensuring the correct functionality; interventions on the dryer must also not affect the conditions of cooling air coming from the compressor.

**Brake pipes**

**Note** In the case of changes to the cantilever, the brake lines involved should preferably be replaced with new pipes 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.
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>
<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)

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.

**Electronic braking control device**

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.

**Withdrawing air from the cooling 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 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 ch. 1.15).}

To minimise torsional stress on the chassis of the vehicle it is advisable to perform the installation in correspondence with a cross-bar, 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 arrangements 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.

**Converting the suspension from mechanical to pneumatic (for example, for shop van fitting)**

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.

**Horn**

The displacement of the horn obligates the body builder 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.

**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 $7^\circ$.

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.

**Additional fuel tank (only diesel vehicles)**

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 27 B, where the implementation of a diverter allows to alternatively use the two tanks.
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.

**Moving the fuel tank**

Moving the position is permitted providing that the absolute minimum pressure at the BP/AP pump inlet is 500 mbar.

On MLC and MLL chassis cab vehicles, horizontal repositioning in relation to the original position is possible when this involves a maximum extension of 500 mm of each return and delivery pipe.

For greater extensions, up to a maximum of 1000 mm, the standard fuel prefilter is to be replaced with a different type able to create a lower drop in pressure on the line.

**2.18 TRANSPORT OF HAZARDOUS MATERIALS - ADR (only diesel vehicles)**

Depending on the specific ECE/TRANS/WP.15/213 document and its national implementations, dangerous goods are classified under “Explosives”, “Flammable Liquids”, “Gas”, “Hydrogen” and must be transported on specially configured vehicles. The type of preparation is specific according to the above categories.

IVECO does not provide versions fully prepared for the ADR, although production vehicles do already comply for some electrical parts, mechanical components and materials inside the cab. The Bodybuilder, upon request, is given a *declaration* containing details of the sections in the ECE document that have already been complied with by the vehicle up from the origin.

As standard, IVECO vehicles already comply with Regulation 105 - series 05 of annex "B" of agreement "ADR 2015 - part 9" (Requirements concerning the construction and approval of vehicles) relating to:

- 9.2.2.2 (pipes)
- 9.2.2.4 (batteries)
- 9.2.2.5 (permanently supplied circuits - excluding tachograph)
- 9.2.2.6 (electrical system behind cab)
- 9.2.4.2 (cab)
• 9.2.4.3 (fuel tank)
• 9.2.4.4 (engine)
• 9.2.4.5 (exhaust gas control)
• 9.2.5 (speed limiter)
• 9.2.6 (trailer coupling)

A higher level of compliance can be obtained through the optional 2342 (ADR pre-configuration) which results in the vehicle having:

• a specific digital tachograph (variant 8818)
• a specific electric switch, either on the chassis or in the cab (variant 76299)
• emergency switch
• protected electrical connections
• wiring protected with polyamide conduit
• ADR approval plate
• instructions on functioning

with this option, centralised door locking can be activated only if the ADR transport is not running; Otherwise the doors can be closed only with the normal keys.

The bodybuilder is responsible for the outstanding work to ensure the vehicle is fully configured for the specific type of goods to be transported; naturally, therefore, the best opportunity to configure the vehicle is at the point of ordering.

One such example is the production of vehicles for transporting materials in the "OX - Peroxides" category, for which the regulations require that the windows and frames of the rear wall of the cab have specific characteristics. As this does not fall within the scope of the ADR pre-configuration planned by IVECO, the option 00741 "Without rear glass" should be selected.

Note  The complete transformation must still be authorised by the authorities responsible for the relative tests.

2.19 INSTALLING A RETARDER

The vehicle transmission should be equipped with a retarder brake (hydraulic or electrical eddy current brake).

▶ The use of a retarder must be authorized by IVECO.

Given that this system is available optionally as part of the original equipment on some models in the Eurocargo range, after-sales applications must correspond to the solution available originally. For different types of projects, the retarder must be selected based on the braking torque obtained using the following formula:

\[
\frac{i_p \cdot C_f}{R' \cdot PPT} \leq 1.00
\]

\[i_p = \text{rear axle ratio}
\]
\[C_f = \text{Maximum braking torque [Nm]}
\]
\[R' = \text{radius under load of the used tyre [m]}
\]
\[GWW = \text{Gross Vehicle Weight [kg]}
\]

The installation of the brake must be carried out by the Manufacturer in their authorized service centres, in accordance with Chapters 2.2 (Page 7), 2.8 (Page 36), 5.7 of these Directives.
For hydraulic retarder cooling, connection to the engine cooling circuit is permitted, provided that the maximum permissible temperature of the fluid in the original system is in not exceeded in any case; otherwise there must be a separate cooling circuit.

If it proves necessary to fit additional heat exchangers, the retarder Manufacturer shall be in charge of defining the dimensions and positioning, provided that this does not alter the functionality of the vehicle's original cooling system.

### 2.20 REAR UNDER-RUN PROTECTION (RUP)

The maximum distance between the rear under-run protection device (RUP = Rear Underrun 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 the standards in force must be demonstrated to the competent authorities by appropriate documentation or test certificates.

**Note**  On vehicles with a GVW higher than 14 tons it is necessary to use a rear under-run protection similar to the one of vehicles with GVW 18 tons, or choose for the opt 4667 provided for vehicles which use a 3rd axis.

### 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 fender 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 30).

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

If not supplied in the original equipment, mudguards must be included in the vehicle's final equipment; the dimensions and positioning of these components must comply with regulations.

2.23 SIDE PROTECTIONS

In some countries, regulations (national or EC) 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 31 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.
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)**

For the front under-run protection bar (FUP = Front Underrun Protection) are provided different fixing positions to the chassis. So it is possible to comply with the EC 2000/40 Directive even with the new vehicle setting after the fitting, the new loads on the axes and/or the use of any 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>
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<th>Vehicle width</th>
<th>Arrows dimensions a x b x c (mm)</th>
</tr>
</thead>
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<tr>
<td></td>
<td>Left-hand drive</td>
</tr>
<tr>
<td></td>
<td>Driving side</td>
</tr>
<tr>
<td>2300 – 2450</td>
<td>152 x 793 x 151</td>
</tr>
<tr>
<td>2400 – 2500</td>
<td>209 x 793 x 209</td>
</tr>
<tr>
<td>2500 – 2600</td>
<td>310 x 793 x 303</td>
</tr>
</tbody>
</table>

Figure 32
SECTION 3

APPLICATIONS OF SUPERSTRUCTURES
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APPLICATIONS OF SUPERSTRUCTURES

NOTE  The specific instructions below are integrated into the requirements stated in Section 1 "GENERAL INFORMATION" in the general rules.

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.

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 (1) 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 Fe 360D</td>
<td>360 (1)</td>
<td>235 (1)</td>
<td>25% (1)</td>
</tr>
<tr>
<td>EUROPE S235J2G3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GERMANY ST37-3N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.K. 40D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IVECO Fe E420</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EUROPE S420MC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GERMANY Q5E420TM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.K. 50F45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IVECO Fe 510D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EUROPE S355J2G3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GERMANY ST52-3N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.K. 50D</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sizing of profiles

The following table shows the values of resistance modulus Wₓ for C section profiles recommended by IVECO.

The indicated value Wₓ 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 resistance modulus Wₓ and inertia time Jₓ of the new C section are not of a lesser value.

Table 3.2 - Profile dimensions

<table>
<thead>
<tr>
<th>Section modulus Wₓ [cm³]</th>
<th>Recommended C profile [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 ≤ W ≤ 19</td>
<td>80 × 50 × 4</td>
</tr>
<tr>
<td>20 ≤ W ≤ 23</td>
<td>80 × 60 × 5</td>
</tr>
<tr>
<td></td>
<td>80 × 60 × 5</td>
</tr>
</tbody>
</table>
While the form of resistance 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.

**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 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, centre axle trailers, etc.), the use of aluminium is generally not recommended and should be authorised from time to time by IVECO.

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

**Longitudinal profiles**

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 $30^\circ$, or another form of equivalent tapering (see Figure 1); the front end in contact with the chassis must be properly coupled, with min. radius of 5 mm.

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 2. 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.
The possibility of building a subframe with a different width from that of the vehicle chassis is permitted only in special cases (e.g. interchangeable equipment with sliding systems on rollers, where the mechanical or hydraulic devices are unified). 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 elastically to the vehicle chassis and box sections when you require greater rigidity of the assembly.

Care should be taken to achieve a gradual transition from the box section to the open section, as in the examples in Figure 3.

---

**Figure 3**

1. Normal boxed profiles
2. Gradual passage from the boxed section to the open section
3. 15 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 undercrawl 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.

Cross members

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 shown in Figure 4 must be used to give adequate resistance to the connection.

When you want to achieve greater stiffness in the connection, this can be done as shown in Figure 5.

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

Figure 6

Figure 7

1. Subframe

2. Diagonals
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

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 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).

▶ In anchoring the structure to the chassis, welding must not be performed on the vehicle chassis, nor may holes be drilled into its wings.
**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 of the same, in a section that is no longer than 150 mm and without weakening the anchoring of any crossbars (see Figure 14).

Alternatively, use the connection in Figure 13, using the screws that connect the rear crossbar to the chassis.

**Connection characteristics**

Elastic connections (see Figures 10, 11 and 12) 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 13), 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 counter chassis allows you to achieve greater resistant capacity compared to the connections with brackets or clamps, obtaining the following benefits:

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

**Subframe dimension**

In case of elastic connection between chassis and subframe the bending moment \( M_f \) must be subdivided proportionately between chassis and subframe at the moments of inertia of the sections:

\[
M_f = M_c + M_t
\]

\[
\frac{M_c}{M_t} = \frac{l_t}{l_c}
\]

\[
M_t = \frac{M_c}{l_t} \cdot \frac{l_c}{l_c + l_t}
\]

\[
M_c = \frac{M_f}{l_t} \cdot \frac{l_c}{l_c + l_t}
\]

\[
\sigma_c = \frac{M_c}{W_c} \leq \sigma_{amm}
\]

\[
\sigma_t = \frac{M_t}{W_t} \leq \sigma_{amm}
\]

\( M_f \) = static bending moment generated by the superstructure \([\text{Nmm}]\)

\( M_c \) = proportional share of the static bending moment \( M_f \), applied to the subframe \([\text{Nmm}]\)

\( M_t \) = proportional share of the static bending moment \( M_f \), applied to the chassis \([\text{Nmm}]\)

\( l_c \) = moment of inertia of the section of the subframe \([\text{mm}^4]\)

\( l_t \) = moment of inertia of the section of the chassis \([\text{mm}^4]\)

\( \sigma_c \) = maximum static stress applied to the subframe \([\text{N/mm}^2]\)

\( \sigma_t \) = maximum static stress applied to the chassis \([\text{N/mm}^2]\)

\( W_c \) = section modulus of the section of the subframe \([\text{mm}^3]\)

\( W_t \) = section modulus of the section of the chassis \([\text{mm}^3]\)
\( \sigma_{\text{max}} \) = maximum static stress allowed on chassis \([\text{N/mm}^2]\) see chapter 2.1, Paragraph "Stresses on the chassis" (Page 7)

**Example of stress calculation in case of elastic connection with the chassis**

We consider two C sections with the following dimensions:

- **chassis**: 250 x 70 x 5 mm
- **subframe**: 140 x 70 x 7 mm

and stressed in a section given by the maximum bending moment \( M_f \) equal to 15,000 Nm, perpendicular applied to the plane containing the rib of the side member.

From the calculation are obtained the following values:

<table>
<thead>
<tr>
<th></th>
<th>( I )</th>
<th>( W )</th>
</tr>
</thead>
<tbody>
<tr>
<td>chassis</td>
<td>1,545 cm(^4)</td>
<td>123 cm(^3)</td>
</tr>
<tr>
<td>subframe</td>
<td>522 cm(^4)</td>
<td>74 cm(^3)</td>
</tr>
</tbody>
</table>

Applying the formulas will be obtained:

\[
M_t = M_f \times \left[ \frac{I_t}{(I_t + I_c)} \right] = 8,500 \times \left[ \frac{588}{(588 + 183)} \right] = 11,200 \text{ Nm}
\]
\[
M_c = M_f \times \left[ \frac{I_c}{(I_c + I_t)} \right] = 8,500 \times \left[ \frac{183}{(588 + 183)} \right] = 3,790 \text{ Nm}
\]

and then:

\[
\sigma_t = \frac{M_t}{W_t} = 91 \text{ N/mm}\(^2\)
\]
\[
\sigma_c = \frac{M_c}{W_c} = 51 \text{ N/mm}\(^2\)
\]

**Connection with brackets**

Some examples of achievements of this type of connection, are shown in Figure 10.
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 counter chassis 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 13). When the front connection is elastic (see Figure 11), 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 counter chassis 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).
Connections with greater elasticity

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 11 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 11](image_url)

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 counter chassis 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 counter chassis and avoid excessive bending moments on the original chassis.

