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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Data and information contained in this publication may be outdated as a result of changes adopted by IVECO, at any time, for technical or commercial reasons or due to the need to adapt the vehicle to new legal requirements.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>
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<th>Description</th>
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<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>
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<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>
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<td>👄</td>
<td>General danger&lt;br&gt;Includes the dangers of both above described signals.</td>
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<tr>
<td>🌍</td>
<td>Environmental protection&lt;br&gt;Indicates correct behaviour in order that vehicle use is as environmentally friendly as possible.</td>
</tr>
<tr>
<td>📄</td>
<td>NOTE&lt;br&gt;Indicates an additional explanation for a piece of information.</td>
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GENERAL INFORMATION

1.1 SCOPE OF THE GUIDELINES

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

These Guidelines also aim to indicate to Bodybuilders:

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

It should be noted that the collaboration with IVECO is based on the assumption that the Bodybuilder uses the maximum of their technical and organisational skills and that operations are technically and perfectly complete. As outlined below, the topic is extensive and we can only provide the rules and minimum precautions that can allow development of the technical initiative.

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

1.2 TECHNICAL DOCUMENTATION AVAILABLE ELECTRONICALLY

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

● 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 WARRANTIES

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

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

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

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

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

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

I.10 ACCIDENT PREVENTION

Do not allow unauthorised personnel to intervene or operate on the vehicle. It is forbidden to use the vehicle with safety devices that have been tampered with or are damaged.

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

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

I.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;
- measure 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;
- report new data on special labels;
- provide confirmation that the operations carried out comply with the indications of the vehicle Manufacturer and legal requirements;
- draw up a guarantee covering the changes made.
1.13 VEHICLE NAMES

The commercial name of IVECO vehicles (for example TRAKKER 450 E6) does not match the type approval name. A complete example is provided below.

**Commercial name**

<table>
<thead>
<tr>
<th>TRAKKER HI-LAND 190 T 36 W/P</th>
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- **TRAKKER** – Vehicle name
- **HI-LAND** – Cab type
- **190** – Total Ground - PTT Cab versions / PTC Tractors with semi-trailers (no./10 = weight in t)
- **T** – Traktor Range Code
- **36** – Engine power (no. x 10 = power in HP)
- **W** – Model
- **/ P** – Suspensions

I.14 TRADEMARKS AND SYMBOLS

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 withdraw 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 vehicle cab 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 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)**

\[
W = \text{Payload plus superstructure} \\
W1 = \text{Measurement of payload on front axle} \\
W2 = \text{Measurement of payload on rear axle (or tandem)} \\
L1 = \frac{W1 \cdot L}{W} \\
L = \text{Actual wheelbase}
\]

**Example to determine the placement of the centre of gravity of the payload plus superstructure (4-axle vehicles with equal loads on each front axle and on each rear axle)**

\[
W = \text{Payload plus superstructure} \\
W1 = \text{Payload quota on the front axles} \\
W2 = \text{Payload quota on the rear axles (tandem)} \\
L1 = \frac{W1 \cdot L}{W} \\
L = \text{Actual wheelbase}
\]
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 superstructure 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:

1. fixed loads,
2. mobile loads;
3. loads that result in increased aerodynamic actions.

---

![Even distribution of load](image1.png)

Even distribution of load

![Uneven distribution of load](image2.png)

Uneven distribution of load

![Even distribution of load](image3.png)

Even distribution of load

![Uneven distribution of load](image4.png)

Uneven distribution of load (attention to loads on axles and minimum ratio)
1. Fixed loads

![Diagram of a truck showing dimensions and ground](image)

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

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

**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

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).

2. 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.

3. Loads that result in increased aerodynamic actions

In outfits characterised by high vertical and surface development (e.g.: advertising panelling), the hight 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,
implementation of stabiliser bars

The application of additional or reinforced stabiliser bars, reinforcing the springs or rubber elastic elements (in accordance with the procedure outlined in Section 2.7 - Paragraph "suspension" (Page 31)) helps to compensate for any high values of the centre of gravity of the payload. 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.
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 that need inspection, maintenance or periodic controls (e.g., battery replacement, access to the air suspension compressor) and, in the case of enclosed superstructures, special compartments and doors should be provided;
- cab tilting must be guaranteed. For this purpose, the indications provided in Figure 7 can be used where the maximum longitudinal clearance "D" of the cab is indicated between the front axle centreline and the semi-trailer body, as well as the rotation radius "R" of the cab:

![Figure 7](image)

- the possibility of disassembling the various groups for assistance operations must be maintained;
- conditions should not be affected regarding cooling (radiator grille, radiator, air passages, cooling etc.), fuel supply (pump positioning, filters, pipe diameter, etc.) and engine air intake;
- 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;
- sufficient ventilation of the brakes must be ensured along with sufficient airing of the battery casing and the DPF/muffler assembly;
- 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. Some models include steering of the 3rd axle in the raised position as well: respect the spaces necessary for this function (see Chapter 2.21);
- adjustment of the vehicle's headlamps must be checked once construction is completed, to correct any changes in their structure; for adjustment, proceed according to the instructions given in the "Use and Maintenance" manual;
- 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.
Access to the exhaust system

Each outfitting must ensure access to the exhaust gas post-treatment assembly (muffler) and, in particular, to the cover of the ceramic particulate filter housing.

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

Remember that the weight of the assembly is approximately 120 kg and that the temperature on the surface can reach 250 °C in certain conditions.

Distance from muffler

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

Take into consideration that:

- synthetic materials must never be exposed to temperatures exceeding 70°C; adequate protections must be implemented if higher temperatures are expected (thermal shielding).
  The factory mounted fuel tank is made from materials belonging to this class and therefore, if fitting in a position that is not original, particular attention must be exercised.
- the minimum distance between the muffler and the cab rear wall, gearbox and braking system components must be at least 50 mm.
- the minimum distance between the exhaust pipe and brake pipes, wiring, spare wheel must be at least 200 mm; this value may drop to 80 mm if using protections.
1.17 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.
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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 16));
- **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 12));
- for cases where modifications to nailed unions are allowed, the nails may be replaced with flanged head screws or with hex head screws classed 8.8 with the next higher class diameter and nuts fitted with an anti-unscrewing system. Screws larger than M14 may not be used (maximum hole diameter of 15 mm), unless otherwise specified;
- for cases where unions that require screws are restored, the suitability of these screws must be checked before being 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

▶ 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 5.5).
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 assembly, making sure that polarity is respected.

Earth connection

For further details on the connections to ground, see the Chapter 5.5 ( ➤ Page 25).

Braking and electrical systems

For additional details on the braking and electrical systems see Chapters 2.15 ( ➤ Page 44) and 5.5 ( ➤ Page 25).

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>
<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 E490</td>
<td>610</td>
<td>490</td>
<td>19%</td>
</tr>
<tr>
<td>Europe S500MC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany QStE500TM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IVECO Fe S10D (1)</td>
<td>520</td>
<td>360</td>
<td>22%</td>
</tr>
<tr>
<td>Europe S355J2G3 (1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany QSt52-3N(1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.K. BS50D (1)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) Alternatively, only by lengthening the rear overhang.

Table 2.2 - Dimensions of the chassis side member cross-section

<table>
<thead>
<tr>
<th>Model</th>
<th>Area of side member A x B x t [mm] (see section 1 - Figure 8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRAKKER 190, 260, 340</td>
<td>289 x 80 x 7.7</td>
</tr>
<tr>
<td>TRAKKER 190W, 260W</td>
<td>199 / 289 x 80 x 7.7</td>
</tr>
<tr>
<td>TRAKKER 380, 410, 410W</td>
<td>289 x 80 x 10</td>
</tr>
<tr>
<td>TRAKKER 380W</td>
<td>199 / 289 x 80 x 10</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 allowed on chassis: 100 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.
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 2.3 - Screws resistance classes**

<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 5.5).

Welds are allowed:

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

![Figure 3](image)

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

- before disconnecting the power cables ensure there are no active electric users;
• if an electric circuit breaker (main switch) is present, wait for it to complete the cycle;
• disconnect the negative pole from the battery;
• disconnect the positive pole of the battery without connecting it to 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]

• 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]

• 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

Sealing holes by welding

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

Good results are obtained by:

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

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

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>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</td>
</tr>
<tr>
<td>Geomet (2)</td>
<td>GEO 321-8</td>
<td>B - B1 - B2 - C - D</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.
### Table 2.6 - Painted parts - IVECO Standard 18 - 1600 (Prospectus III)

<table>
<thead>
<tr>
<th>Cycle phase description</th>
<th>IVECO standard</th>
<th>Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand/shot blasting</td>
<td>yes</td>
<td>–</td>
</tr>
<tr>
<td>Brushing</td>
<td>yes (*)</td>
<td>–</td>
</tr>
<tr>
<td>Sandpapering</td>
<td>yes (**)</td>
<td>–</td>
</tr>
<tr>
<td>Iron phosphating</td>
<td>yes (**)</td>
<td>–</td>
</tr>
<tr>
<td>(only for non-precoated ferrous materials)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc phosphating</td>
<td>yes (**)</td>
<td>–</td>
</tr>
<tr>
<td>High thickness (30-40 μm)</td>
<td>yes (2)</td>
<td>–</td>
</tr>
<tr>
<td>Medium thickness (20-30 μm)</td>
<td>yes (2)</td>
<td></td>
</tr>
<tr>
<td>Acrylic finishing (&gt;35 μm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bi-component (30-40 μm)</td>
<td>yes (2)</td>
<td>–</td>
</tr>
<tr>
<td>Single-component (30-40 μm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single (130 °C) or bicomponent (30-40 μm)</td>
<td>yes (2)</td>
<td>–</td>
</tr>
<tr>
<td>Single (130 °C) or bicomponent (30-40 μm)</td>
<td>yes (2)</td>
<td>–</td>
</tr>
</tbody>
</table>

---

1. Coupling with other materials must not cause the "battery effect".
2. Coatings free from chromium salts.
2.3 RUST AND PAINT PROTECTION

### Cycle phase description

<table>
<thead>
<tr>
<th>Cycle phase description</th>
<th>Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>VARNISH</td>
<td>A</td>
</tr>
<tr>
<td>Powders (40-110 μm)</td>
<td>yes (4)</td>
</tr>
<tr>
<td>Low-temperature single-component (30-40 μm)</td>
<td>–</td>
</tr>
</tbody>
</table>

(1) This operation must be performed when dealing with cutting burr, oxidation, weld slag, or laser-cut surfaces.
(2) Two-layer bodywork cycle.
(3) Three-layer bodywork cycle.
(4) In alternative to single and bi-component paint only for particular bodywork (windscreen wipers, rear-view mirrors, etc.).
(5) Only rear/front axles.
(6) Excluding parts that cannot be immersed in pre-treatment baths or undergo painting because of compromised functionality (e.g.: mechanical parts).
(7) Only if the colour is defined in a drawing according to I.C.
(8) For fuel tanks in ferrous or pre-coated sheets.
(9) Only parts to mount on the engine.
(* ) 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>Table 2.7 - Painted modified parts or add-ons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle phase description</td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td>Mechanical surface cleaning (including elimination of burrs/oxidation and cleaning of cut parts)</td>
</tr>
<tr>
<td>Pre-treatment</td>
</tr>
<tr>
<td>Rust preventer</td>
</tr>
<tr>
<td>Varnish</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

| Type of protection | Class |  
|--------------------|-------|---|
| Stainless steel    |       |   |
| Geomet             | yes   |   |
| Zinc coating (1)   | –     | yes |

(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.);
- sediment bowl and fuel filter assembly;
- 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 basic diesel filter;
- 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 5.5 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. 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:

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

When these conditions do not exist in combination at the same time, which ensure that the schematics of the transformed frame is equal to that of the original, the modification must undergo approval.

For the 6x4 and 8x4 versions, variation in the wheelbase is only allowed with specific approval from IVECO. This also applies for 4x4, 6x6 and 8x8 vehicles with all-wheel drive, for which it is necessary to consider, in particular, the position of the distributor gear.

Note The operations must be performed in compliance with these Directives, taking into account the suitable adjustments (for example, the need for IVECO Service Assistance to reparameterize the control units), as well as all necessary precautions (arranging the exhaust pipe, observance of minimum tare weight on the rear axle, etc.) provided for on the corresponding original wheelbases.

Effects on steering

Generally speaking, extending the wheelbase will have a negative effect on steering. The limits established by Regulations must not be exceeded (for example, Regulation ECE) for the clearance band, the forces exerted on the steering wheel and the negotiating times on a bend.

If a longer wheelbase is required compared to the longest wheelbase possible in production, depending on the vehicle, specific authorisation must be requested and measures must be taken to improve the steering (reduction of the maximum load on the front axle, or the realisation of a trailing arm with more restricted values, additional pump, ...)

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, WHERE PRESENT, GRIP AND STABILITY, REQUIRE AS MANDATORY THE UPDATING OF THE SETTING PARAMETERS (DATASETS) OF THE RELEVANT CONTROL UNITS VIA IVECO TELESERVICES.
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 44) and 5.5 (⇒ Page 25).
- Follow the instructions in Chapter 2.8 (⇒ Page 33) 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 33) for checks of modifications allowed.

2.5 REAR OVERHANG MODIFICATION

General information

When modifying the rear overhang it is necessary to note the variations that this modification shall inflict on the payload distribution on the axles, in compliance with the loads established by IVECO (see Chapter 1.15 (➡ Page 11)). Limits set by national law must also be respected, as well as maximum distances from the rear structural edge and heights from ground, defined for towing 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”.

Figure 6
**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**

Possible solutions concerning elongations are shown in Figures 7 and 8.

Cuts can be of straight type. The minimum dimensions of the reinforcements to apply in the area of modification are shown in Figure 3.

The solution for elongations greater than $300 \div 350 \text{ mm}$ is shown in Figure 7. In this case, the corner reinforcements, which also serve as junction between cross member and frame, must have the same width and thickness of the original gusset plate. The union between the cross member and plate, originally performed using nails, can be done with screws class 8.8 having the next largest scale diameter and anti-unscrewing nuts.

When the connection between the cross member and gusset plate is made by welding, the gusset plate can be connected to the reinforcement by welding (see Figure 7).

The solution for elongations exceeding $350 \text{ mm}$ is shown in Figure 8.

---

1. Added part
2. Reinforcing profile
3. Reinforcing profile (alternative solution)
4. Original rear cross member
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 20).

#### Precautions for Installation

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

*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.
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 cross-bar, 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:

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

**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 frame 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 centre axle trailers therefore requires the use of suitable towing hooks.

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:

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

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

**D_C** = representative value of drawbar class [kN]. This is defined as the determination of the theoretical reference value for horizontal load between tractor

**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 \( S \leq 0.1 \times R \leq 1000 \text{ kg of the trailer} \)

**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 [kN]

**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 m/s² of air suspensions
- **a** = 2.4 m/s² for other types of suspensions

**X** = length of the load bed [m], (see Figure 2.10)
\( L \) = theoretical drawbar length, distance between the centre of the drawbar eye and the centre line of the trailer axles [m], (see Figure 2.10)

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

![Diagram](Figure 10)

\( X \). Length of the trailer load bed

\( L \). Theoretical drawbar length

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.

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.

Moreover, 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 having a larger size than those normally provided.

Table 2.9 - Longitudinal sections of the subframe for centre axle trailers

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<th>Models</th>
<th>Profile chassis [mm]</th>
<th>Wheel-base [mm]</th>
<th>Overhang rear. [mm]</th>
<th>R = Maximum weight of trailer [kg]</th>
<th>S = Vertical static load on the trailer hook [kg]</th>
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## TRAKKER Euro 6 – GUIDELINES FOR BODYBUILDERS
### CHASSIS INTERVENTIONS
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*R = Maximum weight of trailer [kg]
*S = Vertical static load on the trailer hook [kg]

Section modulus Wx [cm³] for longitudinal sections of the counter chassis with material with a yield limit of 360 [N/mm²] (Fe 510)
### CHASSIS INTERVENTIONS

#### 2.6 INSTALLING THE TOW HOOK

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Section modulus $W_x$ [cm$^3$] for longitudinal sections of the counter chassis with material with a yield limit of 360 [N/mm$^2$] (Fe 510)
### CHASSIS INTERVENTIONS

#### 2.6 INSTALLING THE TOW HOOK

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**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 2.11 and 2.12 show the respective realisation examples.

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.
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" (Rightarrow Page 12). The fastening to the vertical rib of the side members must be done with all the union screws of the crossbar to the chassis of the vehicle, integrating them with others whose number and positioning consider the greater time transmitted. In principle, in the lowerings equivalent to the height of the side member, an increase in the number of screws equal to about 40% is predicted.

In applying a supplementary crossbar (see Figure 2.12) 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 2.12 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.
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 two 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 2.13;
- 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 2.14. 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 2.12).

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 2.12), 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

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

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

General information

On some models of the Trakker 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.

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 15 shows several examples of possible solutions.

The reinforcements must concern the entire length of the chassis, up to the cab.

![Image of reinforcements on the chassis]

1. Bracket

2. Plate

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 15).
**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**

**a) rear**

The installation of an axle behind the engine axle generally results in the lengthening of the chassis overhang (see Figure 16) 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 29).

For vehicles with a tapered frame, the adaptation of the section of the new overhang to the rest of the sections of the chassis can be a useful solution for containment of the stresses caused by transformation.

![Figure 16](image_url)

1. Added supplementary axle
2. Lengthening of the overhang
3. Reinforcements for modification of the chassis
4. Connections
5. Reinforcing profile

**b) central**

The installation of an axle in front of the engine axle may make it necessary to reduce the rear overhang (see Figure 17), to be realised according to the indications provided in the Paragraph "Shortening" ( ➤ Page 17) in order to respect the technically permissible load.
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 suspension of an additional axle may be mechanical spring or pneumatic, with the possibility of creating a mixed solution with the suspension of the engine axle.

The solution created should not adversely affect the dynamic behaviour of the vehicle, on the comfort and work angle of the transmission (with its space in the case of an added axle in front of the engine axle).

Full or partial adoption of compensated suspensions (particularly for off-road use), with the aim of keeping the load distribution constant on the two rear axles and to ensure that these axles are able to react to the static and dynamic loads of the design and those required by Legislation (for example, axle misalignment).
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 (Page 11) with regard to the positioning of the centre of gravity of the superstructure plus payload.

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

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

2.8 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.
Maximum allowed angularity

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

- \( \beta \cdot n < 20,000 \) 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 19), may be determined based on the outer diameter of the existing pipe of the vehicle and on the maximum number of operating revs. (see formula and Table 2.10).

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

\[ \text{LG} \quad \text{Length of sliding sections} \]
\[ \text{LZ} \quad \text{Length of intermediate sections} \]
\[ \text{LT} \quad \text{Total length} \]
For sliding shafts, the length LG must be evaluated between the universal joint centres and with the sliding stem in the intermediate position. Always check both stems LG and LZ.