Connections with clevis fasteners or clamps

Figure 12 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 13.

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 14.

**Figure 12**

1. Chassis  
2. Subframe  
3. Clevis fasteners  
4. Closure with anti-unscrewing system  
5. Spacers  
6. Guide plates (if necessary)

**Connection with longitudinal and transverse sealing plates (rigid junction)**

The type of mounting shown in Figure 13, 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 counter chassis 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.

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

### Table 3.3

<table>
<thead>
<tr>
<th>Chassis and subframe height/section ratio</th>
<th>Max. distance between the centre lines of the cut-resistant plates [mm] (1)</th>
<th>Minimum characteristics of the plates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thickness [mm]</td>
<td>Dimensions of the screws (2)</td>
</tr>
<tr>
<td></td>
<td>(min. 3 screws per plate)</td>
<td>M14</td>
</tr>
<tr>
<td>≥ 1.0</td>
<td>500</td>
<td></td>
</tr>
</tbody>
</table>

(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 counter chassis, it is advisable to connect by adopting spacer bushes, in order to use longer screws.

### Mixed connection

Based on the indications in Chapter 3.1 (Page 5) for realisation of the counter chassis and the considerations of Chapter 3.3 (Page 11), the connection between the vehicle chassis and the reinforcing counter chassis 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 counter chassis (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 14.
3.4 CONTAINER APPLICATION

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.

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>Section modulus $W_s$ [cm$^2$] of the minimum reinforcement section</th>
</tr>
</thead>
<tbody>
<tr>
<td>110EL(1), 120EL(1), 120E, 140E, 150E, 160E</td>
<td>up to 3690</td>
<td>40</td>
</tr>
<tr>
<td>110EL(1), 120EL(1), 120E, 140E, 150E, 160E</td>
<td>and 3690</td>
<td>46</td>
</tr>
<tr>
<td>150H, 170H, 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 13 and 14).

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 15.

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.
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 16).

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.
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 13) 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 17. 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/m$^3$ 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, drawbar coupling, etc.) and ensure that, following the addition of the structure, vehicle stability is guaranteed during tipping operations.

Note: The air springs must be completely unloaded during body tipping operations, to ensure the stability of vehicles equipped with air suspensions. Provide a plate to point out this requirement.
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 $W_x$, 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 3) involves the segment between the rear wire 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 3.5

<table>
<thead>
<tr>
<th>Model</th>
<th>Wheel base (mm)</th>
<th>Section modulus $W_x$ [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>120K</td>
<td>T T</td>
<td>45</td>
</tr>
<tr>
<td>140K</td>
<td>T T</td>
<td>53</td>
</tr>
</tbody>
</table>
3.4 CONTAINER APPLICATION

<table>
<thead>
<tr>
<th>Model</th>
<th>Wheel base (mm)</th>
<th>Section modulus $W_x$ [$cm^3$] of the minimum section bar of the subframe (Yield point of the material used = 360 N/mm$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150K, 160K</td>
<td>T T</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.

Light-duty 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 $W_x$ [$cm^3$] of the minimum section bar of the subframe (Yield point of the material used = 360 N/mm$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>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>150H, 170H, 180E, 190EL</td>
<td>69</td>
</tr>
</tbody>
</table>

Note  For the dimensions of the profiles see Table 3.2.
Roll off containers

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" (PageIndex 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 (PageIndex 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.

**Note** The air springs must be completely unloaded during unloading operations, to ensure stability of vehicles equipped with air suspensions. Provide a plate to point out this requirement.

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 (PageIndex 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.

![Figure 18](image-url)
3.5 TRACTOR FOR SEMI-TRAILER

The Eurocargo range does not include a version designed to tow trailers. Conversion from a cab vehicle (in category N2 or N3) to a tractor is a complex task and includes work which, as indicated in Chapter 1.3, requires specific IVECO authorisation. This authorisation provides the technical specifications (structure, articulation, braking, electric system, etc.) that the Bodybuilder must observe, as well as the indications regarding the permitted masses and precautions for use.

3.6 TRANSPORT OF INSEPARABLE MATERIALS (TRAILER TRUCKS)

Not provided.

3.7 INSTALLATION OF TANKS AND LOOSE MATERIAL CONTAINERS

a) 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$^3$] of the minimum section bar of the subframe (Yield point of the material used = 360 N/mm$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>110EL, 120EL</td>
<td>57</td>
</tr>
<tr>
<td>120E, 140E, 150E, 160E</td>
<td>89</td>
</tr>
<tr>
<td>150H, 170H, 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 19) 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.

b) **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 (⇒ Page 54)).

### 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.
Figure 21

\[ M_{G\text{ max}} = (F \cdot L + P \cdot l)_{\text{max}} \]

- \( F = \) mass applied to crane extremity [kg]
- \( L = \) horizontal distance between the load application point \( F \) and vehicle centre line [m]
- \( P = \) mass of the crane at its centre of gravity [kg]
- \( l = \) 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.

Crane behind cab

To arrange appropriate spaces behind the cab for the installation of the crane and the stabilisers, it is recommended that option 75435 "Crane withdrawal" is considered.

The fastening of the reinforcement sections to the chassis must be carried out using the standard brackets (see Figure 22), 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 23). 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 23) can be integrated towards the rear end with that envisaged for another possible superstructure; the length \( L_v \) must in no case be less than 35% of the wheelbase if the superstructure section diameter is smaller.
3.8 INSTALLING A CRANE

1. Reinforcing profile
2. Connections
3. Crane connections
4. Stabilisers

Figure 22

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 Mₕ max [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>180</td>
</tr>
<tr>
<td>110EL(0), 120EL(0)</td>
<td>195.5x65x5</td>
<td>A</td>
</tr>
<tr>
<td>110EL(0H), 120EL(0H)</td>
<td>195.5x65x6</td>
<td>A</td>
</tr>
<tr>
<td>120E, 140E, 150E, 160E</td>
<td>240x70x5</td>
<td>A</td>
</tr>
<tr>
<td>120E, 140E, 150E, 160E</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>150H, 170H, 180E, 190EL</td>
<td>262.5x80x6</td>
<td>A</td>
</tr>
<tr>
<td>180E, 190EL</td>
<td>262.5x80x6.7</td>
<td>A</td>
</tr>
<tr>
<td>150H, 170H, 180E, 190EL</td>
<td>262.5x80x7.7</td>
<td>A</td>
</tr>
</tbody>
</table>

Minimum value of the section modulus of the subframe section Wₓ [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.

Elastic connections between chassis and subframe may be needed to avoid excessive constraint on the chassis torsional movement for application of crane on off-road vehicles on the front and middle parts (see Figure 11). 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>Chassis section [mm]</th>
<th>Total torque $M_G$ max [kNm]</th>
<th>Total torque $M_G$ max [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>110EL(1), 120EL(1)</td>
<td>195.5x65x5</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>
</tbody>
</table>

Minimum value of the section modulus of the subframe section $W_x$ [cm³] (1)
APPLICATIONS OF SUPERSTRUCTURES

3.8 INSTALLING A CRANE

<table>
<thead>
<tr>
<th>Model</th>
<th>Chassis section [mm]</th>
<th>Total torque $M_g$ max [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>120E, 140E, 150E 110E</td>
<td>240x70x5</td>
<td>A</td>
</tr>
<tr>
<td>120E, 140E 150E, 160E 150EVW</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>150H, 170H, 180E, 190EL</td>
<td>262.5x80x6</td>
<td>A</td>
</tr>
<tr>
<td>180E, 190EL</td>
<td>262.5x80x6.7</td>
<td>A</td>
</tr>
<tr>
<td>150H, 170H, 180E, 190EL</td>
<td>262.5x80x7.7</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 $W_x$, not less than $57 \text{ cm}^3$.

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

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 $120 \text{ mm}$ 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></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material yield strength $R_{0.2}$ [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>$L_v$ (see figure 3.22)</td>
<td>$0.25 L_H$ or $L_A$</td>
<td>$0.35 L_H$ or $L_A$</td>
<td>$0.55 L_H$ or $L_A$</td>
<td>$0.60 L_H$ or $L_A$</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>
Cranes on 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) box sections and cross bracings in line with the rear suspension and along the entire length $L_V$ (see Figure 25).

The passage between box section $s$ and open sections must be well fitted as shown in Figure 3.

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).

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 $L_U$ see Figure 25) must be limited to the extent possible (never exceed 50% of the wheelbase) to maintain good vehicle drive 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 (Navigation Page 11)). The axle must be lowered while travelling if the minimum required value is not obtained.

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

<table>
<thead>
<tr>
<th>Models</th>
<th>Chassis section [mm]</th>
<th>Total torque $M_{G,\text{max}}$ [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>110EL(1), 120EL(1)</td>
<td>195.5x65x5</td>
<td>A</td>
</tr>
<tr>
<td>110EL(2), 120EL(2)</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>150H, 170H, 180E, 190EL</td>
<td>262.5x80x6</td>
<td>A</td>
</tr>
<tr>
<td>180E, 190EL</td>
<td>262.5x80x6.7</td>
<td>A</td>
</tr>
<tr>
<td>150H, 170H, 180E, 190EL</td>
<td>262.5x80x7.7</td>
<td>A</td>
</tr>
</tbody>
</table>

$A = \text{The reinforcement section envisaged for the relative superstructure is sufficient (e.g. Table 3.4 for normal containers). In the crane area, brace the reinforcement profile sections which have a thickness of less than 5 mm.}$
### 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 1.15 (☞ 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 24, in the case of other overhangs and/or particular tail lifts (as for example, those with a vertical rest position).

---

**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 $57 \text{ cm}^3$.

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

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 $120 \text{ mm}$ 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 3.12 - Crane mounted on rear overhang (solutions with combined section reinforcement structures)

<table>
<thead>
<tr>
<th>Material yield strength $R_{0.2}$ (N/mm$^2$)</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum reduction in section height [mm]</td>
<td>20</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>$L_v$ (see figure 3.25)</td>
<td>0.60 $L_v$</td>
<td>0.65 $L_v$</td>
<td></td>
</tr>
<tr>
<td>Example of combined section structure used as alternative to a single 250x80x8 [mm] channel section</td>
<td>200x80x8</td>
<td>160x80x8 + corner section</td>
<td>140x80x8 + corner section</td>
</tr>
<tr>
<td>Effective reduction in height [mm]</td>
<td>12</td>
<td>52</td>
<td>64</td>
</tr>
</tbody>
</table>

**B** = Normal box profile

**C - D** = Special combined section profiles

**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.
To ensure the necessary strength and rigidity, and especially in the case of overhangs exceeding 1500 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 26).

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

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

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

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

<table>
<thead>
<tr>
<th>Model</th>
<th>Wheelbase [mm]</th>
<th>Overhang [mm]</th>
<th>Tail lift capacity in kN (kg)</th>
<th>Minimum value of subframe section modulus of resistance Wx [cm³] with ultimate tensile strength of the material equal to 360 N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>110EL</td>
<td>3105</td>
<td>1313</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>120EL</td>
<td>3330</td>
<td>1830</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>3690</td>
<td>1830</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>4185</td>
<td>2145</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>4455</td>
<td>2280</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>4815</td>
<td>2505</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>110EL/P</td>
<td>3690</td>
<td>1830</td>
<td>A</td>
<td>16</td>
</tr>
<tr>
<td>120EL/P</td>
<td>4185</td>
<td>2145</td>
<td>A</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>4455</td>
<td>2280</td>
<td>A</td>
<td>16</td>
</tr>
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<td></td>
<td>4815</td>
<td>2505</td>
<td>A</td>
<td>16</td>
</tr>
<tr>
<td>120E</td>
<td>3105</td>
<td>1313</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>3690</td>
<td>1740</td>
<td>A</td>
<td>A</td>
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<tr>
<td></td>
<td>4185</td>
<td>2055</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>4455</td>
<td>2190</td>
<td>A</td>
<td>A</td>
</tr>
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<td></td>
<td>4815</td>
<td>2460</td>
<td>A</td>
<td>A</td>
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<td></td>
<td>5175</td>
<td>2685</td>
<td>A</td>
<td>16</td>
</tr>
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<td>5670</td>
<td>3000</td>
<td>A</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>6570</td>
<td>2735</td>
<td>A</td>
<td>16</td>
</tr>
<tr>
<td>120E/P, /FP</td>
<td>4185</td>
<td>2055</td>
<td>A</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>4455</td>
<td>2190</td>
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<td>16</td>
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<td>2460</td>
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<td>5175</td>
<td>2685</td>
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<td>16</td>
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<tr>
<td></td>
<td>5670</td>
<td>3000</td>
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<td>16</td>
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<td>6570</td>
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<td>16</td>
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<td>140E</td>
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<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>3690</td>
<td>1740</td>
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<td></td>
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<td>2685</td>
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<td>2055</td>
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### APPLICATIONS OF SUPERSTRUCTURES

#### 3.9 INSTALLATION OF TAIL LIFTS

<table>
<thead>
<tr>
<th>Model</th>
<th>Wheelbase [mm]</th>
<th>Overhang [mm]</th>
<th>Tail lift capacity in kN (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>7.5 (750)</td>
</tr>
<tr>
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<td>3105</td>
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</tr>
<tr>
<td>190EL</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.
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>Material yield strength $R_{0.2}$ (N/mm$^2$)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum reduction in section height [mm]</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>$L_v$ (see Figure 3.26)</td>
<td>0.50 $L_v$</td>
<td>0.60 $L_v$</td>
<td>0.80 $L_v$</td>
<td>0.85 $L_v$</td>
</tr>
<tr>
<td>$L_t$ (see Figure 3.26)</td>
<td>0.60 $L_t$</td>
<td>0.65 $L_t$</td>
<td>0.95 $L_t$</td>
<td>1.00 $L_t$</td>
</tr>
<tr>
<td>Example of combined section structure used as alternative to a single 250x80x8 [mm] channel section</td>
<td>210x80x8</td>
<td>190x80x8</td>
<td>150x50x8 + corner section</td>
<td>130x50x8 + corner section</td>
</tr>
<tr>
<td>Effective reduction in height [mm]</td>
<td>40</td>
<td>52</td>
<td>92</td>
<td>104</td>
</tr>
</tbody>
</table>

A - B = Normal box profiles
C - D = Special combined section profiles

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), for preserving visibility of the rear lights, for the overhang angles, and for the positioning of the drawbar coupling as provided by the respective national requirements.

Base configuration for tail lifts

A base configuration (opt. 4113) for the installation of tail lifts is available on EUROCARGO models (see also 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 27);
- connection to instrument cluster for activation of tail lift warning light (see Figure 27).
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.

**VEHH configuration 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 consists of a simple bar with side marker lights, tail lights and a licence plate mount which the bodybuilder must remove and replace with a definitive under-run bar with its own specific fasteners (see Figure 28);
- 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 (see Figure 29);

**Note**  The opt. 75182 is only available together with opt. 169 (Vehicle without rear under-run protection RUP).
Before operating the tail lift, press switch (A) on the central module of the dashboard. When the green warning light (B) activates, this indicates that the control system is ON and that the engine is off; when the red warning light activates, this indicates that the tail lift is open. Once the movement of the load has completed and after having correctly closed the platform, press the switch (A) again to deactivate the system and allow engine start-up.

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.

▶ A vehicle with no outfitting or subframe may only be moved on very short journeys, at limited speeds. Without such structures, the dynamic stresses could increase so as to compromise the integrity of the chassis. This risk must therefore be pointed out on an appropriate plate on board the vehicle”.

**3.11 CONSTRUCTION OF BOX TRUCK BODIES**

A structure consisting of box section longitudinal and cross members (see Figure 3.15) may be used for connection to the chassis of the vehicle. 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 included in those specifically indicated for this application. These vehicles are listed in Table 3.5 together with the characteristics of the subframe profile to be made.

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 5 and Figure 6).

Connections to the chassis must be elastic (brackets or supports) at the front end and stiff at the rear end (cleat plates, see Figure 13) 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 17. 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. The recommended position is in front of the centre of gravity of the flatbed plus the useful load, in order to reduce the size of the localised load.

▶ 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.

**Note** The air springs must be completely unloaded during floorpan tipping operations, to ensure the stability of vehicles equipped with air suspensions. Provide a plate to point out this requirement.

### 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 is strictly prohibited. It being understood that all the national prescriptions and standards that regulate the application of the aforesaid attachments must be observed, the possibility of using the original parts on the vehicle front (e.g. tow hook, footboard for cleaning the windscreen) must be safeguarded; otherwise the Bodybuilder must consider equivalent systems, in observance of the safety prescriptions.

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 52)), 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 (\(W_x\)) and a moment of inertia (\(I_x\)) 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 30);

#### 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_x) [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.
Applications of Superstructures

3.16 Concrete Mixer Installation

- The subframe must be reinforced (e.g. crossbar, cross brace at rear part - see Chapter 3.2 - Paragraph "Crossbars" (➠ Page 9)) 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 11)) 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);

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.
Note  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).
SECTION 4

POWER TAKE-OFFS
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POWER TAKE-OFFS

4.1 GENERAL SPECIFICATIONS

Different types of power take-offs (PTO) for motion withdrawal 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.

For the definition of the power necessary for the apparatus to be controlled, particularly when the values requested are high, the absorbed power should also be considered during the drive transmission phase (5 to 10% for the mechanical transmissions, belts and gears, and greater values for the hydraulic controls).

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.

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

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

\(P\) = Available power

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

\(n\) = Engine revolutions per minute

\(i\) = Transmission ratio = PT output rpm / engine rpm

Type of use

The maximum torque take-off values indicated are with reference to continuous usage 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.

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 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.

⚠️ During prolonged use, the gearbox oil temperature must not exceed 110 °C and the water temperature must not exceed 100 °C.

⚠️ Not all types of power take-offs are suitable for continuous use; always follow the specific instructions for the power take-off during operation (working times, breaks etc.).
PTO transmission

In full compliance of the Manufacturer’s transmission specifications, the kinematic forces from the power take-off to 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 obtain good kinetic forces, angles equal to the value of the ends of the shafts must be created (see Figure 1) and these values 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 transmission line with spatial inclinations according to angle $\phi$ (as shown in Figure 2), it is important to remember that the kinetic forces of the assembly can only be ensured if the intermediate section has forks offset by the same angle $\phi$ and if equal conditions are respected between the angles at the extremities $X_1$ and $X_2$.

For transmissions employing multiple sections, please refer to the indications provided in Chapter 2.8 (☞ Page 36).

Electric system

On EUROCARGO Euro 6 vehicles, all PTOs - including any PTOs installed after purchase - are managed solely by the EM. Therefore vehicle order shall contain related OPT 4572.

The electrical and electronic VCM / EM systems (see Figure 1 - Section 5) provide innovative methods and processes for the control of power take-offs, which are able to significantly improve safety and reliability. To activate, connect the PTO control switch to pin connector 61071.

Pneumatic system
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 mechanical gearboxes can 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.

**Transmission PTO data**

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>6S700</td>
<td>88ZI/5</td>
<td>RH rear</td>
<td>Anticlockwise</td>
<td>0.97</td>
<td>450</td>
</tr>
<tr>
<td>6S700</td>
<td>NL/1C (1)</td>
<td>Centre rear</td>
<td>Clockwise</td>
<td>0.57</td>
<td>600</td>
</tr>
<tr>
<td>6S800</td>
<td>NH/4C</td>
<td>RH rear</td>
<td>Anticlockwise</td>
<td>0.67</td>
<td>350</td>
</tr>
<tr>
<td>6S800</td>
<td>88ZI</td>
<td>RH rear</td>
<td>Anticlockwise</td>
<td>0.962</td>
<td>450</td>
</tr>
<tr>
<td>6S1000</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>6S1000</td>
<td>NH/1C</td>
<td>Centre rear</td>
<td>Clockwise</td>
<td>0.53</td>
<td>1000</td>
</tr>
<tr>
<td>6S1005</td>
<td>NL/10</td>
<td>Upper rear</td>
<td>Anticlockwise</td>
<td>1.70</td>
<td>320</td>
</tr>
<tr>
<td>6S1005</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>9S -75 TO</td>
<td>N75/10C</td>
<td>RH rear</td>
<td>Anticlockwise</td>
<td>1.27</td>
<td>410</td>
</tr>
<tr>
<td>9S -75 TO</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>9S -1110</td>
<td>N109/10</td>
<td>Upper rear</td>
<td>Anticlockwise</td>
<td>1.45</td>
<td>500</td>
</tr>
<tr>
<td>9S -1110</td>
<td>NH/1C</td>
<td>Centre rear</td>
<td>Clockwise</td>
<td>0.97</td>
<td>800</td>
</tr>
<tr>
<td>9S -1110</td>
<td>P96A1</td>
<td>RH lateral</td>
<td>Anticlockwise</td>
<td>0.985</td>
<td>270</td>
</tr>
<tr>
<td>9S -1110</td>
<td>P96A2</td>
<td>RH lateral</td>
<td>Anticlockwise</td>
<td>1.264</td>
<td>250</td>
</tr>
<tr>
<td>S2500</td>
<td>I7A1</td>
<td>LH lateral</td>
<td>Anticlockwise</td>
<td>0.93</td>
<td>600</td>
</tr>
<tr>
<td>S3000</td>
<td>I7A1</td>
<td>LH lateral</td>
<td>Anticlockwise</td>
<td>0.93</td>
<td>600</td>
</tr>
</tbody>
</table>
4.3 POWER TAKE-OFF FROM TRANSFER BOX

On vehicles with all-wheel drive (4x4), PTOs may be installed on the transfer box. The required take-off speed may be selected by engaging the appropriate gear.

Utilization is only envisaged for stationary vehicles (transfer box in neutral).

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.

The maximum permissible take-off torque values are given as follows:

<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</td>
<td>500</td>
<td>flange Φ est. 90 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 holes Φ 8.1 mm</td>
</tr>
</tbody>
</table>

(*) 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 DRIVE LINE

The authorisation for the application of a power take-off on the drive line downstream of the gearbox is issued after examination of the complete documentation presented to the IVECO.

The power and torque values will be evaluated as each occasion arises on the basis of the conditions of use.

In general, the following should be noted:

- The 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 drive line in two or more sections, the power take-off may also be fitted at the flexible support between the first and second sections (respect the indications given in Chapter 2.8 ( ➤ Page 36));
- the angles of the drive line on the horizontal plane and vertical plane must be kept as close as possible to the original values;
masses and rigidity added to the drive line must not provoke a loss of balance or abnormal vibrations or damage the transmission drive line (from engine to axle) either during vehicle movement or during operation with the power take-off;

- the power take-off must be fixed to the chassis with its own suspension.

![Note](image)

**Note** Any intervention on the driveshaft carried out without prior authorisation from IVECO will immediately invalidate the warranty.

**Note** The power take-offs on the line of the universal joint cannot be used in conjunction with EuroTronic transmissions.

## 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.

### Torque PTO from the front of the engine

The drive take-off from the front of the crankshaft occurs, for limited torque values to be drawn off (for example: 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 uses, when not specifically planned, require significant modifications to the front part of the vehicle (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 fluid 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 be referred to for the pick up.

On the front part of the engine there is a pulley with 2 races from where power can be picked up.

The position of the pick up and the size of the pulley is indicated in the following Figure.
Figure 3

A Front section of the engine

1. Pulley for drive pick up
**Figure 4**

Table 4.3 - PTO on front part of engine

<table>
<thead>
<tr>
<th>Engine</th>
<th>$n_{\text{max}}$</th>
<th>Max. torque available [Nm]</th>
<th>Maximum moment of inertia [kgm$^2$] $^{(1)}$</th>
<th>Maximum flexural moment [Nm] $^{(2)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tector</td>
<td></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>
<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>
</tbody>
</table>
### Power Take-Offs

#### 4.5 Power Take-Off From Engine

<table>
<thead>
<tr>
<th>Multiplication factor</th>
<th>Angular position</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>105 – 65</td>
</tr>
<tr>
<td>3</td>
<td>165 – 210</td>
</tr>
<tr>
<td>2</td>
<td>210 – 225</td>
</tr>
</tbody>
</table>

**Torque PTO from the rear of the engine**

**Multipower PTO on engine fly-wheel**

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.