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

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

- \( n_G \) maximum engine speed [rpm]
- \( n_{\text{max}} \) engine speed [rpm] at maximum output power, see Table 2-10
- \( i_G \) gear ratio at highest speed, see Table 2-11

**Table 2.10 - Engine speed [rpm] at maximum output power**

<table>
<thead>
<tr>
<th>Engine Model</th>
<th>Engine code</th>
<th>Power [HP]</th>
<th>( n_{\text{max}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>CURSOR 9</td>
<td>F2CFE611D*J</td>
<td>310</td>
<td>2200</td>
</tr>
<tr>
<td></td>
<td>F2CFE611C*J</td>
<td>330</td>
<td>2200</td>
</tr>
<tr>
<td></td>
<td>F2CFE611B*J</td>
<td>360</td>
<td>2200</td>
</tr>
<tr>
<td></td>
<td>F2CFE611A*J</td>
<td>400</td>
<td>2200</td>
</tr>
<tr>
<td>CURSOR 13</td>
<td>F3HFE611D*J</td>
<td>410</td>
<td>1900</td>
</tr>
<tr>
<td></td>
<td>F3HFE611C*J</td>
<td>450</td>
<td>1900</td>
</tr>
<tr>
<td></td>
<td>F3HFE611E*J</td>
<td>500</td>
<td>1900</td>
</tr>
</tbody>
</table>

**Table 2.11 - Examples of gear ratio at highest speed**

<table>
<thead>
<tr>
<th>Gearbox</th>
<th>( i_G )</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 S 1830 TO</td>
<td>0.84</td>
</tr>
<tr>
<td>16 S 2230 TO</td>
<td>0.84</td>
</tr>
<tr>
<td>12 AS 2330 TO</td>
<td>0.78</td>
</tr>
<tr>
<td>16 AS 2630 TO</td>
<td>0.83</td>
</tr>
</tbody>
</table>

**Note** Following the modification, the axle shaft crosspiece forks must not be turned from their original position.

**Pipe thickness**

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

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

Hence, the pipe thickness must be established on a case 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 2.12 - Maximum possible lengths**

<table>
<thead>
<tr>
<th>Joint dimensions</th>
<th>External diameter x thickness [mm]</th>
<th>Maximum possible lengths LG to LZ [mm]</th>
<th>Maximum propeller shaft speed [rpm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2040</td>
<td>100 x 4.5</td>
<td>3400 3150 2900 2650 2450 2300 2100 1950</td>
<td></td>
</tr>
<tr>
<td>2040</td>
<td>120 x 3</td>
<td>4450 4100 3750 3400 3150 2900 2650 2450</td>
<td></td>
</tr>
<tr>
<td>2045</td>
<td>120 x 4</td>
<td>4450 4050 3700 3400 3100 2850 2650 2450</td>
<td></td>
</tr>
</tbody>
</table>
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 2.20) the difference in length must not be exceed 600 mm, while it must not be exceed 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.

![Figure 20](image)

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 2.21. 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.

The application of the elastic supports must be realized using support plates with a thickness of at least 5 mm (see Figure 2.22), connected to cross members with characteristics similar to those specified by IVECO.

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

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 Model</th>
<th>Engine code</th>
<th>Exhaust counter-pressure [kPa]</th>
<th>Intake vacuum [kPa]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CURSOR 9</td>
<td>F2CFE611D*J</td>
<td>20</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>F2CFE611C*J</td>
<td>17</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>F2CFE611B*J</td>
<td>16</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>F2CFE611A*J</td>
<td>17</td>
<td>6.3</td>
</tr>
<tr>
<td>CURSOR 13</td>
<td>F3HFE611D*J</td>
<td>27</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>F3HFE611C*J</td>
<td>27</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>F3HFE611E*J</td>
<td>27</td>
<td>6.3</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 ºC, with short durations of 120 ºC, 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.

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

Given the compaction of the “Hi-e SCR” system (see Section 6 (⇒ Page 5)) and the optimal arrangement of its assemblies on the chassis, any modifications to the exhaust pipe formation may be permitted only for the realization of a vertical exhaust outlet, differing from that offered as optional 180.

The realization of a vertical exhaust requires the following:

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

2.10 WORK ON THE ENGINE COOLING SYSTEM

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

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

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

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

- open the supply valve of the heating system and the heater bleed valves;
- fill the circuit while the engine is off with a flow rate of 8 - 10 l/min, until water seeps from the overflow vent;
- one bled, close the heater bleed valves;
- start the engine and run idle for 5 minutes, successively check to see that the water level in the supply tank has not dropped below minimum level;
- gradually rev the engine, checking that average pressure in the water pump outlet pipes steadily increases without and discontinuities;
- keep accelerating the engine until the thermostat opens, causing air bubbles to pass through transparent pipes installed between:
  - engine output and radiator;
  - water supply tank and water pump;
  - engine bleed and water supply tank;
- check, after the thermostat has be open for 15 minutes, that there are no more bubbles in the circuit;
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 5.5 (☞ Page 25)) and install a protection fuse on the new circuit;
- connect - for the fuel supply - the supply system to a supplementary tank that is installed along the return pipe of the engine fuel. Direct connection to the vehicle tank is allowed under the condition that it occurs independently from the engine fuel supply, and the new circuit must be perfectly airtight;
- route piping and wiring layout (and installation of brackets and flexible fittings) in relation to the spaces available and the influence of heat on the chassis parts. Avoid any exposed parts that may be dangerous, and adopt suitable guards when necessary.

The system must allow easy access and prompt maintenance.

The Bodybuilder must provide all necessary maintenance instructions.

a) Water heaters

When the original vehicle heating and engine cooling circuits are involved (see Chapter 2.10 (☞ Page 39)), 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

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 - Paragraphs "Additional batteries" (➤ Page 33) and "Additional alternators" (➤ Page 34)) 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 CO₂ equivalent) must be indicated by a data plate which replaces the original data plate;

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

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

General information

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

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

In relation to 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.

2.14  CHANGING TYRE SIZE

**Note**  Replacing the tyres with others of measure or load bearing capacity that differs from the specifications recorded at vehicle approval require IVECO certification, as well as a test to determine whether the braking system requires adjustment.

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 51));

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 2.14 - Wheel tightening torque according to IVECO STD 17-9219

<table>
<thead>
<tr>
<th>CONNECTING ELEMENTS</th>
<th>Thread</th>
<th>CLASS</th>
<th>Torque [Nm]</th>
<th>FEATURES “S” (*)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Code</td>
<td>Name</td>
<td>CLASS</td>
<td>Min</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Front and rear wheel mounting</td>
<td>Nut M18x1.5</td>
<td>II</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Front and rear wheel mounting</td>
<td>Nut M20x1.5</td>
<td>II</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Front and rear wheel mounting</td>
<td>Nut M22x1.5</td>
<td>–</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 wheelbase or moving the units, the brake lines involved should preferably be replaced with new pipes and in one piece; if this is not possible, use fittings of the same type as those which were used originally.

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 23) 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 24.

![Figure 24](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 devices

In the event of modifications to the wheelbase, the modulators must maintain the original position in relation to the rear wheel axle.

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 piping 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.

Withdraw the air directly from the 4-way safety valve (outlet 24) of the braking system or from the distribution plate (connection 5), if it is not otherwise occupied (see Figure 2.25) is requested.

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 and the current draws, refer to indications provided in Section 5 - Chapter 5.6 ( Page 25) and 5.8 ( Page 36).

**2.17 PART RELOCATION AND ANCHORAGE OF ADDITIONAL UNITS AND EQUIPMENT**

The movement of units (various components, fuel and urea tanks, batteries, spare wheel, etc.) for 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.

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 entry angle of 7°.

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

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

Similarly, it must act for the installation of tanks, compressors, etc.; the distribution of weight must also be taken into account for their placement (see Chapter 1.15 (☞ Page 11)). 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.

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

**Additional fuel tank**

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. 26A).

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 26 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.
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

1. **Vertical** movements are permitted as long as the absolute minimum pressure at the inlet of the LP/HP pump is 500 mbar.
2. **Horizontal** repositioning is possible when, compared to the original position, it 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.

Moving to the opposite side member

![Figure 27](image)

The fuel tank can be moved to the left side member providing a minimum distance of 200 mm from the DPF/muffler housing is maintained. This distance can only be reduced to 80 mm if appropriate heat shields (highlighted in red in figure 27) are used, which are of the same type as those used to protect the front section of the DPF/muffler.

Chassis with free right hand side

In cases where it is necessary that the right side of the chassis, between the front mudguard and the rear wheels, is free from any suspended assembly, it is possible to adopt specific fuel tanks for the left side (see Figure 28). This criterion does not concern the urea tank that, not having to be moved for any reason, should stay positioned right behind the right front mudguard.
On Trakker Hi-Land / Hi-Track trucks with the fuel tank on the left (right side of the chassis free), the minimum space that cannot be used is 905 or 1000 mm (measured from the centre line of the front axle), respectively with a urea tank of 50 or 80 litres (see Figure 29).

2.18 TRANSPORT OF HAZARDOUS MATERIALS (ADR)

Each vehicle complies fully with the technical specifications of Regulation 105 - Series 05 - attachment "B" of the Agreement ADR 2015 - Part 9 (Requirements relating to the construction and approval of vehicles) with regards to the paragraphs:

- 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 tanks)
- 9.2.4.4 (Engine)
- 9.2.4.5 (Exhaust gas device)
- 9.2.5 (Speed limiter device)
- 9.2.6 (Trailer connection device)
Full compliance of the electrical system can be carried out by making use of the optionals 2342 (ADR), No. 8818 (digital tachograph for ADR) and No. 76299 (specific battery cut-off switch).

It is understood that compliance with these requirements by the additional structures and their connections to "incomplete" vehicles, is the full responsibility of the Bodybuilder.

2.19 INSTALLING A RETARDER

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

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

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

2.20 REAR UNDER-RUN PROTECTION (RUP)

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

2.21 REAR MUDGUARDS AND WHEEL ARCHES

On cab version vehicles without rear mudguards, the Bodybuilder must implement solutions equal to those provided by IVECO.

For the realisation of the mudguards, the wheel arch boxes and the shaping of the superstructure, keep in mind that:

- the free shaking of the wheels must be ensured even in the conditions of use with chains; any indications on limit values can be requested via the Support Service;
- the width of the mudguard must be greater than the maximum dimensions occupied by the tyres, within the limits set by the regulations;
- the support structure of the mudguard must have adequate strength and be able to limit the vibrations;
- the connection can be made to the vertical rip of the side members of the vehicle or to the longitudinal sections of the sub-frame. In the first case the connection must be made only using screws (see Figure 30).

The first and second point are also to be considered in the realisation of the wheel arch compartments.
2.22 RAIN FLAP

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

2.23 SIDE PROTECTIONS

In some countries, regulations (national or EC) require the application of side protections. Compliance with the required characteristics should be assured by the bodybuilder who handles completion of the vehicle, if it was not already equipped as such originally (optional setting).

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.
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 × 4</td>
</tr>
</tbody>
</table>
### 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°, 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.

#### Section modulus W<sub>s</sub> [cm<sup>3</sup>] and Recommended C profile [mm]

<table>
<thead>
<tr>
<th>Section modulus W&lt;sub&gt;s&lt;/sub&gt; [cm&lt;sup&gt;3&lt;/sup&gt;]</th>
<th>Recommended C profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 ≤ W ≤ 26</td>
<td>80 × 60 × 6</td>
</tr>
<tr>
<td>27 ≤ W ≤ 30</td>
<td>80 × 60 × 7 100 × 50 × 5</td>
</tr>
<tr>
<td>31 ≤ W ≤ 33</td>
<td>80 × 60 × 8 100 × 60 × 5</td>
</tr>
<tr>
<td>34 ≤ W ≤ 36</td>
<td>100 × 60 × 6</td>
</tr>
<tr>
<td>37 ≤ W ≤ 41</td>
<td>100 × 60 × 7</td>
</tr>
<tr>
<td>42 ≤ W ≤ 45</td>
<td>80 × 80 × 8 100 × 60 × 8</td>
</tr>
<tr>
<td>46 ≤ W ≤ 52</td>
<td>120 × 60 × 6 120 × 60 × 7</td>
</tr>
<tr>
<td>53 ≤ W ≤ 58</td>
<td>120 × 60 × 8</td>
</tr>
<tr>
<td>59 ≤ W ≤ 65</td>
<td>140 × 60 × 7 120 × 70 × 7</td>
</tr>
<tr>
<td>66 ≤ W ≤ 72</td>
<td>140 × 60 × 8</td>
</tr>
<tr>
<td>73 ≤ W ≤ 79</td>
<td>160 × 60 × 7</td>
</tr>
<tr>
<td>80 ≤ W ≤ 88</td>
<td>180 × 60 × 8</td>
</tr>
<tr>
<td>89 ≤ W ≤ 93</td>
<td>160 × 70 × 7 180 × 60 × 8</td>
</tr>
<tr>
<td>94 ≤ W ≤ 104</td>
<td>180 × 60 × 8</td>
</tr>
<tr>
<td>105 ≤ W ≤ 122</td>
<td>200 × 80 × 6 200 × 60 × 8 180 × 70 × 7</td>
</tr>
<tr>
<td>123 ≤ W ≤ 126</td>
<td>220 × 60 × 7</td>
</tr>
<tr>
<td>127 ≤ W ≤ 141</td>
<td>220 × 60 × 8</td>
</tr>
<tr>
<td>142 ≤ W ≤ 160</td>
<td>200 × 80 × 8 240 × 60 × 8</td>
</tr>
<tr>
<td>161 ≤ W ≤ 178</td>
<td>220 × 80 × 8 240 × 70 × 8</td>
</tr>
<tr>
<td>179 ≤ W ≤ 201</td>
<td>250 × 80 × 7 260 × 70 × 8</td>
</tr>
<tr>
<td>202 ≤ W ≤ 220</td>
<td>250 × 80 × 8 260 × 80 × 8</td>
</tr>
<tr>
<td>221 ≤ W ≤ 224</td>
<td>220 × 80 × 8 280 × 70 × 8</td>
</tr>
<tr>
<td>225 ≤ W ≤ 245</td>
<td>250 × 100 × 8 280 × 80 × 8</td>
</tr>
<tr>
<td>246 ≤ W ≤ 286</td>
<td>280 × 100 × 8</td>
</tr>
<tr>
<td>290 ≤ W ≤ 316</td>
<td>300 × 80 × 8</td>
</tr>
<tr>
<td>316 ≤ W ≤ 380</td>
<td>340 × 100 × 8</td>
</tr>
<tr>
<td>440</td>
<td>380 × 100 × 8</td>
</tr>
<tr>
<td>480</td>
<td>400 × 100 × 8</td>
</tr>
</tbody>
</table>

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.
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 chassis side members are not parallel to each other and therefore the longitudinal sections of the subframe must follow the trend. If the front part of the subframe is narrower than the chassis, suitably adapted C-shaped profiles or L-shaped angular profiles with appropriate ribbing can be introduced on the outside of the chassis (see Figure 3).
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 boxed section to the open section, as in the examples in Figure 4.

Figure 3

A. L profile
B. Alternative solution:
C. C Profile
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 dimensioning prescribed for the side members of the various types of superstructure is the recommended minimum value and, as a rule, is valid for vehicles with wheelbases and rear overhangs provided as standard (see Tables from 3.4 to 3.6 and from 3.8 to 3.13). 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 must be used to give adequate resistance to the connection (see the following Figure on the left). When you want to achieve greater stiffness in the connection, it can be carried out according to the following Figure on the right.

![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.

![Figure 6]
1. Subframe

2. Diagonals

---

1. Subframe

2. Box profile
**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 3.13), 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 approx. 250–350 mm from the front end of the subframe.

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

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

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

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

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 13).

Alternatively, use the connection in Figure 12, using the screws that connect the rear crossbar to the frame.

*In all other cases, it is absolutely forbidden to put holes in the wings.*

**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 subframe allows you to achieve greater resistant capacity compared to the connections with brackets or clamps, obtaining the following benefits:

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

\[
\begin{align*}
M_f &= M_c + M_t \\
M_c &= \frac{I_c}{I_c + I_t} M_f \\
M_t &= \frac{I_t}{I_c + I_t} M_f
\end{align*}
\]

\[
\begin{align*}
\sigma_c &= \frac{M_c}{W_c} \leq \sigma_{amm} \\
\sigma_t &= \frac{M_t}{W_t} \leq \sigma_{amm}
\end{align*}
\]

$M_f$ = static bending moment generated by the superstructure [Nmm]

$M_c$ = proportional share of the static bending moment $M_f$ applied to the subframe [Nmm]

$M_t$ = proportional share of the static bending moment $M_f$ applied to the chassis [Nmm]

$I_c$ = moment of inertia of the section of the subframe [mm$^4$]

$I_t$ = moment of inertia of the section of the chassis [mm$^4$]

$\sigma_c$ = maximum static stress applied to the subframe [N/mm$^2$]

$\sigma_t$ = maximum static stress applied to the chassis [N/mm$^2$]

$W_c$ = section modulus of the section of the subframe [mm$^3$]

$W_t$ = section modulus of the section of the chassis [mm$^3$]

$\sigma_{amm}$ = maximum static stress allowed on chassis [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:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>chassis</td>
<td>$I_c = 1,545$ cm$^4$</td>
<td>$W_c = 123$ cm$^3$</td>
</tr>
<tr>
<td>subframe</td>
<td>$I_t = 522$ cm$^4$</td>
<td>$W_t = 74$ cm$^3$</td>
</tr>
</tbody>
</table>

Applying the formulas will be obtained:

$M_c = M_f \times \left[ \frac{I_c}{I_c + I_t} \right] = 8,500 \times \left[ \frac{588}{588 + 183} \right] = 11,200$ Nm

$M_t = M_f \times \left[ \frac{I_t}{I_c + I_t} \right] = 8,500 \times \left[ \frac{183}{588 + 183} \right] = 3,790$ Nm

and then:
3.3 CONNECTION BETWEEN CHASSIS AND SUBFRAME

\[ \sigma_t = \frac{M_t}{W_t} = 91 \text{ N/mm}^2 \]

\[ \sigma_c = \frac{M_c}{W_c} = 51 \text{ N/mm}^2 \]

**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 subframe is 1–2 mm; greater distances should be reduced by means of suitable spacers. At the closure of the screws, brackets must be brought into contact.

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

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

In order to better contain the loads in the transverse direction, the brackets are normally applied so that there is a slight protrusion perpendicular to the upper edge of the chassis. If instead the brackets must be applied exactly to the wire, the side guide for the superstructure must be assured with other devices (e.g. using guide plates connected only to the subframe, or only to the vehicle chassis, see Figure 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 subframe or to the superstructure, resistance characteristics not less than those originally mounted on the vehicle should be provided (see Table 2.1 and Table 3.1).

**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)

1. Rubber block
2. Coil spring

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

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

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

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

In versions where the vehicle is lifted by hydraulic stabilisers (e.g. cranes, aerial work platforms), limit the collapse of the elastic element (30 – 40 mm) to ensure sufficient cooperation of the subframe and avoid excessive bending moments on the original chassis.
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 subframe is snug against the chassis itself;
- the distribution must be limited to the central and rear area of the chassis;
- the number and the thickness of the plates and the number of fixing screws must be adequate to withstand the bending moments and cutting of the section.