**To guarantee correct engagement, the static moment of connected units must not exceed 35 Nm. According to the version of the connected units, it may be necessary to consider a clutch engageable by load (weight) in the transmission.**

The main technical and dimensional characteristics are given in Figure 5 and in Table 4.4.

![Figure 5](image.png)

**Table 4.4 - Technical specifications**

<table>
<thead>
<tr>
<th>Ratio revolutions - rpm</th>
<th>1.29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. torque available</td>
<td>900 Nm</td>
</tr>
</tbody>
</table>
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 ECUs illustrated in figure 6 are situated on the right hand side of the dashboard (lower part), in front of the passenger seat.

The EM ECU (where installed) manages the PTOs.
Principles
PTOs are activated electrically by means of a solenoid and the PTO engagement is checked by the PTO feedback signal. Configuring PTO modes involves programming the following ECUs: expansion module (EM) and vehicle control module (VCM).
The EM is able to drive up to three physical PTOs and controls their activation and the deactivation individually.
The PTO management functionality significantly simplifies conversion as it includes a number of safety and check functions.
The following two conditions must be met to permit activation of a PTO:
1. PTO is mechanically engaged;
2. a PTO mode associated with the PTO must be recalled. See later for the definition of PTO mode.

Actions 1. and 2. may be performed with two separate commands (in the sequence 1. - 2.), or with a single command from the PTO switches on the central island console in the cab.
Generally, a PTO may be engaged with an electric command (which activates a solenoid valve).

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 middle of the dashboard, used to request an action associated with a given PTO (e.g. depending on EM programming, PTO engage/disengage).
Since the EM and VCM are able to control up to three PTOs, there might be up to three switches (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.
Physical PTO Activation

The physical activation of the PTO is an integral part of the PTO Mode and 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 physical activation of the PTO can be customised by IVECO Service upon request. It is stored in the EM control unit, as is the selection if intermediate speed control is requested from the VCM control.

PTO mode 0 (driving mode)

In this mode, the vehicle can travel at a permitted maximum speed of up to 25 km/h in which, by pressing the RES button (CC controls) on the steering column switch, an intermediate engine speed of 900 rpm activates. It is possible to set a new intermediate engine speed value from those stored by the driver by pressing and holding the RES button for more than 5 seconds; in this case, reprogramming by IVECO Service is not necessary.

**Note**  Above 25 Km/h, the speed regulator is activated automatically.

The max. number of rpm obtainable with the SET+ and SET- buttons (CC controls) is identical for all modes (PTO mode 0, PTO modes 1, 2 and 3) and can be configured via E.ASY. only for PTO modes 1, 2 and 3.

The settings indicated in Table 4.5 cannot be modified for PTO mode 0 (driving mode).

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>RES / OFF</td>
<td>Activate/deactivate intermediate engine speed. The factory intermediate engine speed setting is 900 rpm, which may be altered by the driver.</td>
</tr>
<tr>
<td>SET+ / SET-</td>
<td>Increase/reduce active intermediate engine speed setting</td>
</tr>
<tr>
<td>Accelerator pedal</td>
<td>Active</td>
</tr>
<tr>
<td>Max. rpm possible with SET+ button or accelerator pedal</td>
<td>$N_{\text{LL}}(1)$ = maximum rpm permitted by engine</td>
</tr>
<tr>
<td>Torque delivered</td>
<td>Maximum specific engine torque</td>
</tr>
</tbody>
</table>
| Conditions for deactivating intermediate engine speed function | - Operation of the brake or clutch pedal  
- CC Off activated  
- Engine brake operated  
- Intarder operated  
- PTO mode 0 deactivation speed  
- ‘NEUTRAL’ not selected (automatic transmissions) |

(1) $N_{\text{LL}} = \text{rpm at idle speed}$.

PTO modes 1, 2, 3 (configurable)

Three different and independent PTO maps can be programmed by IVECO Service. Since the engine can only operate with one PTO mode at a time, the following priorities have been set:

- PTO mode 3: high priority;
- PTO mode 2: medium priority;
- PTO mode 1: low priority;
- PTO mode 0: driving mode.
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 shows the parameters making up a PTO mode. These parameters can only be programmed using an E.A.S.Y. diagnostics station at IVECO Service.

### Table 4.6

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Possible values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. rpm possible with SET + button, ( N_{\text{SET, max}} ) (1)</td>
<td>( N_{LL} \leq N_{\text{max}} ) (2)</td>
</tr>
<tr>
<td>Max. rpm possible with the accelerator pedal</td>
<td>( N_{\text{max, acc}} )</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 (3)</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>Steady (E.A.S.Y.)/spare (driver) (8)</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)</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 (7)</td>
<td>Active / inactive</td>
</tr>
<tr>
<td>Minimum rpm possible with SET - button, ( N_{\text{SET, min}} ) (9)</td>
<td>( &gt; 500 \text{ 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) ( N_{ZDR, max} )</td>
<td>between 2 Km/h and 95 Km/h (programmable)</td>
</tr>
<tr>
<td>Permissible PTO speed range (1)</td>
<td>( N_{LL} ) - Maximum rpm possible (3)</td>
</tr>
</tbody>
</table>

Abbreviations:

- \( N_{LL} \): minimum number of rpm
- \( N_{\text{max}} \): maximum number of rpm
- \( N_{\text{RES}} \): Stored intermediate engine speed value recalled by pressing RESUME or by activating a PTO mode
- \( N_{\text{SET, max}} \): maximum rpm obtainable with the SET+ button. This value is identical for all PTO modes
- \( N_{\text{SET, min}} \): minimum rpm value settable with SET - button
- \( N_{\text{max, acc}} \): max. 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:

- the value may never be set below \( N_{LL} \)
- the value may never exceed \( N_{\text{max}} \)
- In general, the following situation exists: \( N_{LL} \leq N_{\text{SET, min}} \leq N_{\text{RES}} \) and \( N_{\text{RES}} \leq N_{\text{SET, max}} \leq N_{\text{max}} \). If this latter difference is not verified, the engine speed will be limited to \( N_{\text{max}} \).

(3) See following paragraph.

(4) The "TIP" function (pressing briefly on the rocker button) allows the driver to gradually adjust the intermediate engine speed regulator or the speed regulator setting speed, briefly pressing (< 1 sec) button SET + / SET-. The intermediate engine speed regulator can be activated...
at speeds < 25 km/h; while pressing at speeds > 25 km/h activates the speed control. The variation for the intermediate engine speed regulator is 20 rpm for each "TIP" whereas for the speed regulator, it is 1 km/h for each TIP.

(5) Active - PTO mode deactivates when service brake or clutch is operated
Disabled - PTO mode does not deactivate when the service brake or clutch is operated.
In PTO mode 0, the PTO mode is deactivated when service brake or clutch is operated.

(6) Active - PTO mode deactivates when parking brake or clutch is operated
Disabled - PTO mode does not deactivate when parking brake or clutch is operated.
In PTO mode 0, the PTO mode is not deactivated when the parking brake is operated.

(7) Active - engine speed automatically adjusts to $N_{\text{RES}}$ value set for the specific PTO mode.
Disabled - engine speed remains at previous value. Press RES button to set speed to $N_{\text{RES}}$

(8) See paragraph "Modifying stored intermediate engine speed value $N_{\text{RES}}$"

Values settable for PTO modes 1, 2 and 3 only.

**Changes to the torque curve, maximum rotation speed and steepness of the maximum rotation speed lim-iter**

For mechanical power take-off protection, it is possible to limit:

- engine torque delivery as a protection against overload;
- engine rpm, as a protection against over-speed.

This is qualitatively shown by the diagram in Figure 7 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 be available according to the intended use of the PTO;
- the speed referred to is that of the crankshaft and not that of the PTO, for which the rpm must be calculated taking into account the reduction ratio (see Table 4.3);
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.

We will take a look at the example in Figure 8:
• 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 in Chapters 4-1 (⇒ Page 5)):

\[ P = \frac{600 \times 1100}{9550} = 69 \text{ kW} = 94 \text{ HP} \]

The over-revving regulator curve (gradient) depends on the specific application.

With stationary operation, a steep over-revving 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 8), 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.
4.7 STANDARD CONFIGURATIONS

The following table contains the factory settings.

**Table 4.7**

<table>
<thead>
<tr>
<th>PTO Mode</th>
<th>Mode 0</th>
<th>Mode 1</th>
<th>Mode 2</th>
<th>Mode 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activation from 21-pin connector 61071</td>
<td>No activation necessary</td>
<td>Pins 18 and 17 connected</td>
<td>Pins 19 and 17 connected</td>
<td>Pins 20 and 17 connected</td>
</tr>
<tr>
<td>Max. torque</td>
<td>Max. engine torque</td>
<td>Max. engine torque</td>
<td>Max. engine torque</td>
<td>Max. engine torque</td>
</tr>
<tr>
<td>Max. rpm possible with SET + button, N_{SET,\text{max}}</td>
<td>Maximum speed according to the maximum speed of the engine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. number of rpm value settable with SET - button, N_{SET,\text{min}}</td>
<td>Minimum speed according to the number of engine revs N_{LL} default</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overspeed regulator curve gradient</td>
<td>Dependent on rated curve</td>
<td>0 rpm/Nm</td>
<td>0 rpm/Nm</td>
<td>0 rpm/Nm</td>
</tr>
<tr>
<td>Accelerator pedal</td>
<td>Active</td>
<td>Active</td>
<td>Active</td>
<td>disabled</td>
</tr>
<tr>
<td>Usage of CC buttons (RES / OFF / SET + / SET-)</td>
<td>Active</td>
<td>Active</td>
<td>Active</td>
<td>Disabled</td>
</tr>
<tr>
<td>Stored engine speed, N_{RES}</td>
<td>900 rpm</td>
<td>900 rpm</td>
<td>1100 rpm</td>
<td>1300 rpm</td>
</tr>
<tr>
<td>Maximum vehicle speed above which PTO is deactivated, v_{ZDR,\text{max}}</td>
<td>25 km/h</td>
<td>35 km/h</td>
<td>35 km/h</td>
<td>35 km/h</td>
</tr>
<tr>
<td>PTO mode disabled from brake or clutch</td>
<td>Active</td>
<td>Disabled</td>
<td>Disabled</td>
<td>Active</td>
</tr>
<tr>
<td>Recalling stored intermediate engine speed setting with RES after activation of PTO mode</td>
<td>Active</td>
<td>Disabled</td>
<td>Disabled</td>
<td>Disabled</td>
</tr>
<tr>
<td>PTO mode deactivated from parking brake</td>
<td>Active</td>
<td>Active</td>
<td>Active</td>
<td>Active</td>
</tr>
<tr>
<td>PTO mode deactivated from engine brake</td>
<td>Active</td>
<td>Active</td>
<td>Active</td>
<td>Active</td>
</tr>
</tbody>
</table>

**Note**  The rpm increment/decrement with the SET + / SET - buttons is 250 rpm

**Conditions for activating/deactivating PTO**

The conditions described below can be modified by the IVECO Service Network.

1) **No PTO installed or PTO pre-installation**

Only the engine speed programming is requested by the VCM.

The switches select the three speed modes.

**Table 4.8**

<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) **PTO Multipower**

Only the engine speed programming is requested by the VCM.

The switches select the three speed modes (see Table 4-8).

**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 manual gearbox with electric engagement

**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 Allison gearbox

**Activation conditions**

<table>
<thead>
<tr>
<th>Engine status</th>
<th>ON (500 &lt; rpm &lt; 900)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gearbox status</td>
<td>neutral</td>
</tr>
<tr>
<td>Vehicle status</td>
<td>stationary or crawling speed (0 &lt; v &lt; 2 [km/h])</td>
</tr>
<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; 20 [km/h]</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>&gt; 120 [°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 [°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 [°C]</td>
</tr>
</tbody>
</table>
Intermediate engine speed regulator

Maximum number of 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).

TIP function

As already seen in Note (4) of Table 4.6, the TIP function, namely pressing and releasing (< 1 second) of the SET + / SET- button, allows a gradual variation of the intermediate engine speed regulator, 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 speeds > \( V_0 \) km/h, the speed regulator is activated.