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 subframe, or if you want to contain the height of the subframe 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>
<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>≥ 1.0</td>
<td>500</td>
<td>Thickness [mm]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimensions of the screws (min. 3 screws per plate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M14</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 subframe, 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 subframe and the considerations of Chapter 3.3 (➾ Page 12), the connection between the vehicle chassis and the reinforcing subframe may be of mixed type, i.e. obtained by rationally using the elastic connections (brackets, clevis fasteners) and rigid connections (longitudinal and transverse sealing plates).

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

For this purpose, it is also possible to use connections by means of screws at the rear end of the chassis as shown in Figure 14.

![Figure 14](image)

1. Subframe
2. Chassis
3. Clevis fasteners
4. Hardware for longitudinal and transverse containment

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>
<thead>
<tr>
<th>Models</th>
<th>Wheelbase [mm]</th>
<th>Section modulus W, [cm³] of the minimum reinforcement section</th>
</tr>
</thead>
<tbody>
<tr>
<td>190, 190W</td>
<td>–</td>
<td>89</td>
</tr>
<tr>
<td>260, 260W</td>
<td>–</td>
<td>46</td>
</tr>
<tr>
<td>380, 380W</td>
<td>4200</td>
<td>46</td>
</tr>
<tr>
<td>340, 410, 410W</td>
<td>up to 5020</td>
<td>119</td>
</tr>
<tr>
<td></td>
<td>up to 5800</td>
<td>245</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 14). 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 stabiliser 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 brackets 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 impair stability of the vehicle during tipping operations and not to increase excessively stress on the chassis, it is recommended that in the case of leaf springs, the distances between the tipping hinge and the rear support or tandem centre line are observed as shown in Figure 17. In the case of air suspension, it is recommended that the distances between the tipping hinge and rear axle or tandem centre line are observed as shown in Figure 18. 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 increase the wheelbase of the vehicle rather than create long overhangs.
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** To ensure stability on vehicles with air suspension it is required to deflate the air springs completely. See also Specification 01 in Chapter 5.2.

---

1. Subframe
2. Brackets
3. Plates
4. Joint cover

---

*Figure 17*
Table 3.5 shows which vehicles may be utilized for these applications, with the minimum indications for the main sections of the subframe. For the dimensions, depending on the section modulus $W_x$, see table 3.2.

Particular attention must be paid to the observance of the general prescriptions in order to guarantee vehicle stability during rear tipping operations.

In the event of tippable superstructure assembly on vehicle chassis equipped with brackets (provided for the use of different types of superstructures), replace them with longitudinal and transverse seal plates, in the segment between the front engine axle suspension support and the rear chassis end; or consider the application of additional plates.

For models with two rear axles the following is recommended:

- the box section for the longitudinal reinforcement section (see Figure 4) involves the section between the rear wire and approx. 1300 mm in front of the centre line of the two axles;
- the diagonal cross bracings must 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>Models</th>
<th>Wheelbase [mm]</th>
<th>Section modulus W, [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>190, 190W</td>
<td>4200</td>
<td>65 (1) 113 (2) 173 (3)</td>
</tr>
<tr>
<td>260, 260W</td>
<td>3820</td>
<td>85 (1) 113 (2) 173 (3)</td>
</tr>
<tr>
<td>260W, 380W, 380W</td>
<td>3820</td>
<td>113 (1) 173 (2)</td>
</tr>
<tr>
<td>340</td>
<td>4250 5020</td>
<td>133 (1) 190 (2)</td>
</tr>
<tr>
<td>410</td>
<td>5020</td>
<td>162 (3) (4) 190 (3) (4)</td>
</tr>
<tr>
<td>410W</td>
<td>4750</td>
<td>162 (3) (4) 190 (3) (4)</td>
</tr>
</tbody>
</table>

(1) Maximum load on front axle 7500 kg
(2) Maximum load on front axle 8000 kg
(3) Maximum load on front axle 8500 kg
(4) Boxed section for the entire length

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 good roads, to transport freight with a low density and a low friction coefficient.

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

- carefully check the chassis specifications (suspension, frame, 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 rear tipping hinge must be placed as near as possible to the rear brackets of the rear suspension;
- in cases of vehicles having wheelbases longer than the standard tipper wheelbase, in addition to the superstructure, specially stiffened rear tipping support anchoring should be used so as to contain sag and ensure good stability during operation; the rear 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 and rear stabiliser bar available; when parabolic rear springs are used, the rigidity can be increased using rubber elements which operate at static load;
- for vehicles with pneumatic rear suspension, discharge the air from the springs during tipping operation to allow the vehicle the greatest stability during tipping; It is important that this operation takes place automatically from the tipping control whereas the resetting can also be operated by the tipping control as the body is lowered;
- for vehicles with rear air suspension (for the tandem 6x4 and 8x4 with four air springs for each rear axle), discharge the air from the springs during tipping operations in order to maximize vehicle stability during tipping. It is important that this operation takes place automatically with the load tipping control, whereas the resetting operation can be operated by the body lowering control.
Table 3.6

<table>
<thead>
<tr>
<th>Model</th>
<th>Section modulus Wₘ [cm³] of the minimum section bar of the subframe (Yield point of the material used = 360 N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>190, 190W</td>
<td>89</td>
</tr>
<tr>
<td>260, 260W, 340</td>
<td>105</td>
</tr>
</tbody>
</table>

(1) A box-section with shear-resistant connections from 1000 mm is required in front of the centre line of the drive shaft to the rear end of the frame.

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

**Roll off containers**

The roll-off body is a container which, by means of a specific tipping device on the vehicle, is moved through a sliding movement on the chassis and is subsequently deposited on the ground.

Since additional stresses are generated during loading and unloading operations compared to those which fixed body vehicles are subjected to, the subframe may have the dimensions envisaged for lightweight tipper trucks (see Paragraph “Lightweight services” (⇒ Page 23)).

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 movement device must be anchored to the subframe according to the indications provided in Chapter 3.8 (⇒ Page 34).

Vehicle stability must be guaranteed in compliance with standard DIN 30722 during loading and unloading operations; it is therefore recommended that stabilizers are used at the rear end of the chassis. The stabilizers are strongly recommended when the rear axles have air or mixed suspension.

**Note** In order to guarantee the stability of vehicles equipped with air suspension during the offloading phase, it is necessary to fully discharge the air from the air springs and, in any case, follow the instructions in Paragraph “Lightweight services” (⇒ Page 23)).

It is important, with this type of vehicle, to adhere to the indications concerning the height of the centre of gravity (see Chapter 1.15 (⇒ Page 11)); when containers for high payloads are used, use the most rigid rear suspension and rear stabiliser bar available if IVECO provides for this.
The distance between the last rear axle and the sliding pivot must not exceed 900 mm.

3.5 TRACTOR FOR SEMI-TRAILER

Fifth wheel

- The fifth wheel and the chassis fastening plate are safety devices and must be type-approved; therefore, modifications to their structure is not permitted.

For installation of the aforementioned units, pay careful attention to the indications supplied by the Manufacturer.

Fifth wheel advancement

Generally, the fifth wheel is fitted in a standard position based on the configuration of the tractor axles. Always check that:

- the maximum permitted loads are not exceeded on each axle or axle assembly for any specific position of the fifth wheel and for the loads applied to it. If the original kerb weight indicated on the Certificate of Conformity changes due to outfitting and/or the changes made, reference must be made to the actual kerb weight of the tractor and with all the equipment (including fuel, tools, driver etc.);
- the maximum permitted length for the combination is not exceeded for each and any position of the fifth wheel and for each type of semi-trailer;
- all the geometric conditions are met, to ensure semi-trailer coupling which is both safe and sufficient for Current regulations, in particular in the case of fifth wheel advances other than those normally implemented.
**Tractor and semi-trailer combination**

The semi-trailer's construction characteristics must be suitable to avoid negative effects on the articulated truck handling (e.g.: an overflexible frame, insufficient braking capacity etc.). In the tractor and semi-trailer combination, all movements must be verified in the various conditions of use, to ensure the necessary safety margins and observation of applicable laws and Standards (see Figure 20).
Consult the Standard ISO 1726 for details.

![Diagram of a tractor and semi-trailer showing angles and dimensions](image)

- **E.** Tractor free front radius
- **E1.** Semi-trailer front clearance radius
- **F.** Tractor rear clearance radius
- **F1.** Semi-trailer rear free radius

⚠️ **The axle load must always be checked on the basis of the fifth wheel position.**
Always check the distance between the trailer and the cab.

When required, check that the clearance area on bends respects the established limits.
Respect all other limits established by IVECO for defining fifth wheel heights.

**Fifth wheel supporting structure**

Follow the instructions below for making fifth wheel supporting structure for tractors supplied without one:

- the structure must be suitably dimensioned for vertical and horizontal loads which the fifth wheel transfers; refer to the information provided previously regarding its height.
- see the Paragraphs “Materials” (➡️ Page 5) and “Section dimensions” (➡️ Page 5) for the characteristics of the material of the structure;
- the upper and lower surfaces of the structure must be level so as to ensure a good contact on the chassis and the base of the fifth wheel;
- the structure components, when this is formed by several elements, must be welded and/or nailed to form a single assembly;
- fastening of the structure to the tractor (see Figures 21 and 22) must be carried out on the corner reinforcements, where applicable, unless otherwise specified.

Use class 8.8 screws or higher for correct anchoring of the semi-trailer to the fifth wheel (number and diameter suitable for tightening to a torque of no less than that for the fifth wheel fastening) with washers.

Do not weld or drill the side member wings when applying longitudinal stops.

Running guides maybe installed on to the frame; Consider the following for construction and application:

- adopt suitable dimensions for correct anchoring of the semi-trailer to the fifth wheel;
- securing to the chassis must be carried out without the use of welding and without drilling any holes into the side member flaps.

**Table 3.7 - Application of fifth wheel and plates**

<table>
<thead>
<tr>
<th>Application of fifth wheel and plate</th>
<th>4x2 tractor (4x4 tractor)</th>
<th>Tractor 6x4</th>
<th>6x6 tractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>400 T</td>
<td>400 T/P</td>
<td>440 T</td>
</tr>
<tr>
<td>Fifth wheel H = 185 mm + plate 50 mm</td>
<td>○</td>
<td>○</td>
<td>–</td>
</tr>
<tr>
<td>Fifth wheel H = 185 mm + plate 40 mm</td>
<td>–</td>
<td>–</td>
<td>○</td>
</tr>
<tr>
<td>Fifth wheel H = 185 mm + plate 100 mm</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Fifth wheel H = 190 mm + plate 16 mm</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

*O = Optional*
Assembly instructions for models: 400T and 440T

1. Fifth wheel axis
2. Rear wheel axle
3. Fifth wheel advancement
4. Longitudinal profiles
5. Fifth wheel carrying plate
6. Screws with flange M16x1.5 - 10.9
7. Fastening spacer (h = 15 mm)
8. Flanged head self-locking nuts
9. Chassis side members
10. Spring washer (16x34x4.4)
11. Fastening spacer (h = 15 mm)

- After establishing fifth wheel advancement, secure the plate to the longitudinal section with screws (6), using appropriate spacers (7 or 11), washers (10) and self-locking nuts (8).
- Tighten the nuts (8) (tightening torque 277 - 355 Nm).
Assembly instructions for 720T models - With crossbar (Opt. 7727 - 7728)

1. Fifth wheel
2. Flange nut M16x1.5
3. Washer (h = 6 mm)
4. Screws with flange M16x1.5 - 10.9
5. Fifth wheel assembly plate

Tighten the nuts (3) (tightening torque 277 ÷ 355 Nm).

**Application of a collaborating structure to the vehicle chassis**

The application of a suitable structure such as a subframe (see Figure 23) serves to ensure adequate torsional and bending contribution to the vehicle chassis, aside from distributing the load on the fifth wheel. This structure is required when the loads on the front axle exceed those shown, in the event of high fifth wheel advancements, in addition to particularly demanding uses in some markets and for the models shown in Table 3.8. The table contains the minimum indications to be used for the longitudinal reinforcement sections.

**Table 3.8 - Minimum dimensions of the subframe profile**

<table>
<thead>
<tr>
<th>Models</th>
<th>Wheelbase [mm]</th>
<th>Section modulus $W_x$ [cm$^3$] of the minimum reinforcement section</th>
</tr>
</thead>
<tbody>
<tr>
<td>400T... /W (4x2, 4x4)</td>
<td>3200 - 3500</td>
<td>52</td>
</tr>
<tr>
<td>190T... /W (4x2, 4x4)</td>
<td>2800 - 3800</td>
<td></td>
</tr>
<tr>
<td>440T... T (6x4)</td>
<td>2800 - 3200</td>
<td>60</td>
</tr>
<tr>
<td>260T... /W (6x4, 6x6)</td>
<td>2800 - 3500</td>
<td></td>
</tr>
</tbody>
</table>
### 3.5 TRACTOR FOR SEMI-TRAILER

<table>
<thead>
<tr>
<th>Models</th>
<th>Wheelbase [mm]</th>
<th>Section modulus $W_x$ [cm$^3$] of the minimum reinforcement section</th>
</tr>
</thead>
<tbody>
<tr>
<td>$380T\ldots /W$ (6x4, 6x6)</td>
<td>3200</td>
<td>72</td>
</tr>
<tr>
<td>$720T\ldots /W$ (6x4, 6x6)</td>
<td>3500</td>
<td></td>
</tr>
</tbody>
</table>

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

The longitudinal reinforcement sections must be connected by a suitable number of crossbars arranged in correspondence with the fifth wheel supporting area and by other two crossbars on the two ends of the structure.

The fifth wheel supporting surface may be made as follows:

- using a flat plate of suitable thickness (min. 10 mm), with length and width suited to fifth wheel supports or by means of two longer half plates (thickness min. 8 mm);
- using a ribbed plate provided by the fifth wheel supplier (height 30 or 40 mm) if there are no problems concerning fifth wheel surface height.

The plates forming the fifth wheel support must be connected stiffly to the basis chassis (longitudinal elements and crossbars).

Use fastening elements already provided by IVECO (plates and/or brackets) for fastening the structure to the frame: a good connection requires the use of plates providing transverse and longitudinal resistance in the rear area and near the fifth wheel and brackets towards the front end (see Figure 23).

---

**Figure 23**

1. Solution 1
2. Solution 2
3. Fifth wheel axis
4. Tandem axle centre line
5. Fifth wheel advancement
6. Corner reinforcements - Screws $\Phi$ 14 mm
7. Longitudinal reinforcement section
8. Stiffening cross member
9. Rear cross member (for $L = 400$ mm)
10. Semi-plate
11. Single plate
12. Ripped plate
13. C shaped connecting section ref. Fig. 3.3
14. Fastening reinforcement corner
Adjustable height fifth wheel

IVECO has a variable height fifth wheel, to make the connection possible between Low Tractors and the various types of semi-trailers.

This device can however also be used for other tractors:

- in the low position, with the exception of "quarries and work sites", and the tipping semi-trailer combination;
- in the high position, with the exception of combinations with outfits with a high centre of gravity, silos, tanks, "quarries and work sites" and tippers.

The maximum authorized height, measured from the ground, is 1200 mm in accordance with the CEE certification indications relating to Braking.

3.6 TRANSPORT OF INSEPARABLE MATERIALS (TRAILER TRUCKS)

The carriage of oversize inseparable material is governed in various countries by specific standards.

The type of vehicle to be used must be verified directly with IVECO for transportation requiring particular force configurations due to concentrated vertical loads and dynamic braking forces.

A subframe must be used to support the load supporting structure, while other limitations may be specified on a case-by-case basis.

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 3.9.

**Table 3.9 - Installation of tanks**

<table>
<thead>
<tr>
<th>Model</th>
<th>Section modulus W, [cm²] (Yield point of the material equal to 360 N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>190, 190W</td>
<td>89</td>
</tr>
<tr>
<td>260, 260W</td>
<td>89</td>
</tr>
<tr>
<td>340</td>
<td>59</td>
</tr>
<tr>
<td>380, 380W</td>
<td>59</td>
</tr>
<tr>
<td>410, 410W</td>
<td>59</td>
</tr>
</tbody>
</table>

(1) Stiffen the subframe in the tank and container resting area.

(2) Arrange the front tank support in advanced position or near the second front axle rear spring mount. Use of a larger section and specific authorisation will be required otherwise.

**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 24) 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 3.9. 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 frame-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 (see Chapter 1.15 (➠ Page 11)) as well as the maximum axle loads must be observed for all loading conditions.

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 stabiliser 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 (see Chapter 2.18) for containers intended to carry flammable liquids.

### 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 (eg. CUNA, DIN) and international standards (eg. ISO, CEN) and verifying those required for the vehicle.

While the crane is operating, the stabilisers (hydraulic if possible) must be used and be in contact with the ground.

**Note** To ensure stability on vehicles with air suspension it is required to deflate the air springs completely. See also Specification 01 in Chapter 5.2.
As a general rule, the installation of a crane requires the use of a suitable subframe, the construction of which must take into account all general specifications (see Chapter 3.1 (Page 5)), and with the dimensions of the sections given in Tables 3.10, 3.11 and 3.12.

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 a section modulus greater than that required for the crane (eg 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 Table 3.10 (or for higher values) must be checked individually each time and must receive specific authorisation from IVECO.

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.

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

$g$ = acceleration of gravity equals 9.81 m/s²

$W_L$ = mass applied to crane extremity [kg]

$L$ = horizontal distance between the load application point $W_L$ and vehicle centre line [m]

$W_C$ = mass of the crane at its centre of gravity [kg]

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

告诫：

- 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

The fastening of the reinforcement sections to the chassis must be carried out using the standard brackets (see Figure 27), 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 3.10.

On vehicles for road use only, shearing resistant connections may be used for fastening the subframe to reduce the subframe section height (see Figure 28). The minimum reinforcement section dimensions for all these applications are given in Table 3.11.

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 3.10 and 3.11.

The section of the crane subframe (see Figure 27) 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.

![Figure 27: Crane behind cab](image)

**Table 3.10 - Crane behind cab (subframe secured with shelves or flanges)**

<table>
<thead>
<tr>
<th>Models</th>
<th>Frame section [mm]</th>
<th>Wheelbase [mm]</th>
<th>Total torque ( M_c ) max [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>20 30 40 50 60 70 80 90 100 120 140 160 180 200 220 240 260 280 300</td>
</tr>
<tr>
<td>190, 190W</td>
<td>5700</td>
<td>360 A A A A A A A A A A A A A A A A A A 2(1) 89 119 150 245 374 474 E</td>
<td></td>
</tr>
<tr>
<td>289x80x7.7</td>
<td>420</td>
<td>360 A A A A A A A A A A A A A A A A A A 2(1) 89 119 150 245 374 474 E</td>
<td></td>
</tr>
</tbody>
</table>

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

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TRAKKER Euro 6 – GUIDELINES FOR BODYBUILDERS
APPLICATIONS OF SUPERSTRUCTURES

3.8 INSTALLING A CRANE

<table>
<thead>
<tr>
<th>Models</th>
<th>Frame section [mm]</th>
<th>Wheel-base [mm]</th>
<th>Yield point of subframe material [N/mm²]</th>
<th>Total torque M₂ₘₐₓ [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>260, 260W</td>
<td>289x80x7.7</td>
<td>4800</td>
<td>360</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>420</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>340</td>
<td>289x80x7.7</td>
<td>5820</td>
<td>360</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>420</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>380, 380W</td>
<td>410, 410W</td>
<td>4200</td>
<td>360</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>420</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

A = The reinforcement section specified for the relevant superstructure is sufficient (eg. 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) When a higher section modulus is required for the superstructure (eg. container application) also use the latter for the crane.