For each "TIP", the variation for the intermediate engine speed regulator is 20 rpm while for the speed regulator, it is 1 km/h.

Pressing and holding the SET+ and SET- buttons for longer (>1 sec.) adjusts the intermediate engine speed or the speed control is modified in a continuous manner. The effective rpm or the effective speed value at the time the SET + and SET are released are saved as new requested values.

The TIP function for the SET+ and SET- buttons may be disabled. This configuration is applicable to all PTO modes simultaneously (driving mode PTO 0, PTO mode 1, 2 and 3). Disabling the TIP function limits the functionality of the speed regulator. Only use this configuration after assessing the situation thoroughly.

Note  This function is intended for setting hydraulic units.

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:

\[
\text{time required [s]} = \frac{\text{difference in rpm per second [rpm/s]}}{\text{rpm increment per second [rpm/s/s]}}
\]

Example: the intermediate engine speed setting must be increased from 800 rpm to 1800 rpm with button SET+.

with a modification rate of 250 rpm/s, the interval necessary is 1000/250 = 4 s.

Accelerator pedal enabled/disabled

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.

Allison gearbox

With the Allison gearbox power take-off engagement is coordinated by the gearbox control unit and the Expansion Module control unit and is activated as follows:

- PTO activation 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 activation by the control unit for PTO engagement;
- If the PTO and handbrake are engaged at the same time, the gearbox automatically shifts to neutral and the PTO is activated in mode PTO2 (the relay of the relay carrier plate of the gearbox control unit, on the rear wall of the cab 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 internal transmission conditions required are met, the Allison transmission 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.

PTO use with vehicle in motion

If no limitations are required (e.g. torque limiting, max. rpm etc.) while a PTO is engaged, it is not necessary to activate a PTO mode.

In this case, the engine power available for driving the vehicle is reduced (as part of the power is absorbed by the superstructure), which may lead to difficulties when setting off from a standstill. In certain specific applications (concrete mixer, refuse collection etc.), this problem may be resolved by increasing the idle speed value ("low idle").

If limitations are necessary (e.g. torque limiting, max. rpm etc.), a PTO mode must be activated.

▶ Especially with the vehicle in motion, always bear in mind that activating a PTO mode also recalls the stored intermediate engine speed, which may result in unrequested vehicle acceleration. The bodybuilder must ensure the safety of the vehicle during operation.

Engagement or disengagement depend on the type of PTO used and on the Bodybuilder requirements.

For example: vehicle driving (up to max. 30 km/h) with increased engine speed and PTO engaged.

Certain applications (tipper beds, concrete mixers, refuse collection etc.) also require higher engine speeds for manoeuvring. This may be achieved as follows:

<table>
<thead>
<tr>
<th>storing intermediate engine speed setting NRES number</th>
<th>fixed programming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate engine speed setting NRES number</td>
<td>defined by bodybuilder</td>
</tr>
<tr>
<td>Intermediate speed disengagement</td>
<td>deactivating with clutch or brake</td>
</tr>
<tr>
<td>accelerator pedal</td>
<td>Active</td>
</tr>
<tr>
<td>CC buttons:</td>
<td>disabled</td>
</tr>
</tbody>
</table>

In this case, engine speed may still be controlled solely from the accelerator pedal, between the stored intermediate engine speed value NRES and the maximum rpm value Nmax. When vZDR_max is reached, the intermediate engine speed regulator and the increased engine speed function are deactivated.

Modifying stored intermediate engine speed value NRES

The intermediate engine speed value may be set individually for each PTO mode. There are two different methods for setting this value:

1. Fixed programming (E.ASY.)
   This method is not available for PTO mode 0 (driving mode); modification is only possible by reprogramming with E.ASY. at IVECO Service.

2. Free programming (by the driver)
   Adjust the intermediate engine speed setting as follows:
   - activate the PTO mode for which you intend to modify the intermediate engine speed setting
   - set the desired rpm value with the SET+ / SET- buttons
   - press and hold CC Resume for more than 5 seconds
Adjusting minimum rpm value

The procedure for setting the idle speed consists of three steps and may only be performed with a warm engine:

1. Enabling idle speed adjustment
   With the engine running at idle speed:
   ▪ press the service brake (and hold until the adjustment procedure is complete);
   ▪ press and hold the RES button for more than 3 seconds and then release it; the engine speed immediately adjusts to idle.

2. Adjusting idle speed rpm value
   Press the CC SET+ or CC SET- buttons to adjust the idle speed value in steps of 20 rpm.

3. Storing the idle speed rpm value
   Press and hold CC RES again (for more than 3 seconds).

▶ Idle speed control is only possible in PTO modes in which the CC buttons are active or if intermediate engine speed control is deactivated with the brake or clutch.

4.8 EM (EXPANSION MODULE)

The Expansion Module (EM) is available as option 4572; Furthermore, option 0384 offers a CANopen interface for Bodybuilders. The EM control unit is used for the electronic management of the PTO and for special applications indicated by the EN1501 standard for waste collection vehicles (opt. 6821); As an option it provides a CANopen interface with special gateways for Bodybuilder, in accordance with standard CiA 413 Truck Gateway.

The wiring diagram for the Expansion Module hardware is shown in Figure 9, and the block diagram of the hardware structure is shown in Figure 10.
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 guarantee the PTO can be activated and viewed on the instrument cluster display, the connections of connectors ST91, ST92 and ST93 (see Section 5, Chapter 5.2 for details) must be used as shown in Tables 4.9 and 4.10.

Table 4.9 - PTO mode request

<table>
<thead>
<tr>
<th>PTO</th>
<th>Connector 61071 - pin 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTO 1</td>
<td></td>
</tr>
<tr>
<td>PTO 2</td>
<td></td>
</tr>
<tr>
<td>PTO 3</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.10 - IN / OUT: ST91, ST92, ST93

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PTO feed-back</td>
</tr>
<tr>
<td>2</td>
<td>PTO actuator (solenoid valve control)</td>
</tr>
<tr>
<td>3</td>
<td>Pressure switch (PTO Multipower) or consent to PTO engagement external Bodybuilder</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
</tr>
</tbody>
</table>
SECTION 5

ELECTRONIC SUB-SYSTEMS
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ELECTRONIC SUB-SYSTEMS

5.1 ELECTRONIC SYSTEMS

The innovative Multiplex electronic system (or "Easy Mux" on the Eurocargo) electronically manages and controls the vehicle sub-systems via CAN lines.

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 provided 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.
Position of electronic control units

1. ABS Anti-lock Braking System
2. VCM Vehicle Control Module
3. ECAS Electronic Control Air Suspension
4. EM Expansion Module
5. Central locking
6. Chassis Electronic Module MET
7. Allison Transmission control unit
8. UDS control unit (electronic control for SCR pump module)
9. DDM Drive Door Module
10. EDC Engine Diesel Control
11. IC Instrument Cluster
12. Steering Shaft ECU
13. Voltage reducer
14. PDM Passenger Door Module
15. IBC3 IVECO Body Controller
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.

---

**Bulkhead coupling (passage of electrical wiring)**

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.
**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.
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, ST100, ST99, Cia Cab, Cia frame, 72074, ST91, ST92, ST93**.

Each is described below depending on its location (see Paragraphs "Connectors in Cab" (⇒ Page 11), "Connectors on chassis" (⇒ Page 24) and "Arrangement of side marker lights (Side Marker Lamps)" (⇒ Page 55).

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>
<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>
5.2 BODYBUILDER CONNECTORS

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>

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)
- ST100 (EM)
- ST99 (EM)
- Cia Cab (EM)

These connectors are housed in the lower dashboard, partly on the driver side and partly 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 driver’s side of the windscreen.

![Figure 6](image-url)
Standard connector 61071: 21 pin, brown

**Figure 7**

A. 41 200685 Counterpart to be coupled (female)
B. 504163549 Existing part on vehicle (male)

### 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>
5.2 BODYBUILDER CONNECTORS

<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>15</td>
<td>Cruise Control</td>
<td>8155</td>
<td>10 mA</td>
<td>VCM X3-31</td>
<td>Input signal (3)</td>
</tr>
<tr>
<td></td>
<td>Off/Resume</td>
<td></td>
<td></td>
<td></td>
<td>Open circuit = OFF / RES not activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Connected to Ground = OFF/ Resume activated</td>
</tr>
<tr>
<td>16</td>
<td>CC Driver/BB</td>
<td>0152</td>
<td>10 mA</td>
<td>VCM X3-49</td>
<td>CC activation by Driver or Bodybuilder (BB)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Open wire = CC controlled by driver</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Connected to ground = CC controlled by Bodybuilder (BB)</td>
</tr>
<tr>
<td>17</td>
<td>Ground</td>
<td>0000</td>
<td>10 A</td>
<td>Wiring</td>
<td>Ground</td>
</tr>
<tr>
<td>18</td>
<td>PTO 1 sw</td>
<td>0131</td>
<td>10 mA</td>
<td>VCM X3-47</td>
<td>Input signal (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EM X3-5</td>
<td>Open wire = PTO mode 1 not activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ground = PTO mode 1 activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Input driven by EM, when installed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Else input driven by VCM</td>
</tr>
<tr>
<td>19</td>
<td>PTO 2 sw</td>
<td>0132</td>
<td>10 mA</td>
<td>VCM X3-46</td>
<td>Input signal (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EM X3-6</td>
<td>Open wire = PTO mode 2 not activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ground = PTO mode 2 activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Input driven by EM, when installed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Else input driven by VCM</td>
</tr>
<tr>
<td>20</td>
<td>PTO 3 sw</td>
<td>0123</td>
<td>10 mA</td>
<td>VCM X3-45</td>
<td>Input signal (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EM X3-7</td>
<td>Open wire = PTO mode 3 not activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ground = PTO mode 3 activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Input driven by EM, when installed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Else input driven by VCM</td>
</tr>
<tr>
<td>21</td>
<td>K30</td>
<td>7772</td>
<td>10 A</td>
<td>IBC3 B-09</td>
<td>K30 (after fuse) (4)</td>
</tr>
</tbody>
</table>

(1) 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></td>
<td>1.5</td>
<td>V</td>
<td>$I = 1 \text{ mA}$</td>
</tr>
<tr>
<td>Voltage $U_{\text{high}}$</td>
<td>5.5</td>
<td></td>
<td></td>
<td>V</td>
<td>$I = -1 \text{ mA}$</td>
</tr>
<tr>
<td>Frequency</td>
<td></td>
<td></td>
<td>&lt;1.6</td>
<td>kHz</td>
<td>Square wave</td>
</tr>
<tr>
<td>Pulse duration</td>
<td>0.64</td>
<td>2</td>
<td></td>
<td>ms</td>
<td></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. 40 μs delay ± 10 μs jitter.

(2) Input monitored only when 61071/pin 16 CC Driver/Bodybuilder is connected to ground, otherwise input is ignored.

(3) When the intermediate speed control is activated, 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) The cyclical passage between 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.

**CAUTION:** 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 nevertheless 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 CiA 72072D / Pin 1.

**Standard connector 72071: 9 pin, yellow**

A. 41200681 Counterpart to be coupled (female)

B. 504163547 Existing part on vehicle (male)
Table 5.6 - Basic functions of connector 72071

<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>
</table>
| 1   | 2nd speed-limiter     | 8223      | 10 mA     | VCM X3-13    | 2nd speed limiter activation  
                                 |            |           | 2nd speed limiter activation  
                                 |            |           | Open wire = not activated  
                                 |            |           | +24V = engaged  |
| 2   | Reserved              |           |           |              |                                                                          |
| 3   | Clutch status         | 9963      | 200 mA    | VCM X1-12    | Open circuit = clutch not activated  
                                 |            |           | Connected to ground = clutch activated  |
| 4   | PTS                   | 5542      | 200 mA    | VCM X1-14    | PTS = Programmable Threshold Speed (1)  
                                 |            |           | Programmable threshold (rpm or vehicle speed)  
                                 |            |           | +24 V = limit exceeded  
                                 |            |           | 0 V = limit not exceeded  |
| 5   | Emergency lights      | 1113      | 10 mA     | IBC3 E-04    | Input signal (2)  
                                 |            |           | Connected to ground = on  
                                 |            |           | Open circuit = off  |
| 6   | Reserved              |           |           |              |                                                                          |
| 7   | Reserved              |           |           |              |                                                                          |
| 8   | Engine speed signal   | 5587      | 10 mA     | ECM 1-34     | Pulse signal (3)  |
| 9   | External lights       | 3333      | 5 A       | IBC3 E-24    | 0 V = lights off  
                                 |            |           | +24 V = lights on (parking, low and high beam)  |

(1) VCM default vehicle speed is 6 Km/h  
The value cannot be modified by the Assistance Service with E.A.S.Y. in the presence of the following options:  
- OPT 06821 (EN1501)  
- Certain Refurbishing Near Market requests for RCV (pls contact IVECO Bodybuilders market responsible)

(2) The emergency lights are only supported during the K15 ON phase.