Note For the dimensions of the profiles see Table 3.2.

The application of cranes on off-road vehicles may require flexible connections on the front and middle parts between chassis and subframe (see Figure 11) so as not to excessively restrict torsional movement of the chassis. In these cases, the crane is practically connected to the subframe only, the dimensions of the longitudinal sections must therefore be suited to withstand the moment induced when the crane is used.
The vehicle elements arranged behind the cab (e.g.: the gearbox controls, air filter, cab tilt locking device etc.) must be arranged to ensure functionality; moving certain units such as battery boxes, fuel tanks etc. is allowed providing that the original connection type is restored.

The container 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 3.11 - Cranes mounted behind cab (subframe secured with shear resistant plates)

<table>
<thead>
<tr>
<th>Models</th>
<th>Frame section [mm]</th>
<th>Wheel-base [mm]</th>
<th>Yield point of subframe material [N/mm²]</th>
<th>Total torque M₉ max [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>190, 190W</td>
<td>289x80x7.7</td>
<td>5700</td>
<td>360</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>420</td>
<td>360</td>
<td>A</td>
</tr>
<tr>
<td>260, 260W</td>
<td>289x80x7.7</td>
<td>4800</td>
<td>360</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>420</td>
<td>360</td>
<td>A</td>
</tr>
<tr>
<td>340</td>
<td>289x80x7.7</td>
<td>5820</td>
<td>360</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>420</td>
<td>360</td>
<td>A</td>
</tr>
<tr>
<td>380, 380W 410, 410W</td>
<td>289x80x10</td>
<td>420</td>
<td>360</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>420</td>
<td>360</td>
<td>A</td>
</tr>
</tbody>
</table>

A = The reinforcement section specified for the relevant superstructure is sufficient (eg. 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.

(1) When a higher section modulus is required for the superstructure (eg. container application) also use the latter for the crane.

**Note** For the dimensions of the profiles see Table 3.2.
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 3.12.

Considering the particular distribution of weights on the vehicle (load concentrated on overhang) and to ensure the necessary torsional stiffness for good performance on the road and during the working phase of the crane, the subframe must be suitably stiffened in relation to the crane capacity. Therefore, the use of (see Chapter 3.2 (Page 6)) box sections and bracings must be adopted in the areas of the rear suspension and for the entire rear overhang (measurement L_U - see Figure 29).

The passage between box section s and open sections must be well fitted as shown in Figure 3.4. 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 the front axle and rear axle weight respects the limit defined for each vehicle under any load condition (see Chapter 1.15 (Page 11)).

Considering that the necessary subframe rigidity depends on various factors (e.g. crane capacity, resting surface dimensioning, vehicle tare weight, chassis overhang), instructions valid for all situations cannot be given. For this reason Bodybuilders shall, if necessary, proceed also by testing the vehicle’s stability. If the test results show that rigidity is insufficient, the Bodybuilder will adopt suitable precautions so as to obtain correct realisation.

The rear overhang of the crane (measurement L_U, see Figure 29) must be as limited as possible (never exceeding 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 (Page 11)). The axle must be lowered while travelling if the minimum required value is not obtained.

Figure 29

1. Subframe on the entire body length
2. Plates
3. Brackets
4. Crane connections
5. Stabilisers
6. Connecting corner
### Table 3.12 - Cranes on rear overhang (subframe secured with shear resistant plates)

<table>
<thead>
<tr>
<th>Models</th>
<th>Frame section [mm]</th>
<th>Wheel-base [mm]</th>
<th>Yield point of subframe material [N/mm²]</th>
<th>Total torque $M_c$ max [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>190, 190W</td>
<td>289x80x7.7</td>
<td>5700</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>420</td>
<td>A</td>
</tr>
<tr>
<td>260, 260W</td>
<td>289x80x7.7</td>
<td>4800</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>420</td>
<td>A</td>
</tr>
<tr>
<td>340</td>
<td>289x80x7.7</td>
<td>5820</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>420</td>
<td>A</td>
</tr>
<tr>
<td>380, 380W</td>
<td>410, 410W</td>
<td>4200</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>420</td>
<td>A</td>
</tr>
</tbody>
</table>

**Note**
- The reinforcement section specified for the relevant 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.
- When a higher section modulus is required for the superstructure (e.g., container application) also use the latter for the crane.

**Removable cranes**

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

Since the vehicle may be used with or without the crane (where permitted), it is recommended that the position of the payload is marked on the superstructure.

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

3.10 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.

3.11 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 47)), 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.);
3.12 CONCRETE MIXER INSTALLATION

a) For 6x4 and 8x4 vehicles with mechanical suspensions and only for specific wheelbases, IVECO provides versions already prepared with:

- specific rear overhang;
- subframe connection plates fastened with screws and of large dimensions (see Figure 30);
- rear semi-elliptic leaf springs;
- rear stabiliser bars of suitable dimensions;
- parking brake on front axle;
- Multipower PTO (see Chapter 4.5 ( ➤ Page 9)).

b) On vehicles not pre-installed originally with the Multipower PTO, application of a concrete mixer requires the adoption of a motor reserved exclusively for the drum actuation (see Figure 32).

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

- The concrete mixer must be equipped with a continuous steel subframe, so as 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 \( J_x \) not less than the values given in Table 3.13, 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 31).
3.12 CONCRETE MIXER INSTALLATION

Table 3.13 - Minimum dimensions of the subframe profile

<table>
<thead>
<tr>
<th>Models</th>
<th>Approximate capacity of the drum [m³]</th>
<th>Section modulus W, [cm³] of the minimum reinforcement section with a yield point of the material used = 360 N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>190, 190W</td>
<td>4 – 5</td>
<td>66</td>
</tr>
<tr>
<td>260, 260W</td>
<td>6 – 7</td>
<td>66</td>
</tr>
<tr>
<td>340 (1)</td>
<td>7 – 9</td>
<td>81</td>
</tr>
<tr>
<td>380, 380W</td>
<td>10</td>
<td>81</td>
</tr>
<tr>
<td>410, 410W</td>
<td>10</td>
<td>108 (2)</td>
</tr>
</tbody>
</table>

(1) Up to a wheelbase of 5020 mm.
(2) Boxed section (for 9-10 m³).

The dimensions of the sections shown in the table refer to the maximum load permitted on the front axle, in any case, not greater than 7500 kg, except model 410 for which the specified section is valid up to 2x8500 kg. Higher values require sections of larger dimensions to be defined upon request.

The subframe must be reinforced (e.g. crossbar, cross brace in the rear part (see Chapter 3.2 - Paragraph "Crossbars" (Page 10)) to reduce the stresses on the vehicle chassis caused by the forces (due to the particular geometric configuration) which develop during vehicle operation. In the event of mixer cylinders with a volume of 10 m³ and besides the subframe must be closed in the rear part and be reinforced with a cross brace.

The connections (see Chapter 3.3 (Page 12)) must only involve the two chassis and be realized so as to guarantee secure anchoring. For vehicles not originally equipped with plates, the use of plates is recommended for transverse and longitudinal containment, while the use of elastic connections should be limited to the front end of the subframe (see Figures 12 and 30).
The auxiliary motor for the mixing drum control requires a suitable suspension system.

The centre of gravity of the concrete mixing unit must be as close as possible towards the front axle of the vehicle, obviously in observance of the maximum load permitted on the axle itself.

**Note** To guarantee vehicle stability while the mixing drum is operating (particularly when cornering and on terrain with a transverse incline), the surging of the mass inside the drum and the consequent transverse displacement of its centre of gravity must be taken into account.

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 Chapter 4.5 (**Page 9**).

**Concrete mixer outfitting with EuroTronic II gearbox**

IVECO also offers its customers the chassis for concrete mixer outfitting equipped with EuroTronic II gearbox. This gearbox is extremely convenient thanks to the reduced net weight, low fuel consumption and high levels of comfort.

During unloading operations, use of the concrete mixer vehicle requires an extremely slow manoeuvre at an extremely high engine speed and with clutch slippage (for example, string-course concreting). For this purpose, IVECO has designed a special "Unloading while running" software for these vehicles.

Vehicles equipped with this gearbox do not have a clutch pedal and to ensure correct operation during unloading operations, the Bodybuilder must observe certain precautions during the speed control connection.

**Engine speed increase of the concrete mixer via multiple switch:**

- the Bodybuilder connects the speed request signals of the multiple switch on the outfitting to the specifically provided ST14A interface (see Chapter 5.2 (**Page 8**));
- subsequently, the VCM control unit must be parameterized by IVECO Service

**Unloading mode activation:**

- with vehicle stationary, select the required engine speed using the multiple switch on the version;
- actuate key "D" (Drive) for more than 2 seconds on the gearbox control unit;
- the message "1 slow" appears on the display and unloading mode is activated;
by actuating the accelerator pedal, the clutch is then slowly coupled. i.e. it can be kept in the slippage range to allow the vehicle to move slowly; in this unloading mode, there is no engine speed increase generated by the accelerator pedal. In fact, in this mode, the accelerator pedal serves exclusively for actuating the clutch.

3.13 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 frame.
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**

Both occasional and continuous use may be considered.

For occasional use periods of under 30 minutes are considered.

The values for continuous use are those used for long periods. Whenever this is comparable to that of a stationary engine, the suitability of reducing the scheduled take-off values also on the basis of the conditions of use (engine cooling, gearbox etc.) should be evaluated.

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 overloading (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:
4.1 GENERAL SPECIFICATIONS

- The dimensions should take into consideration the forces which might occur under maximum power and torque conditions;
- To ensure effective kinetic forces, the shaft ends must be at the same angle (see Figure 1) and this angle must not exceed 7°;
- Solution Z is preferred to solution W due to the lower loads on the bearings of the power take-off and the equipment being driven. When it is necessary to obtain a different 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 33).

![Solution Z and Solution W](image1.png)

![Figure 1](image2.png)

**Electric system**

On TRAKKER Euro 6 vehicles all the PTO are managed exclusively by EM, also in the event of PTO fitted after purchase. 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. Activation takes place by connecting the power take-off control switch to connector ST14A.

**Pneumatic system**

See the description in Chapter 2.15 (Page 44).
4.2 PTO FROM GEARBOX

Drive may be taken from the layshaft via flanges or fittings located to the rear side or lower part of the gearbox.

Table 4.1 shows available torque levels and the ratios between output rpm and engine rpm for the different types of IVECO optional gearbox/PTO combinations.

IVECO must authorize high torque take-offs for sporadic use, according to the type of use.

The PTO must normally be used with the vehicle at a standstill and must be engaged and released with the clutch disengaged so as to avoid excessive stress on synchronisers.

When the PTO is used with the vehicle in motion, no gearshift must be carried out.

For gearboxes with a torque converter, the same power take-offs used on the manual gearboxes may be used.

Note however, that when engine speed is lower than approximately 60% of the maximum value, the converter system is in the hydraulic operating phase and that during this phase, depending on the absorbed power the power take-off rpm may fluctuate even if engine rpm is constant.

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 4.1 - PTO on gearbox tested by IVECO

<table>
<thead>
<tr>
<th>Gearbox</th>
<th>Option no.</th>
<th>PTO type</th>
<th>Assembly side</th>
<th>Total PTO ratio</th>
<th>Available torque (*) [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 S 1820 TO 16 S 1830 TO 16 S 2220 TO 16 S 2230 TO 16 S 2530 TO</td>
<td>5202</td>
<td>NH/1b</td>
<td>central</td>
<td>1.09 / 0.91</td>
<td>1000</td>
</tr>
<tr>
<td>5205</td>
<td>NH/1c</td>
<td>central</td>
<td>1.09 / 0.91</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>5209</td>
<td>NH/4b</td>
<td>right</td>
<td>1.40 / 1.17</td>
<td>430 (*)</td>
<td></td>
</tr>
<tr>
<td>5210</td>
<td>NH/4c</td>
<td>right</td>
<td>1.40 / 1.17</td>
<td>430 (*)</td>
<td></td>
</tr>
<tr>
<td>5258</td>
<td>N221/10b</td>
<td>above</td>
<td>1.62 / 1.35</td>
<td>730</td>
<td></td>
</tr>
<tr>
<td>5260</td>
<td>N221/10b</td>
<td>above</td>
<td>2.09 / 1.75</td>
<td>560</td>
<td></td>
</tr>
<tr>
<td>5264</td>
<td>N221/10b</td>
<td>above</td>
<td>2.40 / 2.00</td>
<td>470</td>
<td></td>
</tr>
<tr>
<td>5255</td>
<td>N221/10c</td>
<td>above</td>
<td>1.35 / 1.13</td>
<td>870</td>
<td></td>
</tr>
<tr>
<td>5259</td>
<td>N221/10c</td>
<td>above</td>
<td>1.62 / 1.35</td>
<td>730</td>
<td></td>
</tr>
<tr>
<td>12 AS 2330 TO</td>
<td>5202</td>
<td>NH/1b</td>
<td>central</td>
<td>1.35</td>
<td>1000</td>
</tr>
<tr>
<td>5209</td>
<td>NH/4b</td>
<td>right</td>
<td>1.22</td>
<td>430 (*)</td>
<td></td>
</tr>
<tr>
<td>5210</td>
<td>NH/4c</td>
<td>right</td>
<td>1.22</td>
<td>430 (*)</td>
<td></td>
</tr>
<tr>
<td>5260</td>
<td>N AS/10b flanges</td>
<td>above /H</td>
<td>2.15</td>
<td>490</td>
<td></td>
</tr>
<tr>
<td>6420</td>
<td>Nm AS/10 c+b double output</td>
<td>above/L/pump lower/H/flange</td>
<td>1.23 / 1.42</td>
<td>720 / 580</td>
<td></td>
</tr>
<tr>
<td>16 AS 2630 TO</td>
<td>5202</td>
<td>NH/1b</td>
<td>central</td>
<td>1.11</td>
<td>1000</td>
</tr>
<tr>
<td>5209</td>
<td>NH/4b</td>
<td>right</td>
<td>1</td>
<td>430 (*)</td>
<td></td>
</tr>
<tr>
<td>5210</td>
<td>NH/4c</td>
<td>right</td>
<td>1</td>
<td>430 (*)</td>
<td></td>
</tr>
<tr>
<td>5260</td>
<td>N AS/10b flanges</td>
<td>above /H</td>
<td>1.77</td>
<td>490</td>
<td></td>
</tr>
<tr>
<td>6420</td>
<td>Nm AS/10 c+b double output</td>
<td>above/L/pump lower/H/flange</td>
<td>1.01 / 1.42</td>
<td>720 / 580</td>
<td></td>
</tr>
</tbody>
</table>
4.3 POWER TAKE-OFF FROM TRANSFER BOX

Specifically for vehicles with all-wheel drive, this solution must be requested as first equipment; in fact, deferred installation would be a complex (replacing the components inside the transfer box) and costly operation.

Depending on the intended use, PTO output speed can be obtained by selecting the most suitable gear.

Use is only envisaged for stationary vehicles and therefore, with the transfer box in neutral.

The prescriptions for correct use are provided in the Use and Maintenance manual of the vehicle.

Table 4.2 contains the output torque values:

<table>
<thead>
<tr>
<th>Transfer box type</th>
<th>Maximum torque [Nm] available</th>
<th>Output type</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC 1800 (1)</td>
<td>1180</td>
<td>flange Φ ext. 120 mm with 8 holes Φ 10 mm</td>
</tr>
<tr>
<td>TC 2200 (1)</td>
<td>1180</td>
<td>direct pump coupling</td>
</tr>
</tbody>
</table>

(1) Request for optional power take-off. Its subsequent assembly requires the replacement of internal components of the transfer box.

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 33));
- 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.
The transmission is an important part for the safety of the vehicle, and as such any intervention on the transmission must only be carried out by specialist companies approved by the manufacturer.

Note: Any intervention on the 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 low torque take-off, tending to be constant from the front part of the engine (only Cursor 9), is possible thanks to the belt transmission, while the use of drive shafts is generally reserved for more significant levels of take-off (e.g.: municipality uses). In both cases, a specific pre-installation is required which can be requested at the origin (optional 5151) or created with major work carried out on the crankshaft, radiators, bumpers and chassis front cross member.

It is also necessary to pay particular attention:

- 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. A margin of approx. 10% should however be left. In other cases include supplementary heat exchangers.

Please contact IVECO for further information on the maximum values of the parameters relating to the torque take-off (moment of inertia, moment of bending, multiplication factor, angular position).

Torque PTO from the rear of the engine

Multipower PTO on engine fly-wheel

On some models it is possible to install an optional IVECO Multipower power take-off, designed to take off higher torques than those of other PTOs. 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.

Table 4.3 - Technical specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio revolutions - rpm</td>
<td>1.29</td>
</tr>
<tr>
<td>Max. torque available</td>
<td>900 Nm</td>
</tr>
<tr>
<td>Output flange</td>
<td>ISO 7646-120 x 8 x 10</td>
</tr>
<tr>
<td>Control</td>
<td>pneumatic</td>
</tr>
<tr>
<td>Direction of rotation</td>
<td>as engine</td>
</tr>
<tr>
<td>Installation on engines</td>
<td>CURSOR 9-13</td>
</tr>
<tr>
<td>Weight</td>
<td>70 kg</td>
</tr>
<tr>
<td>Oil capacity</td>
<td>2 litres</td>
</tr>
</tbody>
</table>

If PTO is engaged during driving, it must be remembered that depending on the gearing ratio of the power take-off, connected pumps may reach high rotating speeds (e.g.: an engine speed of 1800 rpm corresponds to a pump speed of 2400 rpm).
Power take-off from the camshaft gearing

Vehicles can be fitted with a power take-off which drives a camshaft gear through clutch engagement. This power take-off can be prepared for direct coupling of a pump or, alternatively, it can be equipped with a DIN 10 flange to connect a drive shaft for transferring drive to the user (see Figure 4).

Engagement is only possible when the vehicle is stationary, while torque take-off can occur when the vehicle is moving and when it is stationary.

> The installation of this power take-off must be requested when ordering the vehicle; retrofitting in After Sales would require the replacement of the whole engine.

Direct application of pumps

The static moment due to the added masses must not exceed 90 Nm, measured on the pump coupling surface.

Connection with cardan shaft.

When the maximum permitted torque take-off is requested (see Figure 5), the moment of inertia of the connected rotating masses (including the drive shaft) must not exceed 0.03 kgm².

Once the maximum admissible value for the inertia has been exceeded, a flexible coupling needs to be applied the technical specifications of which are to be requested directly from IVECO.
1. Flange connection DIN 10 (optional 5367)

2. ISO 4-hole pump connector (optional 6366)

**Note**: When using OPT 6366 it is necessary to check compatibility between the pump to be applied and the fitting case by case.

**Table 4.4 - PTO specifications**

<table>
<thead>
<tr>
<th>Engine</th>
<th>Max. torque available [Nm]</th>
<th>Engine / output speed ratio</th>
<th>Maximum speed [rpm]</th>
<th>Direction of rotation</th>
<th>Clutch engagement air pressure [bar]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CURSOR 9</td>
<td>800 (ttv)</td>
<td>1.14</td>
<td>3200</td>
<td>Opposite to engine</td>
<td>8.5</td>
</tr>
<tr>
<td>CURSOR 13</td>
<td>800</td>
<td>1.12</td>
<td>3200</td>
<td>Opposite to engine</td>
<td>8.5</td>
</tr>
</tbody>
</table>
Max. torque available depending on engine speed

![Graph showing torque vs. rpm for Cursor 9 and Cursor 13]

- **A. Cursor 9**
  - Torque take-off of 600 Nm (Cursor 9) and 800 Nm (Cursor 13) is permitted at engine speeds exceeding 1100 rpm.

- **B. Cursor 13**
  - No torque limitation available in relation to rpm.
  - The engine idle speed is set at 800 rpm (Cursor 9) or at 700 rpm (Cursor 13).
  - The air supply system pressure for PTO clutch engagement must exceed 8.5 bar.

### 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.
**General information**

The PTOs are activated by means of solenoid valves and engagement is verified by the "PTO Detection" signal. "PTO Management" includes safety and control functions and in particular, if the engagement has occurred correctly, carries out "Intermediate speed control".

The "PTO Mode" configuration (most advanced definition) requires programming of the Expansion Module (EM) and the Vehicle Control Module (VCM). The EM is able to drive up to three PTOs and controls their activation and deactivation individually.

The following two conditions must be met to permit activation of a PTO:

1. mechanical engagement
2. recall of a "PTO mode" to be paired

These actions can be carried out with two separate commands and in sequence, or with a single command using the PTO switches on the central island console in the cab.

▶ Only use the signals available on the Bodybuilder connectors (such as parking brake engaged signal, vehicle stopped signal, reverse not engaged signal) to ensure correct PTO management and prevent the risk of drive train damage.

**Definitions**

**Multiplex (or “Easy Mux”)**

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, EuroTronic, etc. present on the vehicle. Information and messages are exchanged by means of Bus CAN lines.

**PTO switch (PTOsw x, x = 1, 2, 3)**

Switch located in the middle of the dashboard (control panel). This is used to request an action relating to a given PTO (e.g. depending on EM programming, PTO engagement/disengagement, activation of Intermediate Speed Control).

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 ST14A (pins 18, 19, 20).

**Connector ST14A**

Connector ST14A provided specifically for body builders is located on the passenger side below the electric control unit in the foot area. More detailed information is given in Chapter 5.2 (Page 8).

**PTO Mode x (x = 1, 2, 3)**

Following a request from a PTO switch on the dashboard resp. ST14 input, a PTO mode makes available a set of parameters that allow regular PTO operation.

A PTO mode offers:

- a physical PTO activation request. Possible selections: Yes/No (described below),
- a Intermediate Speed Control mode. Possible selections: Yes/No (option, described below).

It is possible to activate up to three PTO modes simultaneously.
Physical PTO Activation

The physical PTO activation is an integral part of a PTO Mode. This includes a set of parameters for mechanical engagement of a PTO. Various parameter sets are available for the different PTOs (depending on the engine and transmission). These guarantee PTO engagement is compliant with the specific requirements.

The PTO configuration may be customised by Iveco Service upon the specific customer request.

The physical PTO Activation configuration is stored in the EM, as well as selection if Intermediate Speed Control should be requested from VCM control.

Intermediate Speed Control mode x (x = 1, 2, 3)

The Intermediate Speed Control mode may be requested by the EM. If request is sent the VCM activates a set of parameters that defines the engine behaviour (activation of an intermediate speed, low idle rpm, high idle rpm, accelerator deactivation etc.). This configuration is stored in the Vehicle Control Module (VCM).

Note  Since the engine can only support one set of parameters at a time, a choice must be made when multiple Intermediate Speed Control modes are required.

This is performed by priority assignments. ISC mode 1 (low prio) / ISC mode 2 (medium prio) / ISC mode 3 (high prio).

It is absolutely necessary to consider these priorities in management of the conversion!

Functional sequence

When both physical PTO activation and Intermediate Speed Control are configured the engagement is performed according to the following sequence:

1. Request received via ST14A (pins 18, 19, 20).
2. EM checks PTO engagement restriction (max 20sec, then request cleared).
3. If restrictions o.k., then PTO solenoid activated.
4. PTO feedback signal arrived - expected within configured time (PTO type dependent, if not arrived in time PTO solenoid switched off, then request needs to by cycled).
5. The EM sends the mode X of Intermediate Speed Control to the VCM.
6. The VCM activates the mode X of Intermediate Speed Control according to the configured values.

In each case, a power take-off must be electrically activated by means of an electromagnetic valve.

Only management of the power take-offs through the EM control unit ensures comprehensive, reliable and safe PTO management. Only in this way is it possible to guarantee the integration with other vehicle functions.

Operating the power take-off without connection to the EM control unit may cause damage to the vehicle.

Connection to the EM control unit presupposes activation and electrical control of the power take-offs (by means of electromagnetic valves).

Air-activated power take-off and/or without connection to the EM control unit are not therefore not recommended by IVECO.

Note  The electromagnetic valve used to activate a power take-off is connected in the chassis to the relevant ST91 connector (PTO1) / ST92 (PTO2) / ST93 (PTO3).

An electromagnetic valve is to be allocated to each power take-off.
PTO switch

The following Figure shows the installation position of the PTO switches. As already mentioned, up to three PTO switches may be fitted in the dashboard.

![Diagram of PTO switches installation](image)

1. PTO 1 switch
2. PTO 2 switch
3. PTO 3 switch

**Table 4.5 - PTO switches**

<table>
<thead>
<tr>
<th>PTO switch</th>
<th>Connected to pin ST14A</th>
<th>Description</th>
<th>IVECO Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTOsw 1</td>
<td>18</td>
<td>PTO 1</td>
<td>580132 8776</td>
</tr>
<tr>
<td>PTOsw 2</td>
<td>19</td>
<td>PTO 2</td>
<td>580132 8710</td>
</tr>
<tr>
<td>PTOsw 3</td>
<td>20</td>
<td>PTO 3</td>
<td>580145 7839</td>
</tr>
</tbody>
</table>

**Note**

The command may be also given directly on ST14A.
The PTO switches may be purchased directly through IVECO; the table summarises the part numbers.
PTO modes

Operation of a power take-off is generally determined by:

1. Physical PTO activation configuration.
2. Intermediate Speed Control mode configuration.

EM - PTO 1, 2, 3 configuration

Depending on the planned use of the vehicle, body builders are bound to contact IVECO Service in order to carry out the necessary programming of the controls involved (EM, VCM, EuroTronic Transmissions) in the operation of a power take-off.

Body builders may examine the following tables to organise the configuration of a system in advance (described as PTO configuration below).

A PTO unit may then be selected.

If the body builder needs custom settings, these may be programmed via IVECO Service for each individual power take-off.

Note  As already mentioned, the body builder shall respect the PTO mode priority already in the early project phase. Changes later on would require unnecessary efforts, since wiring harness changes and EM/VCM/EuroTronic re-programmings would result.

EM - PTO 1, 2, 3 Programming

PTO programming includes the following function groups:

1. PTO switch function
   Possibility of choosing between:
   - physical activation of PTO only;
   - physical activation of PTO and activation of Intermediate speed Control mode (after successful PTO engagement);
   - activation of Intermediate speed control mode only.

2. PTO hardware
   For the selection of:
   - PTO type including PTO activation and feedback method (status signal).

3. Conditions for mechanical engagement of the PTO (see the following table for EM programming)
   The selection determines which conditions must be satisfied in order to engage the PTO mechanically (electrical activation by means of the electromagnetic valve).

4. Conditions for mechanical engagement of the PTO (see the following table for EM programming)
   The selection determines the conditions and the limit values that must not be exceeded or that must at least be reached, respectively.

5. Extended functions (see the following table for programming in EM)
   - Dynamic behaviour relating to PTO activation/deactivation.

The adjustments within the five function groups may be defined separately for each PTO mode x1, 2, 3.

1) PTO switch function

The EM control unit controls the PTO modes and speeds by means of a PTO SW switch from 1 to 3 allocated on each individual occasion, located in the dashboard, which is connected to the relevant pin of the ST14A connector.

Operation of the switch may determine one of the following actions:

1. Mechanical engagement of the PTO (in conjunction with a given PTO configuration)
2. Activation of Intermediate speed Control mode
3. Mechanical engagement of the PTO (in conjunction with a given PTO configuration) and after successful engagement activation of Intermediate speed control mode
4. No effect
Each switch is allocated to a one single PTO, in other words two switches are required if two PTOs are fitted. Activation of a PTO by the EM is always connected to a switch operation. Switch operation should not, however, necessary lead to engagement of a PTO, can be used (see table above). Each switch may be allocated its own PTO configuration. A switch operation also activates fast mode, a selection must be made in the case of simultaneous operation of various switches. The following priority must be observed:

- PTO 3 configuration (PTOsw 3): maximum priority (PTOsw 1 and 2 status is ignored);
- PTO 2 configuration (PTOsw 2): medium priority (PTOsw 1 and status is ignored);
- PTO 1 configuration (PTOsw 1): minimum priority.

Note As already mentioned, the body builder shall respect the PTO mode priority already in the early project phase. Changes later on would require unnecessary efforts, since wiring harness changes and EM/VCM/EuroTronic re-programmings would result.

2) PTO hardware

The following PTOs may be installed and activated:

- Predisposition, no PTO installed,
- PTO dependant on engine (PTO engines),
- PTO1 on manual gearbox,
- PTO2 on manual gearbox,
- Switchable multipower,
- PTO1 on EuroTronic transmission,
- PTO2 on EuroTronic transmission,
- PTO on transfer box.

On one vehicle, up to 3 of these PTOs may be installed and managed simultaneously.

Table 4.6 - Example of configuration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating brake</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Parking brake</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Clutch status output</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Clutch Timeout</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connector ST91/92/93 3 Pin</td>
<td>Open</td>
<td>Earthed</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>40-100 °C</td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Expansion module pressure switch (inactive)</td>
<td>Not controlled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. rpm for engagement</td>
<td>650 rpm</td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Max. rpm for engagement</td>
<td>700 rpm</td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Min. vehicle speed</td>
<td>0 km/h</td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Max. vehicle speed</td>
<td>1 km/h</td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Lowest speed engaged</td>
<td></td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Highest speed engaged</td>
<td></td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Gear in neutral</td>
<td>In neutral</td>
<td>Gear engaged</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Reverse gear</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
</tbody>
</table>
3) **Selection of conditions for PTO engagement**

The power take-off is engaged only if all conditions are met.

All the configured conditions should be met within a certain time (20 s standard), if not the EM generate warning message to IC display and stops the engagement procedure.

PTO engagement must be requested again (deactivation and reactivation of the PTO switch).

4) **Selection of conditions for PTO deactivation of an engaged PTO**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating brake</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Parking brake</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Clutch status output</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Clutch Timeout</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connector ST91/92/93 3 Pin</td>
<td>Open</td>
<td>Earthed</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>40-100 °C</td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Clutch slip limit</td>
<td></td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Expansion module pressure switch (inactive)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. rpm for engagement</td>
<td>650 rpm</td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Max. rpm for engagement</td>
<td>700 rpm</td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Min. vehicle speed</td>
<td>0 km/h</td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Max. vehicle speed</td>
<td>1 km/h</td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Lowest speed engaged</td>
<td></td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Highest speed engaged</td>
<td></td>
<td>Not controlled</td>
<td></td>
</tr>
<tr>
<td>Gear in neutral</td>
<td>In neutral</td>
<td>Gear engaged</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Reverse gear</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
</tbody>
</table>

The engaged PTO is supervised. If any one of the conditions is not met, the deactivation scenario is detected and certain actions can be initiated (PTO disengagement, sending an ISC Off or ISC RESUME command) and a warning is displayed on the instrument panel.

When selecting the activation/deactivation parameter, care must be taken to ensure no plausibility is violated (for example, activation condition: Brake pedal operated and simultaneously condition for deactivation: Brake pedal operated).

5) **Extended functions**

**Timing behaviour of PTO Mode request**

The EM control unit expects certain PTO engagement conditions to be met within a certain time period (standard 20 seconds) after the PTO request. Once this period has elapsed, the PTO mode request is rejected and an error is displayed.

The time interval is programmable (0÷25 s). The PTO switch must then be cycled (switched off and on again).

**Timing behaviour of physical PTO engagement monitoring**

Establishes the interval between PTO solenoid activation and physical PTO engagement, being checked by PTO feedback signal. If the set interval is exceeded, the request is rejected and an error is displayed.

**Timing behaviour of PTO ShutOff condition monitoring**

If any configured ShutOff condition during PTO being physically engaged gets violated for longer than a timeout default (10 seconds standard), the configured actions (physical PTO de-activation, sending an ISC OFF command, sending an ISC RESUME command) will be initiated and an error is displayed. The time interval is programmable (0 - 10s).

**Timing behaviour of physical PTO disengagement**
Establishes the interval between PTO solenoid de-activation and physical PTO disengagement, being checked by PTO feedback signal. If the time interval is exceeded, an error message is displayed.

**Timing behaviour between clutch depression and PTO engagement**

Establishes a minimum time interval within which the clutch must be operated before PTO engagement is permitted and carried out (to be used only with manual non Single_H transmission).

**Timing behaviour of error identification**

Time that elapses before an error activates Degraded Mode.

### Table 4.8

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition 1</th>
<th>Condition 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timeout at activation</td>
<td>1 - 10 s</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Timeout at PTO activation conditions</td>
<td>1 - 10 s</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Timeout at activation via switch</td>
<td>1 - 10 s</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Timeout at PTO deactivation conditions</td>
<td>1 - 10 s</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Timeout for error identification</td>
<td>1 - 10 s</td>
<td>Not controlled</td>
</tr>
</tbody>
</table>

**Note** In general, all the activation and deactivation and Timeout control condition parameters must be set to enable monitoring. When a failure tolerant approach is needed the selection of “is not controlled” is to be preferred.

### Status of number of revs (to be programmed in VCM control unit)

A speed mode may be allocated to a PTO within the VCM control unit. The speed mode may be activated directly by means of a PTO switch or after a successful PTO engagement (based on the programmed PTO switch function).

**RPM 0 mode (driving mode)**

When the vehicle speed is for example below 25 km/h, an intermediate engine rpm may be activated.

Activation of an intermediate speed may take place by activating the Resume function, from SET+ or SET- on the control lever or by means of the respective inputs of ST14A connector.

The intermediate engine rpm on a standard vehicle is set to 900 rpm and may be altered on the basis of the following procedure:

1. activate Resume
2. adjust the speed to the required level using SET+ or SET-
3. activate the Resume function for at least 5 seconds in order to store the set speed.

The speed adjustment range with the gearbox in neutral is set to 100 rpm. It may be increased up to 200 rpm. The selective setting will then apply also to the speed modes.

Speed mode “0” will be considered the standard speed mode. For safety reasons, it is not possible to modify the following settings:

### Table 4.9

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resume/OFF</td>
<td>Activation/deactivation of intermediate speed</td>
</tr>
<tr>
<td>SET+ / SET-</td>
<td>Increase/reduction of intermediate speed</td>
</tr>
<tr>
<td>Conditions leading to intermediate speed deactivation</td>
<td>• Operation of the brake or clutch pedal</td>
</tr>
<tr>
<td>CCOff activation on control lever or on ST14A</td>
<td>• Operation of engine brake/Intarder</td>
</tr>
<tr>
<td>Accelerator</td>
<td>Activated</td>
</tr>
<tr>
<td>Maximum engine speed set with SET+</td>
<td>NLL - 1800 rpm</td>
</tr>
</tbody>
</table>
### Parameter Function

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum speed achievable by means of the accelerator pedal</td>
<td>NLL ÷ 2700 rpm (CURSOR 9)</td>
</tr>
<tr>
<td></td>
<td>NLL ÷ 2340 rpm (CURSOR 13)</td>
</tr>
<tr>
<td>Engine torque</td>
<td>Maximum torque according to engine</td>
</tr>
</tbody>
</table>

### Configurable rpm mode 1, 2, 3

For each programming action, it is possible to establish three independent parameter sets for engine control (on the basis of speed modes from 1 to 3).

With the simultaneous activation of several inputs, it is necessary to determine an input priority with regard to engine control. The following priorities are set for this purpose:

- speed mode 3: maximum priority (speed modes 1 and 2 are ignored);
- speed mode 2: average priority (speed mode 1 is ignored)
- speed mode 1: minimum priority.

**Note** The Bodybuilder must observe this order of priority when managing the outfitting and interface outfitting. This is so as to avoid additional costs for subsequent modifications to the wiring or reprogramming.