(3) Not available for vehicles with CNG engines.

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 $U_{\text{low}}$</td>
<td>0</td>
<td>1.5</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage $U_{\text{high}}$</td>
<td>$U_{\text{bat}}$ - 2</td>
<td>$U_{\text{bat}}$</td>
<td>V</td>
<td></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 impulses per camshaft revolution, namely three pulses for every turn of the crankshaft (see Figure 10).
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Figure 10

A. Top Dead Centre
a. 120° crankshaft = 60° camshaft
b. Complete crankshaft rotation (360°)
c. Complete camshaft rotation (360°)

When the signal is not available, contact the IVECO Assistance Service.

Optional connector 72070: 12 pin, green

A. 41 200682 Counterpart to be coupled (female)
B. 99478888 Existing part on vehicle (male)

Figure 11

Table 5.8 - Basic functions of connector 72070

<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></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 FMS CAN H FMS = Fleet Management System</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>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 FMS CAN L</td>
<td></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>
5.2 BODYBUILDER CONNECTORS

### Table 5.9 - Basic functions of connector ST100

<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>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Request gearbox in neutral Gearbox activation</td>
<td>6983</td>
<td>500 mA</td>
<td>EM X4-05</td>
<td>Only with automatic gearbox Indicated that Driver requested Neutral gear &amp; Neutral gear being physically engaged Ground = ON Open circuit = OFF</td>
</tr>
<tr>
<td>3</td>
<td>Bodybuilder Enable</td>
<td>0991</td>
<td>Load between 10 mA and 1 A (1)</td>
<td>EM X3-17</td>
<td>This must be activated by the Bodybuilder when the version is operating. Otherwise some Bodybuilder functions will not be supported ● Neutral shift for automatic gearboxes ● Safe State activation by B8 EMCY (ST14B/2) ● CANOpen controls under Firewall monitoring Ground = active, low side Switch</td>
</tr>
<tr>
<td>4</td>
<td>Signal for vehicle with CAN fully operational</td>
<td>9089</td>
<td>10 A (2)</td>
<td>Relay wiring Activated via EM X4-04 and VCM X1-07</td>
<td>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</td>
</tr>
<tr>
<td>5</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></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
(2) Up to 10A can be used in combination with CiA cab connector 72072C / Pin 1

FMS CAN line is enabled with option 14569.
For further information please see Chapter 5.3 ( ➤ Page 28)

Optional connector ST100: 6 pin, blue

![Image of connector ST100](image_url)

A. 41040341 Corresponding opposite connector to be coupled (male)  
B. 41200680 Existing part on vehicle (female)  

Only available with OPT 4572 (EM-light) or OPT 0384 (EM-full) installed.
(1) 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 each second to avoid 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.

**f) Optional connector ST99: 20 pin, black**

<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>Gearbox in neutral request signal</td>
<td>0992</td>
<td>10 mA (1)</td>
<td>EM X3-18</td>
<td>Not supported on Eurocargo Euro VI and Allison 2500 gearbox</td>
</tr>
</tbody>
</table>
| 2   | Bodybuilder emergency signal                    | 0993      | 10 mA (1) | EM X3-19     | Input to activate the Vehicle StoppedState values, only if Body-  
|     |                                                  |           |           |               | builder Enable (ST100/pin 2) is also active                             |
|     |                                                  |           |           |               | List of configurable signals (2)                                       |
|     |                                                  |           |           |               | Ground = active, low side switch                                        |
| 3   | External stop brake request (ENI 501)           | 0994      | 10 mA (1) | EM X3-20     | Only supported with opt 6821 (4)                                       |
|     |                                                  |           |           |               | Input to activate the Stopping brake (V<2km/h)                         |
|     |                                                  |           |           |               | Ground = active, low side switch                                        |
| 4   | Stop brake signal return (ENI 501)              | 0995      | 10 mA     | EM X3-21     | reserved for IVECO exclusively                                         |
|     |                                                  |           |           |               | Only supported with OPT 6821                                           |
|     |                                                  |           |           |               | Input to monitor the stop brake pressure                               |
|     |                                                  |           |           |               | Ground = active, low side switch                                        |

Only available with OPT 0384 (EM-full) installed.

Figure 13

A. 500314809 Existing part on vehicle (male)  
B. 500314816 Counterpart to be coupled (female)
### Table of Bodybuilder Connectors

<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>5</td>
<td>Stepper swt req. (EN1501)</td>
<td>0996</td>
<td>10 mA (4)</td>
<td>EM X4-06</td>
<td>Only supported with opt 6821 (9) Input to activate the Refuse stepper switch Ground = active, low side switch n.a. when ABS-HSA (OPT 14861) installed</td>
</tr>
<tr>
<td>6</td>
<td>LMM (Light Management Module) Right direction light</td>
<td>6985</td>
<td>1.5 A</td>
<td>EM X1-03</td>
<td>Right turn signal light 0 V = not engaged +24 V = engaged</td>
</tr>
<tr>
<td>7</td>
<td>LMM (Light Management Module) Left direction light</td>
<td>6986</td>
<td>1.5 A</td>
<td>EM X1-08</td>
<td>Left turn signal light 0 V = not engaged +24 V = 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>reserved for IVECO exclusively Only supported with OPT 6821 Output EN1501 Warning sound indicator 0 V = not engaged +24 V = 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>0 V = not engaged +24 V = 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>reserved for IVECO exclusively Only supported w/ opt 6821 Output EN1501 Reverse protections Brake active 0 V = not engaged +24 V = engaged after K15 active for 2 sec (w/o brake activated) n.a. when ABS-HSA (OPT 14861) installed</td>
</tr>
<tr>
<td>11</td>
<td>Brake engaged (EN1501)</td>
<td>6990</td>
<td>1 A</td>
<td>EM X4-21</td>
<td>reserved for IVECO exclusively Only supported with OPT 6821 Output EN1501 Solenoid Brake 0 V = not engaged +24 V = 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>-</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>Indicate 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 that &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 signals 0 V = OFF - no PTO engaged +24 V = ON - at least one PTO engaged</td>
</tr>
<tr>
<td>16</td>
<td>Level information</td>
<td>5981</td>
<td>0-32 V, 0-500 Ohm (1)</td>
<td>EM X4-14</td>
<td>Analogue input to display fluid level information on the IC(3) when enabled CANopen 0x6167 n.a.</td>
</tr>
<tr>
<td>17</td>
<td>Pressure information</td>
<td>5982</td>
<td>0-32 V, 0-500 Ohm (1)</td>
<td>EM X4-15</td>
<td>Analogue input to display pressure information on the IC(3) when enabled CANopen 0x6167 n.a.</td>
</tr>
<tr>
<td>18</td>
<td>Temperature information</td>
<td>5983</td>
<td>0-32 V, 0-500 Ohm (1)</td>
<td>EM X4-29</td>
<td>Analogue input to display temperature information on the IC(3) when enabled CANopen 0x6167 n.a.</td>
</tr>
</tbody>
</table>
5.2 BODYBUILDER CONNECTORS

<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>19</td>
<td>ReGen inhibit 5991</td>
<td>0-2000 Hz</td>
<td>EM X4-16</td>
<td></td>
<td>reserved for IVECO exclusively</td>
</tr>
<tr>
<td>20</td>
<td>ReGen force 5992</td>
<td>0-2000 Hz</td>
<td>EM X4-38</td>
<td></td>
<td>reserved for IVECO exclusively</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 100, pin 3) is 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 or
  - 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 "Refuse packer footboard switch" input and the CANopen 0x6148 object initiate the following actions on the switch when the footboard is occupied (as described in Standard Fpr EN 1501-1:2010 of 2010-02, Chapter 5.11.3.3.1 – Directives on occupied footboard(s)):

- speed limiting
- in the case of reverse gear engaged (rear-loading refuse packer), protection by:
  - activating the brakes;
  - torque limit set to 0% (only low idle governor) in case of reversing;
  - inhibiting reverse gear on automatic gearboxes when this is engaged, only when the Bodybuilder Enable input (ST100/03) is connected to ground by the Bodybuilder.

Requirements for Functional Safety
The vehicle shall not be obliged to meet all DIN EN1501-1 safety requirements. The Bodybuilder has the responsibility that the final application corresponds to the Safety standards as described in EN1501. In particular, the Bodybuilder must manage the safety devices described in the Standard Fpr EN1501-1:2010 of 2010-02 - Chapter 5.1.3.3.2, including reset management in the event of malfunctions or traffic-related emergencies.

Vehicle load information can be displayed on the Instrument Cluster, but only for comfort functions. The function is disabled by default; please contact IVECO Customer Services to have it enabled. When wiring is added to the input(s), the corresponding CANopen objects concerning vehicle load information are no longer available.

This function allows the driver to also set alarm thresholds for each type of load from the second menu screen of the display on the instrument panel.

<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 ()</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>CANopen Truckgateway, see CIA 413</td>
<td></td>
</tr>
</tbody>
</table>

Only available with OPT 0384 (EM-full) installed.
## 5.2 BODYBUILDER CONNECTORS

### Table 5.1 - Basic functions of connector 72072A (vehicle CAN)

<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>5</td>
<td>CAN Gnd</td>
<td>0999</td>
<td></td>
<td>EM X4-09</td>
<td>HF Ground (High Frequency), capacitive coupled</td>
</tr>
<tr>
<td>6</td>
<td>Bodybuilder CAN</td>
<td>CAN L</td>
<td></td>
<td>EM X4-19</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

**Optional connector 72074: 12 pin, black**

![Diagram of connector 72074](image)

A. 500314807 Corresponding opposite connector to be coupled (male)

B. 500314814 Existing part on vehicle (female)

### Table 5.12 - Basic functions of connector 72074 (Allison automatic gearbox)

<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>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>
</tbody>
</table>
| 2   | Multi-state switch            | 4123      | 15 mA     | ALL 23       | 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 only Neutral and/or in the (selectable*) range of reduced forward gears. Operator requests to upshift beyond the maximum* 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 downsplits until the specified gear range is attained.  
The function is disabled when the enabling switch is released. |
| 3   | Gear range inhibition         | 0259      |           | ALL 42       |                                                                          |
### 5.2 BODYBUILDER CONNECTORS

<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>
</table>
| 4   | PTO active                                 | 8131      | 15 mA     | ALL 43       | 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 “modulated main pressure” feature in the transmission, 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 "low";  
|     |                                            |           |           |              | ● engine speed and output speed are within Customer Modifiable Constant limits. |
| 5   | PTO control                                | 8333      | 500 mA    | ALL 30       | For special applications - 24V 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. |
| 6   | PTO 2 control                              | 6164      |           | ALL 50       |                                                                                                                                        |
| 7   | Relay control                              | 5146      |           | ALL 2        |                                                                                                                                        |
| 8   | Activation "Pump Pack" signal (only with Allison 3000 gearbox) | 5145 | ALL 17 | | For special applications - Logic mode "and" 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 engage neutral when an additional brake is actuated. |
| 9   | Automatic neutral signal                   | 0258      | 5 mA      | ALL 1        | For special applications - Logic mode "and" mode with pin B  
|     |                                            |           |           |              | 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 engage neutral when an additional brake is actuated. |
| 10  | Digital ground                             | 0000      |           | ALL 3        | It must be used as return for "closed on digital ground" inputs.  
|     |                                            |           |           |              | Do not connect to the battery negative or to other grounds. |
| 11  | Range indicator                            | 0103      | 500 mA    | ALL 13       | 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 |
| 12  | Gearbox speed indicator output             | 8039      | 15 mA     | ALL 5        |                                                                                                                                        |

Contact Customer Service for any modifications.
CONNECTORS ON CHASSIS

The following connectors (all black) are located on the frame:

- 61069 (SML) - see Paragraph "Arrangement of side marker lights (Side Marker Lamps)" (➡️ Page 55)
- Cia Frame (EM)
- ST91 (PTO 1)
- ST92 (PTO 2)
- ST93 (PTO 3)

**b) Cia Frame optional connector: 7 pin, black**

A. 504111928 Corresponding opposite connector to be coupled (male)

B. 41118387 Existing part on vehicle (female)

Only available with OPT 0384 (EM-full) installed.