The following table provides an overview of parameters that must be determined individually for each mode (programming by IVECO Service).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Option 1</th>
<th>Option 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine speed adjustable by means of Set+ (1)</td>
<td>550 - 1800 rpm</td>
<td></td>
</tr>
<tr>
<td>Engine speed adjustable by means of Set- (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum torque (3)</td>
<td></td>
<td>According to engine</td>
</tr>
<tr>
<td>Theoretical speed in neutral (4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angular coefficient of torque curve Nm/rpm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed threshold for PTO/CC activation (km/h) (1)</td>
<td>1 km/h</td>
<td></td>
</tr>
<tr>
<td>Speed deactivation with parking brake not engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activation of parameter for maximum PTO speed (6)</td>
<td>Yes, by selection</td>
<td>No</td>
</tr>
<tr>
<td>Maximum PTO speed (km/h) (7)</td>
<td>1 km/h</td>
<td></td>
</tr>
<tr>
<td>Speed deactivation by operating brake pedal (9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed deactivation by driver operating brake pedal (9)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation by driver operating Intarder (9)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation by operation of engine brake by means of CAN</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation by operation of Intarder by means of CAN</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation by operation of clutch (8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed deactivation if this is lower than minimum speed setting (8)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation if this is greater than maximum speed setting (8)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation due to an error in the CC module (1)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation in the event of service brake and parking brake switch error (1)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Deactivation of accelerator pedal</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Resume function on start-up</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Maintaining other PTO operating modes via Resume function key (1)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation in the event of speed sensor error (1)</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
### TRAKKER Euro 6 – POWER TAKE-OFFS
#### 4.6 PTO MANAGEMENT

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Option 1</th>
<th>Option 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed deactivation in the event of exceeding coolant temperature <strong>(9)</strong></td>
<td>Yes, by selection</td>
<td>No</td>
</tr>
<tr>
<td>Coolant temperature (°C)</td>
<td>80 °C - 110 °C</td>
<td></td>
</tr>
<tr>
<td>Speed deactivation with gear engaged <strong>(10)</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation with reverse gear engaged <strong>(11)</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Activation for control of lowest speed for PTO engagement/discharging <strong>(11)</strong></td>
<td>Yes, by selection</td>
<td>No</td>
</tr>
<tr>
<td>Lower speed for speed activation/deactivation <strong>(11)</strong></td>
<td>1st - 5th gear</td>
<td></td>
</tr>
<tr>
<td>Activation for control of the highest gear for PTO engagement/discharging <strong>(11)</strong></td>
<td>Yes, by selection</td>
<td>No</td>
</tr>
<tr>
<td>Highest speed for speed activation/deactivation <strong>(11)</strong></td>
<td>1st - 5th gear</td>
<td></td>
</tr>
<tr>
<td>CC adjustment and Memo function <strong>(12)</strong></td>
<td>See description</td>
<td>See description</td>
</tr>
<tr>
<td>Engine speed via Memo <strong>(13)</strong></td>
<td>Final speed 550-LL</td>
<td></td>
</tr>
<tr>
<td>Maximum speed via Set+ <strong>(14)</strong></td>
<td>Final speed</td>
<td></td>
</tr>
<tr>
<td>Temporary activation of engine speed increase by another control device <strong>(15)</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Temporary activation of speed increase by driver <strong>(16)</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Activation for a reserved speed <strong>(17)</strong></td>
<td>Yes, by selection</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Value of reserved speed (km/h) <strong>(17)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torque limitation according to engine speed (rpm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torque limitation according to torque moment (Nm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase/reduction of speed with SET+ / SET- (rpm/min) activation <strong>(18)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time required to reach selected speed <strong>(19)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed deactivation via external torque moment request (Nm)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**(1)** Maximum rpm may not be exceeded using Set+.

**(2)** Minimum rpm may not be exceeded using Set-.

**(3)** To avoid damage to the PTO and transmission, engine torque should be adapted to the PTO.

**(4)** Maximum variable rpm of engine with no load. Caution: this speed (rpm) differs from the PTO speed according to the PTO transmission ratio.

**(5)** Up to this setting, the intermediate speed regulator is active in the following PTO modes (it regulates engine speed independently of the gear). If the set value is exceeded by pressing Set+ again, automatic switching takes place to CC mode (Cruise Control: speed is suggested independently of the gear).

**(6)** If this value is exceeded, the intermediate speed will be deactivated and the speed will return to the value indicated in Note **(14)**.

**(7)** If the set speed is exceeded, the set intermediate speed will return to the value indicated in Note **(14)**. Despite possible speed fluctuations, the value is always 5 km/h lower than the set value. If the value is changed, the value indicated in Note **(14)** is also automatically changed.

**(8)** The intermediate speed is deactivated and returns to the value indicated in Note **(2)**.

**(9)** If the setting is on "Yes", the speed of the previously engaged mode is maintained, despite switching between the individual speed modes. If the setting is "No", the speed is adjusted to that of the corresponding selected mode (considering priority).

**(10)** If the setting is "No", fields 20, 21 and 22 are activated. If the setting is "Yes", no input is possible in these fields.

**(11)** Becomes an unsatisfied condition. The intermediate speed setting returns to the value in Note **(2)**.

**(12)** Three adjustment options are available in this case:

- **Option 1**: No possibility of calibration. The speed set at Note **(13)** is fixed and cannot be altered by the driver by means of SET+ / SET-.
- **Option 2**: calibrations possible. The speed set at Note **(13)** is fixed and may be adjusted by the driver using Set +/- on the basis of the adjustment range shown in Notes **(1)** and **(2)**.
• Option 3: with calibration and possibility of storage. The speed set at Note (13) is fixed and may be adjusted by the driver using Set +/Set - on the basis of the adjustment range shown in Notes (1) and (2) and stored as a new speed.

(13) If a speed is already stored, this will be automatically activated at the time of engagement. This speed may be altered, as described under Note (16).

(14) Speed that may be achieved at maximum with SET+.

(15) Must be set to "No". With the programming on "YES" intermediate speed may be imposed by the EuroTronic transmission switching procedure. One consequence of this could be a PTO over speed.

(16) Must always be set to "No" to ensure that the Kickdown function is excluded. If set to "Yes", the driver could exceed the set speed limit by operating the kickdown function.

Custom settings

Table 4.11

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Option 1</th>
<th>Option 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activation for a reserved speed</td>
<td>Yes, by selection</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Value of reserved speed (km/h) (17)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torque limitation according to engine speed (rpm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torque limitation according to torque moment (Nm)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(17) If a power take-off is used on the cardan shaft (N90 - Omsi - etc.), it is possible to engage a speed higher than 90km/h in this case in order to allow it to work in the highest gear with high engine rpm without the speed limit cutting in.

Setting for special functions

Table 4.12

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Option 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase/reduction of speed with SET+ / SET- (rpm/min) activation (18)</td>
<td></td>
</tr>
<tr>
<td>Time required to reach selected speed (19)</td>
<td></td>
</tr>
<tr>
<td>Speed deactivation via external torque moment request (Nm)</td>
<td></td>
</tr>
</tbody>
</table>

(18) Possibility of adjustments to modify rpm each time Set+/- is pressed.

(19) The speed control activates after a correction time (time during which the modified signal remains uninterrupted in order to be accepted as valid) in the new selected speed mode (pin connector ST14 pins 18, 19, 20). This correction time may be shortened in relation to the factory setting (500 ms), down to 100 ms.

Changes to the torque curve, maximum rotation speed and steepness of the maximum rotation speed limiter

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

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

The diagram in Figure 7 shows this qualitatively 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 speed increases, the control unit uses the torque value which is the lower of those of curve 1 and those of straight line 2 and then, for speeds exceeding that determined by point "X", makes the overspeed adjustment intervene with the subsequent torque reduction.

Please note that:

- the Bodybuilder chooses the engine speed up to which the selected torque must available according to the intended use of the PTO;
- The speed referred to is that of the crankshaft and not the PTO, for which the rpm must be calculated taking into account the reduction ratio (see Table 4.4);
• 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.

![Diagram](image)

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 on page 3):

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

The overrevving regulator curve (gradient) depends on the specific application.

With stationary operation, a steep overrevving rpm adjustment curve is therefore generally sufficient, while in driving mode this may give rise to rapid load changes (which could be a problem).

Therefore:

• with regulator at 0.05 rpm/Nm (curve C in figure), a torque of 600 Nm is available up to 1100 - (0.05 \times 600) = 1070 rpm;
• with regulator at 0.1 rpm/Nm (curve B), the torque is available up to 1040 rpm;
• with regulator at 0.2 rpm/Nm (curve A), the torque is available up to 980 rpm.
4.7 STANDARD CONFIGURATIONS

No PTO installed or PTO predisposition

PTO options:

- none: 1484, 5194, 6368;
- prearrangement: 1483.

Only the engine speed programming is requested by the VCM.

The switches select the three speed modes.

Table 4.13

<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>

PTO Multipower

PTO option: 2395 for all gearboxes and, in the case of concrete mixers, also 7342 (always live).

Only the engine speed programming is requested by the VCM.

The switches select the three speed modes (see Table 4-12).

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] |

Note  These conditions may be modified through the IVECO Service Network.

PTO manual gearbox with electric engagement

PTO options: 5202, 5205, 5209, 5210, 5255, 5258, 5259, 5260, 5264 for all manual gearboxes.

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>

Note  These conditions may be modified through the IVECO Service Network.
### Engine PTO
Option: 5367, 6366.

**Activation conditions**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</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>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle status</td>
<td>OFF</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>&gt; 120 °C</td>
</tr>
</tbody>
</table>

**Note**  These conditions may be modified through the IVECO Service Network.

### PTO Eurotronic 2 gearbox
PTO options: 5202, 5209, 5210, 5260, 6420.

**Activation conditions**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gearbox status</td>
<td>consent</td>
</tr>
<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>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine status</td>
<td>OFF</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>&gt; 120 °C</td>
</tr>
</tbody>
</table>

**Note**  These conditions may be modified through the IVECO Service Network.

### PTO Transfer box
PTO options: 391, 392.

**Activation conditions**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clutch status</td>
<td>released</td>
</tr>
<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>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine status</td>
<td>OFF</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>&gt; 120 °C</td>
</tr>
</tbody>
</table>

**Note**  These conditions may be modified through the IVECO Service Network.
4.8 EXPANSION MODULE (EM)

The EM control unit can be used for the electronic management of the PTO and for special applications (for example: waste collection); alternatively, the EM provides a CANopen interface with special access points for Bodybuilder, in accordance with standard CiA 413 Truck Gateway.

Figure 9 shows the wiring diagram, while Figure 10 shows the block diagram of the hardware structure.

1. PTO switches
2. EM control unit
3. PTO control solenoid valves
4. PTO return signal
5. PTO Pressure switch resp. Bodybuilder PTO3 engagement consent
6. Bulkhead connector "B"
To ensure PTO activation and representation of this on the IC instrument panel, the connections on ST91, ST92 and ST93 (described in Chapter 5.2 - Paragraph “Connectors on the chassis” (➠ Page 19)) must be made as indicated in Figure 9; the Table below describes the functions available at the terminals of these connectors.

**Table 4.14 - IN / OUT: ST91, ST92, ST93**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PTO feedback</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>

---

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SECTION 5

ELECTRONIC SUB-SYSTEMS
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ELECTRONIC SUB-SYSTEMS

5.1 ELECTRONIC SYSTEMS

An innovative electronic system, called Multiplex (or also, on Trakker, "Easy Mux"), electronically manages and controls the vehicle’s subsystems by means of 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 indicated below.

- It is not permitted to connect devices or electrical circuits directly to the control units. Only the connectors or special interfaces listed in Chapter 5.2 may be used.

Position of electronic control units

1. IBC3 IVECO Body Controller
2. EM Expansion Module
3. VCM Vehicle Control Module
4. ECAS Electronic Control Air Suspension
5. Central locking
6. EBS Electronic Brake System
7. Chassis Electronic Module MET
8. IC Instrument Cluster
9. BM Bed Module
10. Steering Shaft ECU
11. DDM Drive Door Module
12. PDM Passenger Door Module
13. CC Climate Control
14. EDC Engine Diesel Control

IVECO Body Controller (IBC3)

The IVECO Body Controller is the vehicle’s central control unit 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 IVECO 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 Chassis Electronic Module (MET) is part of the Easy Mux system together with the IBC3 control unit.

It transmits and receives information from all the components and sensors located on the chassis (e.g. the lighting devices, brake system sensors, differential lock sensors, etc.)

The information is transmitted through the IVECO Body Controller to the vehicle's systems for which it is intended.

The MET is located behind the cab exit footboard on the right.
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.
5.2 BODYBUILDER CONNECTORS

The standard vehicle outfitting provides for the connectors ST14A, ST14B, ST64, ST77, ST78. Optional connectors are: ST40, 72072, ST91, ST92, ST93. Each is described below depending on its location in the cab (§ 5.2.1) or on the chassis (§ 5.2.2).

In order to interface with the equipment, the Bodybuilder must have the counterpart (female) and must use contacts realized according to the following diagrams:

![Figure 5](image.png)

<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>
<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>

For an in-depth analysis of the EM functions, please contact the IVECO Customer Centre.
Table 5.3 - Connectors ST64, ST77, ST78, ST91, ST92, ST93

<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>

A) Connectors in cab

The following connectors are located inside the cab:

- ST14A (standard connector for Bodybuilder)
- ST14B (standard connector for Bodybuilder)
- ST40 (FMS)
- 72072A (EM)
- 72072B (EM)
- 72072C (EM)

Location of connectors inside cab

The connectors in the cab are almost all housed behind a cover in the passenger side foot rest compartment. The ST40 connector (FMS - Fleet Management System) is housed in one of the compartments in DIN format, located on a cross-bar above the driver’s side sun visor.

a) Standard connector ST14A: 21 pin, blue

A. 41118338 Counterpart to be coupled (female)  
B. 41118319 Existing part on vehicle (male)
Table 5.4 - Basic functions of connector ST14A

<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 standstill +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 (socket under key switch)</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) 0 V = 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) 0 V = Set - not activated Ground = Set - activated</td>
</tr>
<tr>
<td>14</td>
<td>CC OFF</td>
<td>8154</td>
<td>10 mA</td>
<td>VCM X3-30</td>
<td>Input signal (2) 0 V = Off not activated Ground = OFF activated</td>
</tr>
<tr>
<td>15</td>
<td>CC Resume</td>
<td>8155</td>
<td>10 mA</td>
<td>VCM X3-31</td>
<td>Input signal (2) 0 V = RES not activated Ground = RES 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) Open wire = CC controlled by driver Connected to ground = CC controlled by Bodybuilder (BB)</td>
</tr>
<tr>
<td>17</td>
<td>Ground</td>
<td>0000</td>
<td>15 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 EM X3-S</td>
<td>Input signal (2) 0 V = PTO mode 1 not activated Ground = PTO mode 1 activated Input driven by EM, when installed Else input driven by VCM</td>
</tr>
</tbody>
</table>

---

(1) Pulse signal
(2) Input signal
### 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>
| 19  | PTO 2 sw   | 0132      | 10 mA     | VCM X3-46, EM X3-6 | Input signal (3)
|     |             |           |           |              | Open wire = PTO mode 2 not activated
|     |             |           |           |              | Ground = PTO mode 2 activated
|     |             |           |           |              | Input driven by EM, when installed
|     |             |           |           |              | Else input driven by VCM |
| 20  | PTO 3 sw   | 0123      | 10 mA     | VCM X3-45, EM X3-7 | Input signal (3)
|     |             |           |           |              | Open wire = PTO mode 3 not activated
|     |             |           |           |              | Ground = PTO mode 3 activated
|     |             |           |           |              | Input driven by EM, when installed
|     |             |           |           |              | Else input driven by VCM |
| 21  | K30         | 7772      | 10 A      | IBC3 B-09    | K30 (after fuse) (4)

#### (2) 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>1.5</td>
<td>V</td>
<td>I = 1 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage $U_{\text{high}}$</td>
<td>5.5</td>
<td>V</td>
<td>I = -1 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>&lt;1.6 kHz</td>
<td>Square wave</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulse duration</td>
<td>0.64-2-4 ms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Tachograph B7 output provides the speed pulse according to ISO 16844-2.

![Figure 8](image)

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 ST14A/pin 16 CC Driver/Bodybuilder connected to ground, otherwise input is ignored.

(3) Cycling of PTO, sw inputs must be not faster than 500ms. Switching faster may ignore the request. Input will activate physical PTO - when configured - and VCM intermediate Speed Control Mode 1,2,3 On contemporaneous activations of PTO 1,2,3 inputs.
the VCM intermediate Speed Control Mode is assigned by means of prioritization: PTO_3 - highest priority, PTO_2 - medium priority, PTO_1 - lowest priority

**WARNING:** The Deactivation of a physical PTO is only allowed in load-free conditions. Therefore the deactivation of a physical stationary/non stationary PTO device during driving operation and/or with a gear engaged is not permitted as in such a case the connection to the PTO is not load-free. If the PTO is nevertheless deactivated, this may result in malfunctions and the PTO and/or gearbox may be damaged.

(4) They are useable up to 10 A in combination with the chassis connector CiA 72072D / Pin 1.

**Specification 01 - Vehicles with ECAS system (Electronically Controlled Air Suspension)**

To lower the air suspension, pin 5 of connector X1 on the ECAS control unit must be supplied with a +24 V signal. This can be realised e.g. when the PTO is switched on a relay connected to ST14A will supply this +24 V signal to the pin. As said ECU pin is fed by the „2nd driving height“ or „ECAS reset“ switch in the cabin, it is necessary to install a relay according the following circuit diagram:

![Figure 9](image)

1. PTO request / ST14 pin 18  
2. +15 / ST14 pin 11  
3. 2 speed level / Reset ECAS  
4. ECU ECAS / X1 pin 5

Lowering the air suspension via connector X1, pin 5 the "exhausted bellow function with high safety level" is activated. That means the vehicle will not react to changes of the level sensor signal.

**b) Standard connector ST14B: 9 pin, blue**

A. 41118303 Counterpart to be coupled (female)  
B. 41118302 Existing part on vehicle (male)
### Table 5.5 - Basic functions of connector ST14B

<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            | 0172      | 10 mA     | VCM X3-13         | 2nd speed limiter activation  
Open wire = not activated  
+24V = engaged                                                   |
| 2   | Reserved                     |           |           |                   |                                                                         |
| 3   | Clutch status                | 9963      | 200 mA    | VCM X1-12         | Clutch activated (switch 10%)  
Open circuit = clutch open  
Connected to ground = closed clutch activated                     |
| 4   | PTS                          | 5542      | 200 mA    | VCM X1-14         | PTS = Programmable Threshold Speed (1)  
Programmable threshold (rpm or vehicle speed)  
+24 V = PTS activated (speed > limit)  
0 V = PTS not activated (speed ≤ limit)                       |
| 5   | Emergency lights             | 1113      | 10 mA     | IBIC3 E-04        | Input signal (2)  
Connected to ground = on  
Open circuit = off                                                  |
| 6   | Reserved                     |           |           |                   |                                                                         |
| 7   | External lights              | 3333      | 5 A       | IBIC3 E-24        | 0 V = lights off  
+24 V = lights on (parking, low and high beam)                           |
| 8   | Engine speed signal          | 5587      | 10 mA     | EDC17-34          | Pulse signal                                                          |
| 9   | Reserved                     |           |           |                   |                                                                         |

(1) VCM Default Vehicle Speed is 3 km/h

The value cannot be modified in Customer Service with EASY in the presence of the following options:

- OPT 06821 (EN1501) or OPT 14861 (HillStartAid on Trakker Euro6 ABS vehicles)
- Certain Refurbishing Near Market requests for RCV (pls contact IVECO Bodybuilders market responsible)

(2) Vehicles with electrically activated main battery switch (OPT 2532)

- Emergency lights will be activated for no longer than 30 minutes. After 30 minutes the emergency lights are switched off and the main battery switch will be opened.

c) Optional connector ST40: 12 pin, blue

![Diagram of ST40 connector](image)

A. 41118264 Counterpart to be coupled (female)  
B. 41118266 Existing part on vehicle (male)
Table 5.6 - Basic functions of connector ST40

<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>7772</td>
<td>5 A</td>
<td>70605-1</td>
<td>Protected by fuse 5 A</td>
</tr>
<tr>
<td>2</td>
<td>K15</td>
<td>8871</td>
<td>7.5 A</td>
<td>70605-6</td>
<td>Protected by fuse 7.5 A</td>
</tr>
<tr>
<td>3</td>
<td>Vehicle speed</td>
<td>5541</td>
<td>10 mA</td>
<td>IC 20</td>
<td>Instrument Cluster</td>
</tr>
<tr>
<td>4</td>
<td>+12 V</td>
<td>7712</td>
<td>5 A</td>
<td>70401-8</td>
<td>Protected by fuse 5 A</td>
</tr>
<tr>
<td>5</td>
<td>CAN H</td>
<td>7772</td>
<td>10 A</td>
<td>VCM X3-37</td>
<td>FMS (1) CAN H (line activated with opt 14569)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+24V = engaged</td>
</tr>
<tr>
<td>6</td>
<td>CAN L</td>
<td>7772</td>
<td>10 A</td>
<td>VCM X3-38</td>
<td>FMS (1) CAN L (line activated with opt 14569)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+24V = engaged</td>
</tr>
<tr>
<td>7</td>
<td>Dashboard lights</td>
<td>4442</td>
<td>1 A</td>
<td>BC2 J7-19</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Reversing lights</td>
<td>2268</td>
<td>200 mA</td>
<td>BC2 J5-05</td>
<td>+24 V = reverse gear engaged</td>
</tr>
<tr>
<td>9</td>
<td>Ground</td>
<td>0000</td>
<td>5 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>K30</td>
<td>7972</td>
<td>5 A</td>
<td>70601-2</td>
<td>Protected by fuse 5 A</td>
</tr>
<tr>
<td>11</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) Fleet Management System
FMS CAN line is enabled with option 14569.
For further information please see Chapter 5.3 (Page 23)

d) Optional connector 72072A: 6 pin, yellow

A. 41118323 Counterpart to be coupled (female)  B. 41118304 Existing part on vehicle (male)

Only available with OPT 4572 (EM-light) or OPT 0384 (EM-full) installed.

Table 5.7 - Basic functions of connector 72072A

<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>
</tbody>
</table>
| 2   | Request gearbox in neutral Gearbox activation | 6983      | Output 500 mA | EM X4-05    | Only with automatic gearbox
Indicated that Driver requested Neutral gear & Neutral gear being physically engaged
Ground = ON
Open circuit = OFF
### 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>
| 3   | Bodybuilder Enable                           | 0991      | Input Load between 10 mA and 1 A (1) | EM X3-17     | It must be activated by the Bodybuilder when the version is in operation, otherwise some of the Bodybuilder functions will not be supported:  
- Neutral shift for automatic gearboxes  
- Safe State activation by BB EMCY (ST14B/2)  
- CANOpen controls under Firewall monitoring  
- Extent of use of Bodybuilder power for vehicle systems  
Ground = active, low side switch |
| 4   | Vehicle CAN fully operational signal         | 9089      | Output 10 A (2) | HS: EM X4-04, LS: VCM X1-07 | Allows Bodybuilder the supervision of "Vehicle CAN fully operational" information (3)  
+24 V = ON, vehicle CAN systems are operational  
Ground = OFF at least one system is not operational |
| 5   | Reserved                                      |           |           |              |                                                                          |
| 6   | Reserved                                      |           |           |              |                                                                          |

(1) During the K15 OFF phase, the input will not be activated so as to avoid an increase in the sleep current  
(2) Up to 10A can be used in combination with CiA cab connector 72072C / Pin 1  
(3) Allows the Bodybuilder to check the “Vehicle with CAN fully operational” information. It shows at the same time:  
- IVN (In Vehicle Network) communication w/o timeouts and  
- Bodybuilder interface application running

Output Signal is debounced by 1 sec in order to filter temporary disturbances. Output remains off for ~5 sec after K15 ON. The Bodybuilder must check this delay at each K15 ON 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)  
- Body Controller System  
- Tachograph  
- Instrument panel

Detailed information for each system is available via CANopen – see EMCY 0x1014 object.

**Requirements for Functional Safety**

- **When Bodybuilder application is interfacing the vehicle for Safety related functions then IVECO supports the Bodybuilder application with a “Vehicle CAN fully operational” output.** For Safety related Bodybuilder applications, which are interfacing the vehicle, IVECO requires from the Bodybuilder to integrate this information in the Bodybuilder application Technical Safety Concept. The “Vehicle CAN fully operational” information does not check the contents of any transmitted CAN message, but it ensures that CAN communication - and as a result, also extracted information provided to the Bodybuilder - are still regularly updated within their timing constraints.  
- Furthermore, at each K15 cycle, the delayed state change (between 4 to 6 sec after K15 ON) needs to be checked. When this check fails, the "Vehicle CAN fully operational" output is not to be considered valid.  
- Since the "Vehicle CAN fully operational" output is active, it provides the information that none of the monitored messages of the Vehicle CAN systems remains in CAN timeout for more than 1 s.  
- **In case of OPT 0384 present:**  
  - Bodybuilder is able to identify the vehicle degradation level by reading CANopen EMCY message and  
  - use BB EMCY input,  
    see BB EMCY (ST 72072B, pin 2) input for Vehicle StoppedState management
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 Bodybuilders interface functioning properly (as for instance the CAN-open 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.

When in Customer Service a client specific programming have been required, then after each programming session the affected functionality is to be checked and confirmed by the Bodybuilder.

The Bodybuilders have to ensure reliable design and wiring for all connections with the IVECO Bodybuilder interface.

e) Optional connector 72072B: 20 pin, black

A. 500314809 Existing part on vehicle (male)  
B. 500314816 Counterpart to be coupled (female)

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

<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>Request gearbox in neutral signal</td>
<td>0992</td>
<td>Input 10 mA ¹</td>
<td>EM X3-18</td>
<td>Only supported with 6821 (Std. EN 1501). Only if Bodybuilder Enable is also active (72072A/3). Signal change needed, earliest 1 second after K15 ON. Brings the gearbox to neutral just once. Ground = active, low side switch</td>
</tr>
<tr>
<td>2</td>
<td>Bodybuilder Emergency Signal</td>
<td>0993</td>
<td>Input 10 mA ¹</td>
<td>EM X3-19</td>
<td>Input to activate the Vehicle StoppedState values, only if Bodybuilder Enable is also active (72072A/2). List of configurable signals ². Ground = active, low side switch</td>
</tr>
<tr>
<td>3</td>
<td>External stop brake request (EN1501)</td>
<td>0994</td>
<td>Input 10 mA ¹</td>
<td>EM X3-20</td>
<td>Only supported with 6821 (Std. EN 1501) ³. Input to activate the Stopping brake (V &lt; 6 km/h). Ground = active, low side switch</td>
</tr>
<tr>
<td>4</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Stepper swt req. (EN1501)</td>
<td>0996</td>
<td>Input 10 mA ¹</td>
<td>ST14E-9</td>
<td>Only supported with 6821 (Std. EN 1501) ⁴. Input to activate the Refuse stepper switch. Ground = active, low side switch. <strong>Not available with ABS-HSA (opt 14861) installed</strong></td>
</tr>
<tr>
<td>6</td>
<td>LMM (Light Management Module) Right direction light</td>
<td>6985</td>
<td>Output 1.5 A</td>
<td>EM XI-03</td>
<td>Right turn signal light. 0 V = not engaged. +24V = engaged</td>
</tr>
<tr>
<td>7</td>
<td>LMM (Light Management Module) Left direction light</td>
<td>6986</td>
<td>Output 1.5 A</td>
<td>EM XI-08</td>
<td>Left turn signal light. 0 V = not engaged. +24V = engaged</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>8</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td>Positive for warning light</td>
</tr>
<tr>
<td>9</td>
<td>Parking brake engaged</td>
<td>6988</td>
<td>I A</td>
<td>EM X4-02</td>
<td>Only supported w/ opt 6821&lt;br&gt;Output EN1501 Reverse protections brake active&lt;br&gt;0 V = not engaged&lt;br&gt;+24 V = engaged&lt;br&gt;after K15 active for 2 sec (w/o brake activated)&lt;br&gt;Not available with ABS-HSA (opt 14861) installed</td>
</tr>
<tr>
<td>10</td>
<td>Brake lights (EN1501)</td>
<td>6989</td>
<td>Output 1 A</td>
<td>ST1E-4</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Gearbox in neutral request (EN 1501)</td>
<td>6991</td>
<td>Output 1 A</td>
<td>EM X4-22</td>
<td>Reserved for IVECO exclusively&lt;br&gt;Contact IVECO for further details [1]&lt;br&gt;Supported with Automatic Gearbox&lt;br&gt;0 V = not engaged&lt;br&gt;+24 V = engaged</td>
</tr>
<tr>
<td>13</td>
<td>Chassis ready (acc. EN1501-1)</td>
<td>6992</td>
<td>Output 1 A</td>
<td>EM X4-23</td>
<td>Indicates Chassis Information ready (acc. EN1501-1) for adjustment contact the IVECO Technical Service&lt;br&gt;0 V = Off - Frame not ready&lt;br&gt;+24 V = On - Frame ready</td>
</tr>
<tr>
<td>14</td>
<td>Low accelerator pedal idle switch</td>
<td>6993</td>
<td>Output 1 A</td>
<td>EM X4-31</td>
<td>Indicate that Accelerator pedal idle switch&lt;br&gt;0 V = OFF - low idle switch not active&lt;br&gt;+ 24 V = ON - low idle switch active</td>
</tr>
<tr>
<td>15</td>
<td>&quot;At least one PTO is engaged&quot;</td>
<td>6994</td>
<td>Output 1 A</td>
<td>EM X4-32</td>
<td>Indicates at least one PTO is engaged&lt;br&gt;Signal based on PTO feedback signal/s&lt;br&gt;0 V = OFF - no PTO engaged&lt;br&gt;+ 24 V = ON - at least one PTO engaged</td>
</tr>
<tr>
<td>16</td>
<td>Fluid level</td>
<td>5981</td>
<td>Input 0-500Ohm (1)</td>
<td>EM X4-14</td>
<td>Analogue input for IC display of fluid level (Bodybuilder) [1]&lt;br&gt;n.d. with CANopen enabled 0x6167</td>
</tr>
<tr>
<td>17</td>
<td>Pressure</td>
<td>5982</td>
<td>Input 0-32 V (1)</td>
<td>EM X4-15</td>
<td>Analogue input for IC display of pressure (Bodybuilder) [1]&lt;br&gt;n.d. with CANopen enabled 0x6167</td>
</tr>
<tr>
<td>18</td>
<td>Temperature</td>
<td>5983</td>
<td>Input 0-500Ohm (1)</td>
<td>EM X4-29</td>
<td>Analogue input for IC display of temperature (Bodybuilder) [1]&lt;br&gt;n.d. with CANopen enabled 0x6167</td>
</tr>
<tr>
<td>19</td>
<td>EN1501-1 Reverse Roll external sensor</td>
<td>5991</td>
<td>Input 10 mA (1)</td>
<td>EM X4-16</td>
<td>For future IVECO applications</td>
</tr>
<tr>
<td>20</td>
<td>EN1501-1 Roll Protection</td>
<td>5992</td>
<td>Input 10 mA (1)</td>
<td>EM X4-38</td>
<td>For future IVECO applications</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 StoppedState. IVECO offers a set of pre-configured StoppedState settings to satisfy Bodybuilders application specific needs; for details please contact IVECO.

- This feature is only available when the Bodybuilder application is in operation and not during normal vehicle driving. Therefore, the Bodybuilder enable input (ST 72072A, pin 3) will be simultaneously switched to ground; otherwise no other action will be initiated.
- Please note that the Vehicle Stopped State values are transmitted via CAN to the other vehicle subsystems. Therefore, this feature requires that the "Vehicle CAN fully operational" output is active.
- When the "Vehicle CAN fully operational" output is not active then the Bodybuilder application does not have to implement actions (or rather reactions) which rely on the EM nor on the entire IVECO Bodybuilder interface functioning properly (as for instance the CAN-open 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

Rem: During this 'StoppedState' 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 Step swt input, as well as the CAN open object 0x6148 (Refuse packet step switch) activate the following actions on occupied stepper switch as described in Standard Fpr EN 1501-1:2010 date: 2010-02, Chpt 5.11.3.3.1 – Provisions for footboard(s) occupied:

- speed limiting
- reversing of rear loaded RCV. Reversing protection by means of:
  - brake activation in case of reversing;
  - 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 (72072A/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 overriding safety devices EN1501-1 described in the Standard Fpr EN1501-1:2010 dated: 2010-02; Chapter 5.11.3.3.2 including reset management in the event of function failures or traffic emergencies must be managed by the Bodybuilder (see EN1501-1 chapter 5.11.3.3.2).

(5) It is possible to display vehicle load information on the Instrument Panel, but only for comfort functions. The functionality is per default disabled, for enabling please contact IVECO Customer Services. When wiring is added to the input(s), the relative CAN-open objects on the vehicle load information are no longer available. The trailer load information via ISO11992-3 is not supported on the Euro 6 range.
Using this function the driver can also set alarm thresholds for each type of load.

**f) Optional connector 72072C: 9 pin, yellow**

![Diagram of connector 72072C](image)

A. 41200681 Counterpart to be coupled (female)  
B. 504163547 Existing part on vehicle (male)

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

**Table 5.9 - Basic functions of connector 72072C**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>K30</td>
<td>7796</td>
<td>Output 10 A (1)</td>
<td>K30</td>
<td>Protected by fuse 10 A</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
<td>0000</td>
<td></td>
<td>Ground</td>
<td></td>
</tr>
</tbody>
</table>
| 3   | CO (CANopen) operational | 0975   | Output 0.5 A | EM X4-28     | LSO (Low Side Output), activated in the case of CO initiated (typically ~3 seconds after K15 ON)  
For adjustment contact IVECO Technical Service  
Open circuit = CANopen not operational  
0 V = CANopen operational |
| 4   | Bodybuilder CAN | CAN H | EM X4-17 | CANopen Truckgateway |
| 5   | CAN Gnd      | 0999     | EM X4-09  | HF Ground (High Frequency), capacitive coupled |
| 6   | Bodybuilder CAN | CAN L | EM X4-19 | CANopen Truckgateway |
| 7   | Reserved     |          |           |              |         |
| 8   | Reserved     |          |           |              |         |
| 9   | Reserved     |          |           |              |         |

(1) 10 A can be used in combination with "Vehicle CAN fully operational" signal, connector 72072A pin 4

**B) Connectors on the chassis**

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

- ST64 (for Bodybuilder specific solutions)
- 72072D (EM)
- ST91 (PTO 1)
- ST92 (PTO 2)
- ST93 (PTO 3)
Location of chassis connectors

Connector ST64: 3 pin, black

Table 5.10 - Basic functions of connector ST64

<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>15-pin trailer socket</td>
<td>8075</td>
<td></td>
<td>72010-11</td>
<td>Connection with 15-pin Trailer socket - Pn 11</td>
</tr>
<tr>
<td>2</td>
<td>Positive +15 for Bodybuilders</td>
<td>8075</td>
<td>10 A</td>
<td>MET-C1</td>
<td>K15</td>
</tr>
<tr>
<td>3</td>
<td>15-pin trailer socket</td>
<td>6021</td>
<td></td>
<td>72010-10</td>
<td>Connection with 15-pin Trailer socket - Pn 10</td>
</tr>
</tbody>
</table>
For general use by Bodybuilder: allows the use of 3 terminals of the 15-pin connector for the trailer.

**f) Optional connector 72072D: 7 pin, black**

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

**Table 5.11 - Basic functions of connector 72072D**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>K30</td>
<td>7795</td>
<td>Output 10 A</td>
<td>K30</td>
<td>Fused with 10 A F41 via ST48/1 (1)</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
<td>0000</td>
<td>Ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CO enable (CANopen)</td>
<td>0975</td>
<td>Output 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 the IVECO Technical Service 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</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>CAN line Ground</td>
<td>0999</td>
<td>EM X4-09</td>
<td>HF Ground (High Frequency),capacitive coupled</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Bodybuilder CAN</td>
<td>CAN L</td>
<td>EM X4-19</td>
<td>CANopen Truckgateway</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) 10 A can be used in combination with K30 on the connector ST14A pin 21

**c) Optional connectors ST91, ST92, ST93: 4 pin, black**

Only available with OPT 4572 (EM-light) or OPT 0384 (EM-full) installed.
Table 5.12 - 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>Input 10 mA (¹)</td>
<td>EM X3-08</td>
<td>Connect to ground to read the PTO1 feedback</td>
</tr>
<tr>
<td>2</td>
<td>PTO1 activation via electromagnetic valve</td>
<td>9131</td>
<td>Output 1.5 A</td>
<td>EM X1-01</td>
<td>OFF = 0V = valve not activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ON = +24V = valve activated</td>
</tr>
<tr>
<td>3</td>
<td>PTO1 pressure switch</td>
<td>0391</td>
<td>Input 10 mA (¹)</td>
<td>EM X3-11</td>
<td>Connected to ground if active</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Used for Multipower and engine PTO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>It could also be used to monitor the Bodybuilder consent</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td>Ground</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.

Table 5.13 - 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>Input 10 mA (¹)</td>
<td>EM X3-09</td>
<td>Connect to ground to read the PTO2 feedback</td>
</tr>
<tr>
<td>2</td>
<td>PTO2 activation via electromagnetic valve</td>
<td>9132</td>
<td>Output 1.5 A</td>
<td>EM X1-04</td>
<td>OFF = 0V = valve not activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ON = +24V = valve activated</td>
</tr>
<tr>
<td>3</td>
<td>PTO2 pressure switch</td>
<td>0392</td>
<td>Input 10 mA (¹)</td>
<td>EM X3-12</td>
<td>Connected to ground if active</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Used for Multipower and engine PTO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>It could also be used to monitor the Bodybuilder consent</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td>Ground</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.

Table 5.14 - 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>Input 10 mA (¹)</td>
<td>EM X3-10</td>
<td>Connect to ground to read the PTO3 feedback</td>
</tr>
<tr>
<td>2</td>
<td>PTO3 activation via electromagnetic valve</td>
<td>9123</td>
<td>Output 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>3</td>
<td>PTO3 pressure switch</td>
<td>0393</td>
<td>Input 10 mA (¹)</td>
<td>EM X3-16</td>
<td>Connected to ground if active</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Used for Multipower and engine PTO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>It could also be used to monitor the Bodybuilder consent</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td>Ground</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.
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:

- a green connector (FMS), housed in one of the DIN coating cases above the windscreen;
- a bridle, which connects the connector to the ST40;
- 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.

### Characteristics of the CAN line

<table>
<thead>
<tr>
<th>Physical level</th>
<th>Unshielded twisted pair cable compliant with ISO std. 11898 (SAE J1929/11). Termination of internal bus to cable with 120 Ω resistor.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application level</td>
<td>Messages and parameters compliant with SAE J1939/71.</td>
</tr>
</tbody>
</table>

The information that can be retrieved contains the message "FMS Standard Interface" and identifies the version that is supported. This message is not present if you have installed an interface that does not support this standard.

The telematic devices connected to the FMS connector, wanting to use the Remote Tachograph Download Data functionality must be set to use the "source address" F0; if you do not operate in this way, on the message "error 13", relative to problems on the CAN network, could appear on the tachograph.

### 5.4 ELECTRONIC CONTROL UNITS

- **CAN line wires and electric/electronic devices must not be modified.**
- **Any modifications on the electrical system will reduce quality and safety characteristics.**
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.