**Table 5.13 - Basic functions of Cia frame connector**

<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>
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</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</td>
<td>9131</td>
<td>1.5 A</td>
<td>EM X1-01</td>
<td>OFF = 0 V = valve not activated</td>
</tr>
<tr>
<td></td>
<td>electromagnetic valve</td>
<td></td>
<td></td>
<td></td>
<td>ON = +24 V = 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</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</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 the</td>
<td>9132</td>
<td>1.5 A</td>
<td>EM X1-04</td>
<td>OFF = 0 V = valve not activated</td>
</tr>
<tr>
<td></td>
<td>electromagnetic valve</td>
<td></td>
<td></td>
<td></td>
<td>ON = +24 V = 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</td>
<td>EM X3-12</td>
<td>Connected to ground if active</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 BODYBUILDER CONNECTORS

<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>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</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</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.

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.

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>
</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>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 5.19 - 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 clearance light</td>
<td>3332</td>
<td>6 A</td>
<td>MET-A07</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Daylight running lights/right trailer clearance light</td>
<td>3331</td>
<td>6 A</td>
<td>MET-A08</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>
</tbody>
</table>
5.3 FMS (FLEET MANAGEMENT SYSTEM)

For the management of a fleet it is necessary that each vehicle provides a set of information on its operation, the movements made and the driving style of the driver.

The main information can be displayed directly on the radio screen, if this is the type designed for such purpose.

If the vehicle does not have such a solution, detailed information about:

- rpm, engine torque, water and oil temperature;
- mileage, type of route and driving times;
- consumption, speed and braking;
- loads on axles (if provided);

they can be acquired by means of an electronic device or personal computer connected to the CAN line.

The format of this information complies with the FMS standard on the Company website: [www.fms-standard.com](http://www.fms-standard.com).

The connection to the CAN line is possible by means of the optional 14569, which consists of:

### 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 clearance light</td>
<td>3331</td>
<td>6 A</td>
<td>MET-A07</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>
<tr>
<td>7</td>
<td>Daylight running lights/left trailer clearance light</td>
<td>3332</td>
<td>6 A</td>
<td>MET-A08</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>
● a green connector (FMS), housed in one of the DIN coating cases above the windscreen;
● A bridle, which connects the connector to connector 72070;
● a resistor which is used to terminate the CAN line.

To use the CAN FMS it is necessary to unplug the resistor and use the green connector; obviously the telematic device to be inserted must be compatible with the CAN FMS termination.

**Note** If the vehicle is not equipped with the optional 14569, it is mandatory that the necessary modifications to the electrical system and software upgrades are made at an authorised IVECO Service Centre.

<table>
<thead>
<tr>
<th>Table 5.21 - Characteristics of the CAN line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical level</td>
</tr>
<tr>
<td>Application level</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

#### Base configuration

Vehicles with the base configuration (opt. 4113) are equipped with specific wiring between the instrument cluster and the bulkhead connector, and with a switch on the dashboard. Pressing the switch closes the electrical circuit connected to the tail lift. An indicator lamp illuminates on the instrument cluster when the switch is pressed, and engine start is inhibited until the switch is pressed again (see Chapter 3.9 - Paragraph "Base configuration for tail lifts" (เจอ Page 37)).

To complete the electrical wiring to the tail lift, refer to the diagram in Figure 22.

The tail lift anchoring kit (option 6229), should preferably be used together with this configuration.
5.4 CONFIGURATIONS FOR TAIL LIFTS

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

25219 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
**Base configuration with additional ECAS remote control (opt. 4115)**

Vehicles with air suspension (/P 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.

![Diagram of ECAS contactors](image)

**Figure 23**

- **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
VEHH configuration (opt. 75182)

To attain compliance with the VEHH standard (defined by the VEHH association of European tail lift manufacturers), opt. 75182 is also available (see Chapter 3.9 - "VEHH configuration for tail lifts" (Page 38)).

Refer to the following diagrams for the VEHH configuration without and with ECAS.

**VEHH tail lift without ECAS**

![Diagram of VEHH tail lift without ECAS](image)

- **251890** 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

---
VEHH tail lift with ECAS

25550 Contactor for preventing start-up with tail lift engaged
25551 Contactor for tail lift indicator lamp
25571 Contactor for VEHH tail lift control
25573 ECAS contactor 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
5.5 OPERATOR’S FOOTBOARD

For refuse collection vehicles, 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 manual or automatic gearbox

![Diagram](image-url)
b) vehicles with 6AS automated gearbox

With this type of vehicle, the following operations must be carried out on the electrical system:

- Cut the connection between the VCM control unit and button "N" (blue line on the diagram)
- Add a relay
- Insert the relay contact in series between the VCM and button "N"

![Diagram](image-url)
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.
- IVECO cannot be liable for system malfunctioning if the instructions contained in this chapter are not followed.

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.

Wiring harness length
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.

- It is strictly forbidden to carry out any modifications or connections to the CAN lines, which are to be considered unalterable. Diagnostic and maintenance operations can only be carried out by authorised personnel and with IVECO approved equipment.

Note For any exception to mounting instructions, IVECO's written authorisation is necessary. Lack of observance of above described prescriptions involves guarantee lapse.

Disconnecting 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 49));
- isolate the battery by disconnecting the battery cables: disconnect the negative terminal first followed by the positive terminal;
- disconnect the control unit.
Repositioning 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.

5.7 ELECTRICAL SYSTEM: OPERATIONS

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.

Precautions for work 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 prescribed capacity for the specific function, and do not under any circumstances use higher capacity 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.

Precautions for work 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 8).

If required by the application of additional devices, 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.

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 28**

**Figure 29**

- **MC1** Cab interior left side ground
- **MM2** Front right side member frame ground
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 30), 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
- With junction connectors (Figure 30) the unshielded sections "d" must be 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

**Electromagnetic comparability**

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 by 24V 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 5.22 - Electromagnetic emission levels**

<table>
<thead>
<tr>
<th>Type of emission</th>
<th>Type of transducer</th>
<th>Type of disturbance</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>Frequency range and limits acceptable in dBμV/m</td>
<td>Unit of measurement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>almost peak</td>
<td>63 54 35 35 24 24 24 31 37</td>
<td>dBμV/m</td>
</tr>
<tr>
<td>radiated</td>
<td></td>
<td>Broad-band peak</td>
<td>76 67 48 48 37 37 37 44 50</td>
<td>dBμV</td>
</tr>
<tr>
<td>radiated</td>
<td></td>
<td>Narrow band peak</td>
<td>41 34 34 34 24 24 30 24 31 37</td>
<td>dBμV</td>
</tr>
<tr>
<td>conduit</td>
<td>LISN 50 Ω 5 μH 0.11 μF</td>
<td>Broad-band</td>
<td>Frequency range and limits acceptable in dBμV/m</td>
<td>Unit of measurement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>almost peak</td>
<td>80 66 52 52 36 36</td>
<td>dBμV</td>
</tr>
<tr>
<td>conduit</td>
<td></td>
<td>Broad-band peak</td>
<td>93 79 65 65 49 49</td>
<td>Not applicable</td>
</tr>
<tr>
<td>conduit</td>
<td></td>
<td>Narrow band peak</td>
<td>70 50 45 40 30 36</td>
<td>dBμV</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:

```
Figure 32
```

![](191312.png)

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.
Reception/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.

General instructions

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.

![Figure 33](image-url)
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.

**Amateur equipment for CB (27 MHz) and 2 m band (144 MHz)**

The transmitter part must be installed in a separate area from the vehicle’s electrical components; if the transmission is impulsive it must be at a distance of 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 < 1V/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.

**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. If the transmission is impulsive 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.

**GPS reception and satellite navigation equipment**

Install the transmitting part in a flat, dry area, separate from the electronic components of the vehicle, away from humidity and vibrations. If the transmission is impulsive 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 136 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.
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 an 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

**Warning**

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.

**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.

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 dashboard, 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.

1. Standard alternator
2. Supplementary alternator
3. To the batteries
4. Signal K15 from connector ST14A/pin 11
5. Front Frame Computer
6. Body Computer
7. Instrument panel
8. No battery charging warning light or led
Drawing current

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 \(\leftrightarrow\) 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>
<tr>
<td></td>
<td>3</td>
<td>18</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>Alternators</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>Bosch 70 A</td>
<td>Bosch 90 A Δ</td>
<td>Bosch 70 A  Bosch 90 A Δ</td>
<td>Bosch 70 A  Bosch 90 A Δ</td>
</tr>
<tr>
<td>Total available potential (80 °C) [A]</td>
<td>55 71 16</td>
<td>60 77 17</td>
<td>58 73 15</td>
</tr>
<tr>
<td>Potential for recharge and opt (without vehicle consumption) [A]</td>
<td>41 56 15</td>
<td>42 59 17</td>
<td>42 58 16</td>
</tr>
<tr>
<td>Max supply at idle speed (80 °C) [A]</td>
<td>47 58 11</td>
<td>47 57 10</td>
<td>40 47 7</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.
Current withdrawal 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 37).

Note  The fuse holder, placed on the side of the battery casing, must not be changed or moved.

The current drawing 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**

A. Current draw points not to be used

![Diagram of fuse box]

M1. **Power supply outlet for starter motor**
M2. Power supply outlet DGC / TGC / Batt.
M3. **Fuse box 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 switching device (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 (e.g. transport of fuel, transport of dangerous substances) it may be necessary to use a safety switch that 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 150A, 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.
Main current contactor (TGC option)

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.

Voltage reducer

The electrical system of the vehicle is prepared for the power supply of 12V devices. Connection with a voltage reducer (from 24V to 12V) is possible in the cab.

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.

Maxifuse and Megafuse fuses

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.

<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>

![Figure 39](image)
### 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 $2 \pm 0.2$ Nm.

### Voltage reducer

The electrical system of the vehicle is prepared for the power supply of 12V 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.

### Additional circuits

The additional circuits must be separated from the vehicle and protected by means of a specific fuse.

As already seen in chapter 5.7(→ page 38) Paragraph "Precautions for work on the system", the used cables must be:

- of appropriate sizes and equipped with good original insulation;
- connected to the original system by means of tin joints equivalent to the original ones, protected with sheaths (not PVC) or intubated in polyamide conduits of type 6;
- installed protections from shock, heat, rubbing with other components (in particular with the sharp edges of the bodywork);
- secured separately with insulated cable clamps (e.g. made of nylon) and at adequate intervals (approx. 200 mm).

The passage through crossbars and/or sections must provide special fairleads or protections; it is not possible to drill the chassis and/or the bodywork.

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.

Where possible it shall also be provided a different cable path that transfers interference signals with high absorbed intensity (e.g. electric motor, solenoid valves) and low absorbed intensity susceptible signals (e.g. sensors); for both must be remained a positioning as close as possible to the metallic structure of the vehicle.

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 5.30 - Use of cables and fuses according to the current drawn

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

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

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

**Precautions**

- Incorrect installation of electrical accessories may affect occupant safety and cause severe damage to the vehicle. Contact IVECO if you have any questions.
- Avoid coupling with signal transmission cables (e.g. ABS), for which a preferential path has been defined for electromagnetic requirements (EMI).
  It should be noted that when grouping several cables together, in order to compensate for 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.

**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.

**Side Marker Lamp installation**

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 40).

**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>
</table>
| 1   | Ground                       | 0000      | 10 A      | Ground       | +24V = Daylight running lights on signal, when: (1)
|     |                              |           |           |              | K15 OFF and parking lights on K15 ON and parking/high beam/low beam lights on |
| 2   | Side lights left sides       | 3332      | 5 A       | MET P-A07    | +24V = Daylight running lights on signal, when: (1)
|     |                              |           |           |              | K15 OFF and parking lights on K15 ON and parking/high beam/low beam lights on |
| 3   | Side lights right sides      | 3331      | 5 A       | MET P-A08    | +24V = Daylight running lights on signal, when: (2)
|     |                              |           |           |              | K15 OFF and parking lights on K15 ON and parking/high beam/low beam lights on |
| 4   | K15                          | 8869      | 10 A      | MET P-C01    | K15                                                                 |

(1) If the maximum current is exceeded:

- The output signal is deactivated
- A MUX 0x26D55 FMI 0x06 error is generated
- The interior lights of the vehicle switch off together with the left side lights and right tail lights

The error and the output signal are reset at the next K15 cycle.

If the behaviour 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
- A MUX 0x26D51 FMI 0x06 error is generated
- The interior lights of the vehicle switch off together with the side lights and both tail lights (the rear fog light may still be on).

The error and the output signal are reset at the next K15 cycle.
If the behaviour is not acceptable, the Bodybuilder must limit the maximum current, for example with the addition of a fuse on the bodybuilder wiring.
SECTION 6

ADBLUE AND SCR SYSTEM
(Euro V versions only)
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ADBLUE AND SCR SYSTEM (Euro V versions only)

6.1 GENERAL INFORMATION

To comply with Euro V engine emissions standards, IVECO has developed the SCR (Selective Catalytic Reduction) system – a chemical treatment for exhaust gases.

This treatment requires the use of an additive, marketed under the name "AdBlue" (an aqueous urea solution).

![Diagram of the ADBLUE AND SCR SYSTEM](image)

1. Engine coolant diverter valve
2. Catalytic converter exhaust gas temperature sensor
3. Sensor signal amplifier (5)
4. Pump module
5. Nitrogen oxides detecting sensor
6. Tank of reagent solution (water - urea: AdBlue)
7. AdBlue fluid level gauge control
8. Intake air humidity sensor
9. Mixing and injection module
10. Catalytic converter intake exhaust gas temperature sensor
11. Catalytic converter
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 the AdBlue into the exhaust pipe. The mixture of exhaust gas and additive is then fed to the catalytic converter where the nitrogen oxides (NOx) and urea are converted into nitrogen and water, which are harmless to the environment.

![Diagram of Adblue and SCR system]

1 Pump module
2 Catalytic converter
3 Dosing module
4 AdBlue tank
SM Pumping module

![Diagram of SM Pumping module]

1. AdBlue return pipe to the tank
2. AdBlue return pipe to the dosing module
3. AdBlue solution outlet
4. AdBlue solution intake
5. Electric connection
6. DCU control unit
7. Filter
8. Pre-filter

Dosing module (DM)

![Diagram of Dosing module]

1. AdBlue inlet
2. Electric connection
3. AdBlue outlet

Its function is to dose the AdBlue solution to be injected into the exhaust pipe upstream of the catalytic converter.
Catalytic converter

As it is fitted with soundproofing material, the catalytic converter takes the place of the exhaust silencer. The catalytic converter mounts temperature sensors (1) and (2) and the nitrogen oxide detection sensor (3).

AdBlue tank

6.3 INSTRUCTIONS

If changes are made to the chassis which involve this system, the following procedure must be followed under all circumstances:

- 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 following disassembly/assembly sequence on the SM and DM must be respected so as to prevent the AdBlue coming into contact with the electrical connectors:
  - (disassembly) AdBlue fittings - water fittings - electrical connectors;
  - (assembly) electrical connectors - water fittings - AdBlue fittings;
● 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);

● the DM screw threads must be treated with a sealant paste as specified on the assembly diagrams however, the DM and the inside of the exhaust silencer must not be contaminated with the sealant.

**AdBlue tank**

**Note** The fuel and AdBlue level sensors are specific to the type of tank to which they are connected. Therefore, the tank and sensor cannot be modified independently of each other.

In line with this constraint, we recommend that only the standard tank is used, if this is not the case, different shapes and any modifications to the brackets (specific) securing to the chassis must be authorized by IVECO.

At the end of any operations which involve the tank, make sure that:

● the tank ventilation pipe is not closed;

● the tank contains at least 5 litres of AdBlue to ensure the dosing module is cooled;

● the tank does not contain more than 85% of AdBlue (corresponding to the maximum reading of the level sensor) with respect to the tank total volume, so as to guarantee enough room for AdBlue to expand during freezing at temperatures below -11 °C.

### 6.4 PIPES

After having switched off the engine, the supply pipes (PL/UPL) and intake pipes (IL/UIL) are emptied to prevent the AdBlue freezing at low temperatures. This takes approximately 2 minutes and must not be interrupted by any operation using the isolator switch. This process can be clearly seen on the AdBlue pump, as it remains running even after the engine has been switched off.

Regarding the connections between the tank, supply module and dosing module, it must be ensured that:

● the length of the pipes between the AdBlue tank and supply module ("Inlet Line" and "Return Line") must not exceed 5 m;

● the length of the pipes between the supply module and the dosing module ("Pressure Line" inlet and "Cooling Line" return) must not exceed 3 m.

### 6.5 POSITIONING THE DOSING MODULE

For some types of use, it may be necessary to remove the AdBlue system components and reposition them out of their original positions; in this case, pay attention to the new positioning heights.

In this regard, the figure below compares different cases in terms of quality which serve as a guide; the figures further below provide more details.
6.5 POSITIONING THE DOSING MODULE

The supply unit must be mounted on a fixed base. Ideally, the supply unit should be mounted vertically with the connections pointing downwards. In contrast, when connecting the AdBlue pipe to the DM, the pipe is mounted upwards just before the DM itself (Figure 6.8).

If the position of the supply module (SM) is modified, you must check that the ambient temperature matches that of the original installation. If in doubt, it is advisable to recheck the temperatures.
AdBlue tank positioned below the supply module (SM)

The maximum intake height corresponds to the difference between the point of reference (6) and the lower edge of the intake pipe (5). The intake height must not exceed 1 m.

1 Supply module (SM) 5 Lower edge of intake pipe
2 Supply line 6 Lower edge of supply module
3 AdBlue tank
4 AdBlue minimum level

<1.0 m
AdBlue tank positioned above the supply module (SM)
The maximum intake height corresponds to the difference between the lower edge of the intake pipe (5) and the highest point on the intake pipe (2). This height must not exceed 1 m.

Dosing module (DM) positioned below the supply module (SM)
The upper edge of the supply pipe (2) must be positioned above the point of reference (8).
Dosing module (DM) positioned above the supply module (SM)

The upper edge of the supply pipe (1) must be positioned above the point of reference (5).

1. Pressurized pipe
2. AdBlue Level
3. AdBlue tank
4. AdBlue minimum level
5. Lower edge of supply module

Positioning the dosing module

If repositioning is necessary, some important warnings must be taken into account.

1. Thermal protection
2. Temperature sensor
3. Dosing valve structure
4. AdBlue connectors
5. Dosing valve connector
6. Cooling adapter
7. Isolation
There is a diffuser (1) inside the exhaust pipe therefore the pipe section concerned must NOT be modified.

**Orienting the dosing module (DM) in the exhaust pipe**

When orienting the DM, there is a difference between the rotation angle of positioning in the exhaust pipe and the angle of fitting of the exhaust pipe (see figure below).
Orienting the dosing module (DM) with reference to the rotation angle in the exhaust pipe

To avoid malfunctions and damage to the DM, the following positions must be respected during fitting:

- **315° → 45° (A):** The rising heat in the exhaust pipe can damage the DM or cause it to malfunction. In this case, it is essential to fit a heat guard.
- **90° → 270° (D):** The dosing module contains AdBlue fluid. At very low temperatures, this can freeze and damage the module.
- **45° → 90° and from 270° → 315° (C-E):** Installation is possible in this position; a minimal quantity of AdBlue remains in the module.
- **60° → 70° (B):** This is the ideal position for fitting the DM and must be chosen as a matter of priority, conditions permitting.

**Angle of fitting of the exhaust gas pipe**

The angle of fitting must be between +45° and -45°.

**Installing the dosing module in relation to the SCR catalytic converter:**

Example of DM installation
6.5 POSITIONING THE DOSING MODULE

### Figure 18

1. Mixer pipe length
2. Silencer
3. SCR catalytic converter

#### Note

The exhaust gas pipe inlet in the SCR catalytic converter must be as low as possible. If the catalytic converter is rotated and the pipe inlet is positioned high, if the engine stops, there is a danger that gases will return to the dosing module and a risk of serious damage owing to high temperatures.

---

#### Exhaust gas pipe

**Note** Modifications to the layout of the exhaust system are not authorised without prior approval from IVECO.

The exhaust pipe may be modified, taking into account the following warnings:

- the routing must respect the type-approved counter-pressure values.
- the radius of curvature must be greater than 2.5 times the diameter of the pipe.
- rubber or plastic components must be sufficiently spaced and heat guards should be fitted where necessary.
- the diameters, thickness and materials of the pipes must match the original specifications.
- any hoses must be limited in length.

Taking these warnings into consideration, the exhaust gas pipe (from the start of the mixer pipe up to the SCR inlet) can be extended up to 3 m.

For values above this, it is essential to provide adequate insulation to prevent excessive heat dissipation which could cause the SCR system to malfunction.

Notwithstanding, the overall length must not exceed 5 m.
Interventions on the wiring and AdBlue and water pipes

a) With regards to the electrical wiring please note that:

- it is only possible to lengthen cables relating to the temperature, AdBlue heater and AdBlue level sensors
- it is not permitted to alter the length of the NOx sensor cable. (If it is absolutely impossible to keep these cables unchanged, IVECO must be contacted and the indications provided must be followed).

b) With regards to the pipes for the AdBlue and heating water:
the recent adoption of a flexible materials now allows bending and not just interventions for lengthening or shortening.

**Note**  In order to limit the loss of load, only one lengthened stretch is allowed per pipe.

**Note** The pipes may only be modified using the fittings available from the Service Network.

![Figure 19](image)

1. T fitting for water pipes
2. Female fitting for water pipes
3. Fitting NS6 for AdBlue pipes
4. Fitting NS10 for water pipes

To change the length of the pipes (type 8x1 - PA for AdBlue and corrugated NS 10 for water):

- ensure that the fittings indicated in Figure 19 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 20.

> It is compulsory to work in a completely dust-free environment to prevent dust from reaching the injectors and subsequently clogging them.
6.6 WIRING FOR POSITIONING SCR SYSTEM COMPONENTS

If SCR system components are removed (e.g. total or partial removal of side members and extension of the wheelbase), Iveco shall provide replacement wiring and materials, to ensure the quality of the end product.

Replacing cables to reposition SCR system components

C-MET/UDS chassis wiring

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>ORIGINAL WIRING (dwg. 504266553)</th>
<th>REPLACEMENT WIRING (dwg. 504256339)</th>
<th>MARKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCR dosing module solenoid valve</td>
<td>L = 800 mm</td>
<td></td>
<td>78266</td>
</tr>
<tr>
<td>Catalytic converter sensor out connection (4-way super seal)</td>
<td>L = 250 mm</td>
<td></td>
<td>st 59</td>
</tr>
<tr>
<td>UREA tank with SCR temperature and level sensor</td>
<td>L = 300 mm</td>
<td></td>
<td>85142</td>
</tr>
<tr>
<td>C-MET/UDS cable connection to CILC (4-way super seal)</td>
<td>L = 1,000 mm</td>
<td>L = 5,000 mm</td>
<td>44030</td>
</tr>
<tr>
<td>Engine water circulation solenoid valve for UREA heating with SCR</td>
<td>L = 500 mm</td>
<td></td>
<td>78267</td>
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<tr>
<td>UREA filter outlet heater with SCR</td>
<td>L = 400 mm</td>
<td></td>
<td>61150</td>
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<tr>
<td>Control for SCR pumping unit</td>
<td>L = 800 mm</td>
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<td>85140</td>
</tr>
</tbody>
</table>

E-A/MET wiring

Clamp connecting the NOx sensor to the MET control unit

Clamp length: 2 m
(to be added to the standard cable, on longer wheelbases and/or when extending the wheelbase itself)

Design no. 504279753
### Clamp connecting the NOx sensor to the MET control unit

<table>
<thead>
<tr>
<th>Clamp length:</th>
<th>2.6 m</th>
</tr>
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<td>(to be added to the standard cable, on longer wheelbases and/or when extending the wheelbase itself)</td>
<td>design no. 504280652</td>
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</tbody>
</table>