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 36));
● 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.
5.5 ELECTRICAL SYSTEM

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 on the vehicle’s electrical system refer to the specific Service Manual, printed material 603.95.493 (New TRAKKER Euro 6).

This Manual is available from the Service Network and may also be requested from the 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 the ground cable from the battery negative terminal.

To prevent damage to the vehicle's electrical system, follow the instructions of the cable manufacturer. 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 different cables for signal and negative;
  - be placed at a distance of at least 100 mm (reference value = 150 mm) from the high heat parts (turbine engine, exhaust manifold, etc.);
  - be placed at least 50 mm from containers of chemical agents (batteries, etc.);
  - be placed at least 50 mm from moving parts.

- The route of the cables should be defined as much as possible by dedicated and closely placed brackets, in order to avoid dangling parts and to provide the possibility (and the obligation) to reconstruct the same installation arrangement in the event of repairs or outfitting.

- The cables must have a suitable sectioning for the type of load and the position of the load in the vehicle.

- The passage of cables in the holes and on the edges of metal sheets must be protected by cable gaskets (in addition to the corrugated tube).

- The corrugated tubing must completely protect the entire cable and be connected (with heat shrinking or taping) to the rubber caps on the terminals. In addition, the clamps of the hose (cut lengthwise) must not be in contact with the sharp edge of the tube.

- All the terminals (+) connection of these cables and their housings must be protected by rubber caps, (hermetic for areas exposed to atmospheric agents or with possible water stagnation).

- The fastening of the cable housings to the terminals (also negative), should be secured to prevent unscrewing, applying a torque where possible and placing them "radially" in the case of multiple connections (to be avoided if possible).

It is always necessary to isolate the battery before performing any work on the electrical system, disconnecting the power cables, the negative terminal first and then the positive.
Use fuses with the prescribed capacity for the specific function, and do not under any circumstances use higher capacity fuses; replace with keys and users disconnected, only after eliminating the problem. Restore the original conditions of the wiring (paths, protections, strips, completely preventing the cable from coming into contact with the surface of the metal structure that can affect its integrity), if operations have been carried out on the system.

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).

In cases where the application of additional devices requires it, the installation of protective diodes for inductive current spikes must be provided for.

The ground signal from the analogue sensors must be wired exclusively 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 metal plane of reference, that is 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 26)); 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, dislocation, strips, cable shielding connection, etc..) comply with the original IVECO provision.

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.
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, while tightening must be done in an orderly and adequate manner.

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

- electronic control units must be connected to the system ground when equipped with metal housings.
- the negative cables of the electronic control units are to be connected to a system ground point, connected to the negative terminal of the battery;
- the analogue grounds (sensors), while not being connected to the system ground/negative terminal of the battery, are to have good conductivity. Consequently, particular care should be given to terminal parasitic resistances: oxidation, scratches, etc.
- the metal braid of the shielded circuits must be in electrical contact only at the control unit side to which the signal is to be sent.
- In the presence of junction connectors the unshielded section d, near them, should be as short as possible;
- The cables must be routed in such a way as to be parallel to the reference plane, as close as possible to the chassis/body.

“STELLA” connections of various negatives with the system ground
Shielding by means of a metal braid of a cable leading to an electronic component

**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 24 V must:

- be immune to interferences such as -600 V negative spikes, +100 V positive spikes, bursts of ±200 V;
- operate correctly during the phase when voltage drops to 8 V for 40 ms and to 0 V for 2 ms;
- resist the load dump phenomena up to 58 V.

The maximum radiated emission levels measured at the bench and the levels of conducted emissions generated by devices and also by 24 V power supplies are given in the following table:
Table 5.15 - Electromagnetic emission levels

<table>
<thead>
<tr>
<th>Type of emission</th>
<th>Type of transducer</th>
<th>Type of disturbance</th>
<th>Type of detector</th>
<th>Frequency range and limits acceptable in dBμV/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiated</td>
<td>Aerial at a distance of 1 metre</td>
<td>Broadband</td>
<td>almost peak</td>
<td>150-300 kHz</td>
</tr>
<tr>
<td>Radiated</td>
<td>Broadband</td>
<td>peak</td>
<td>0.53-2 MHz</td>
<td>67</td>
</tr>
<tr>
<td>Radiated</td>
<td>Narrow band</td>
<td>peak</td>
<td>5.9-6.2 MHz</td>
<td>48</td>
</tr>
<tr>
<td>Radiated</td>
<td>Broadband</td>
<td>peak</td>
<td>30-54 MHz</td>
<td>24</td>
</tr>
<tr>
<td>Radiated</td>
<td>Broadband</td>
<td>peak</td>
<td>68-87 MHz mobile services only</td>
<td>37</td>
</tr>
<tr>
<td>Radiated</td>
<td>Broadband</td>
<td>peak</td>
<td>76-108 MHz broadcast only</td>
<td>44</td>
</tr>
<tr>
<td>Radiated</td>
<td>Broadband</td>
<td>peak</td>
<td>142-175 MHz</td>
<td>50</td>
</tr>
<tr>
<td>Radiated</td>
<td>Broadband</td>
<td>peak</td>
<td>380-512 MHz</td>
<td>50</td>
</tr>
<tr>
<td>Radiated</td>
<td>Broadband</td>
<td>peak</td>
<td>820-960 MHz</td>
<td>50</td>
</tr>
<tr>
<td>Radiated</td>
<td>Broadband</td>
<td>peak</td>
<td>820-960 MHz</td>
<td>50</td>
</tr>
<tr>
<td>Conduit</td>
<td>LISN 50 Ω 5 μH 0.11 μF</td>
<td>Broadband</td>
<td>almost peak</td>
<td>80</td>
</tr>
<tr>
<td>Conduit</td>
<td>Broadband</td>
<td>peak</td>
<td>5.9-6.2 MHz</td>
<td>52</td>
</tr>
<tr>
<td>Conduit</td>
<td>Broadband</td>
<td>peak</td>
<td>30-54 MHz</td>
<td>36</td>
</tr>
<tr>
<td>Conduit</td>
<td>Narrow band</td>
<td>peak</td>
<td>68-87 MHz mobile services only</td>
<td>49</td>
</tr>
<tr>
<td>Conduit</td>
<td>Narrow band</td>
<td>peak</td>
<td>76-108 MHz broadcast only</td>
<td>49</td>
</tr>
<tr>
<td>Conduit</td>
<td>Narrow band</td>
<td>peak</td>
<td>142-175 MHz</td>
<td>49</td>
</tr>
<tr>
<td>Conduit</td>
<td>Narrow band</td>
<td>peak</td>
<td>380-512 MHz</td>
<td>50</td>
</tr>
<tr>
<td>Conduit</td>
<td>Narrow band</td>
<td>peak</td>
<td>820-960 MHz</td>
<td>50</td>
</tr>
<tr>
<td>Conduit</td>
<td>Narrow band</td>
<td>peak</td>
<td>820-960 MHz</td>
<td>50</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:

\[ a \geq 6 \text{ mm} \]

The values in the table are only to be considered respected if the device comes from "IVECO Spare Parts" or it has been certified as per the international standards ISO, CISPR, VDE etc.
Whenever equipment is used which runs on mains power (220 V AC) for its primary or secondary source of power, it must be checked to ensure that its characteristics are in line with IEC regulations.
5.6 RECEIVER-TRANSMISSION SYSTEMS

The most frequent applications include:

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

▶ If devices are fitted which could interact with the electronic systems already present (retarders, additional heaters, power take-offs, air conditioners, automatic gearboxes, telematics and speed limiters) contact IVECO to optimize the application.

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 25);
   ■ 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 therefore following the Manufacturer’s fitting instructions and warnings (see Figure 24).

Installation on the centre of the roof is to be considered the best by far, as the grounding is proportional in all directions. Inside the cab, the transmitter equipment must be positioned as shown in Figure 25.

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.
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 at least 1 meter away from other devices.

- The ROS value (Stationary Wave Ratio) must be as close as possible to the unit (the recommended value is 1.5), while the maximum acceptable value must never be greater than 2.
- The ANTENNA GAIN values must be as high as possible and guarantee a sufficient level of spatial uniformity, characterised by deviations in relation to the average value to the order of 1.5 dB in the typical CB band (26.965-27.405 MHz).
- The IRRADIATED FIELD in cab value must be as low as possible, and however < 1 V/m.

In any case, limits set by the applicable European legislation 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.
5.7 ADDITIONAL EQUIPMENT

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 < 1V/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.

5.7 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 sizing 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 too much additional electrical equipment or high absorption equipment (e.g. engines operated frequently or used for long periods with heat engine off, as in the case of tail lifts), could require power that the basic vehicle system cannot provide. In these cases, additional batteries of suitable capacity must be adopted.

The insertion of additional batteries in the vehicle circuit should include an adequate recharge system, using an alternator with more power or adopting and additional alternator with a separate recharge system, integrated with that of the vehicle. In this case it is necessary to provide additional batteries with a capacity equal to those originally fitted (170 Ah / opt. 220 Ah) for correct charging of all the batteries.

In case of installation of additional batteries, it is possible to use:

1. recombination batteries (AGM or gel);
2. traditional batteries.

In both cases it is necessary to adequately separate the batteries from the environment of the vehicle occupants by means of an appropriate container that ensures sealing in case of:

- emission of vapours (for example, in the event of a fault in the alternator voltage regulator);
- explosion of the battery;
- Leakage of liquid electrolyte, even in case of tilting.

If type 1 batteries are used, it is necessary to place a breather towards the outside of the housing compartment.

If type 2 batteries are used, it is necessary to use batteries equipped with:

- cover with a system that emits gas towards the outside, equipped with a tube for spraying acid spray outwards;
- flame arrestor system by means of porous pad.

It is also necessary to ensure that the evacuation of gas is located far from possible spark trigger points, from mechanical/electric/electronic parts, placing the exhaust outlet so as to avoid generating vacuum inside the battery housing compartment.

▶ Ground connection of the additional battery must be made using a cable (the shortest possible) of adequate section.
5.7 ADDITIONAL EQUIPMENT

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.

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**

Special care must be given when installing cooling units that use a second alternator, mounted on the engine (extra generator) as a power source. These generators provide, depending on the number of turns, a voltage of the order of 270 ÷ 540 V which goes through the wiring to the cooling unit installed on the vehicle.

There is a clear danger of any crosstalk (electromagnetic interference between adjacent cables) that can be generated between the aforementioned cable and the wiring already present on the vehicle.

In these cases it is necessary to use cables with high insulation, adopting a preferential path, though not in the vicinity of the standard vehicle wiring.

For these units, respect the electromagnetic emissions levels mentioned above.

In case of a standard alternator malfunction (e.g. low voltage, no signal) on the control panel, an error message will be reported. A possible additional alternator cannot be connected to the MUX and therefore in case of malfunction, the MUX is not able to detect which alternator is not operating properly.
5.8 CURRENT DRAWS

On Trakker vehicles it is forbidden to connect additional electrical systems directly to the positive pole of the battery; the positive pole is occupied by the cables going to the fuse box located on the side of the battery casing.

The fuse holder must not be changed or moved.

Current draws are possible from the general switch (standard equipment) or the TGC main current contactor (if installed).

General battery switch

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.

Specific solutions must be authorised by IVECO.

Note  It is permissible to connect in parallel with the output of the diverter (max 100 A).

Main power contactor (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.

▶ 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. In the cab there is a connection with a voltage reducer (from 24 V to 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.

On the chassis

▶ It is not permitted to draw current from the bulkhead connector below the front grille, nor to disconnect or modify the terminals used.

▶ Operations which do not comply with the instructions specified by IVECO or carried out by non-qualified personnel can cause severe damage to on-board systems, affect driving safety, reliability and good operation of the vehicle and cause considerable damage which is not covered by warranty.
Maxifuse and Megafuse fuses

At IVECO Shop there are five fuse holder kids available, to protect high absorption draws. Their positioning (always as close as possible to the draw terminal on the batteries), shall be made by the Bodybuilder depending on the space available on the vehicle.

![Figure 28](image)

A. Maxifuse  
B. Battery case  
C. Megafuse

<table>
<thead>
<tr>
<th>Table 5.16 - Maxifuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Kit 40 A</td>
</tr>
<tr>
<td>Kit 60 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 5.17 - Megafuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Kit 100 A</td>
</tr>
<tr>
<td>Kit 125 A</td>
</tr>
<tr>
<td>Kit 100 A</td>
</tr>
</tbody>
</table>

The fuse must be fastened to the chassis with a tightening torque of 2 ± 0.2 Nm.
5.9 MISCELLANEOUS

Additional circuits

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

As already seen in chapter 5.5 (.getProperty("PageNumber") Page 25) 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>
<thead>
<tr>
<th>Max. continuous current (1) (A)</th>
<th>Cable cross-section (mm²)</th>
<th>Fuse capacity (2) (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ÷ 4</td>
<td>0,5</td>
<td>5</td>
</tr>
<tr>
<td>4 - 8</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>8 ÷ 16</td>
<td>2,5</td>
<td>20</td>
</tr>
<tr>
<td>16 - 25</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>25 - 33</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>33 ÷ 40</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>40 - 60</td>
<td>16</td>
<td>70</td>
</tr>
<tr>
<td>60 - 80</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>80 - 100</td>
<td>35</td>
<td>125</td>
</tr>
<tr>
<td>100 - 140</td>
<td>50</td>
<td>150</td>
</tr>
</tbody>
</table>

(1) For uses of more than 30 seconds.
(2) Depending on the position and 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.

⚠️ 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.

- 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.

Connector ST14E

Connector ST14E may be present on New Stralis in the case of applications in which opt. 6821 (EN 1501) is fitted by the Service Assistance after the vehicle has been purchased.

OPT 6821 is incompatible with OPT 14861 (Hill Holder).
Please contact the IVECO Service Assistance to have the control units reprogrammed (EM, EBS, IC, ...).

Table 5.19 - Basic functions of connector ST14E

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Cable code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground</td>
<td>0000</td>
<td>–</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Brake solenoid valve</td>
<td>6990</td>
<td>1 A</td>
<td>EM X4-21</td>
<td>used on Euro IV/Euro V applications</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Output EN1501 Solenoid valve Brake</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 V = not engaged</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+24V = engaged</td>
</tr>
</tbody>
</table>

Figure 29
### TRAKKER Euro 6 – GUIDELINES FOR BODYBUILDERS
#### ELECTRONIC SUB-SYSTEMS

## 5.9 MISCELLANEOUS

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Cable code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| 3   | EN1501 Brake lights | 6990 | 1 A | 78065-1 | Power supply of parking brake activation solenoid valve (EN 501)  
0 V = not engaged  
+24V = engaged |
| 4   |  | 6989 | | 72072B-10 | Output EN1501 Reverse protections brake active  
0 V = not engaged  
+24V = engaged  
after K15 active for 2 sec (w/o brake activated) |
| 5   | External stop brake request (EN1501) | 6989 | 10 mA | EM X4-03 | Input signal to activate the Stopping brake (V<2km/h)  
Ground = active, low side switch |
| 6   | EN1501 Brake diagnostics warning light | 0996 | 1 A | EM X4-06 | Output EN1501 Reverse protections brake active  
0 V = not engaged  
+24V = engaged  
after K15 active for 2 sec (w/o brake activated) |
| 7   | K30 | 6987 | 10 A | EM 04-01 | Protected by 10A fuse F41 via ST48/1 () |
| 8   | Ramp switch request (EN1501) | 7795 | 10 mA | IBC3-89 | Input to activate the Refuse stepper switch  
Ground = active, low side switch |
| 7   | Buzzer (EN1501) | 0996 | 1 A | 72072B-05 | reserved for IVECO exclusively  
Output EN1501 Warning sound indicator  
0 V = not engaged  
+24V = engaged |

### 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 side marker lights must be carried out on the added structures (containers, van conversions etc), while electrical power supply must be provided by the specific connectors ST77 and ST78 on the frame.

Below is an illustration of the position for these terminals.

**Note** It is not possible to draw current from side marker lights.
Table 5.20 - Basic functions of connector ST77

<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>Sidelights</td>
<td>3330</td>
<td></td>
<td>MET P-A08</td>
<td>Common with 15-pin Trailer socket - Pin 6</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>Sidelights</td>
<td>3330</td>
<td></td>
<td>MET P-A08</td>
<td>Common with 15-pin Trailer socket - Pin 6</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td></td>
<td>Ground</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.21 - Basic functions of connector ST78

<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>Sidelights</td>
<td>3339</td>
<td></td>
<td>MET P-A07</td>
<td>Common with 15-pin Trailer socket - Pin 5</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>Sidelights</td>
<td>3339</td>
<td></td>
<td>MET P-A07</td>
<td>Common with 15-pin Trailer socket - Pin 5</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td></td>
<td>Ground</td>
<td></td>
</tr>
</tbody>
</table>
Table 5.22 - Connectors for side lights

<table>
<thead>
<tr>
<th>Connector on the vehicle</th>
<th>Interface to be used</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>9843 5341 Male connector</td>
<td>9843 5337 Female connector</td>
<td>1</td>
</tr>
<tr>
<td>9844 7233 Half shell</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9843 5370 Cable terminal</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>486 1936 Gasket</td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

**Trailer connectors**

Two connectors are provided for connecting the trailer:

- 15-pin for general electrical devices (72010), located on the left;
- 7-pin for vehicles with EBS (72006), located on the right.

These are on the rear wall of the cab (tractors) or on the rear crossbar of the chassis (trucks).

Table 5.23 - 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>FCM A01</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Right trailer indicator</td>
<td>1185</td>
<td>6 A</td>
<td>FCM A33</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Trailer rear fog light</td>
<td>2283</td>
<td>6 A</td>
<td>FCM A07</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>Left trailer clearance light</td>
<td>3339</td>
<td>6 A</td>
<td>FCM A09</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Right trailer clearance light</td>
<td>3330</td>
<td>6 A</td>
<td>FCM A28</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Trailer stop lights</td>
<td>1179</td>
<td>6 A</td>
<td>FCM A13</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Trailer reverse light</td>
<td>2226</td>
<td>6 A</td>
<td>FCM A19</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Power supply for trailer socket after fuse for T.M.P. users</td>
<td>7790</td>
<td>11 A</td>
<td>86131 XI-33</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>15-pole socket power supply</td>
<td>6021</td>
<td>11 A</td>
<td>ST64-3</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5.24 - Basic functions of the 7-pin connector (72006) 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>Battery positive connected to fuse for trailer EBS</td>
<td>7772</td>
<td>30 A</td>
<td>75000-B25</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Key activated positive connected to fuse for EBS / speed limiter</td>
<td>8847</td>
<td>10 A</td>
<td>75000-A8</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ground</td>
<td>0000</td>
<td>6 A</td>
<td>Ground</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>Trailer EBS fault signal</td>
<td>6671</td>
<td>6 A</td>
<td>BCM E22</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>CAN H line</td>
<td>WS/Bl</td>
<td>11 A</td>
<td>EBS X3-2</td>
<td>Connected to EBS control unit</td>
</tr>
<tr>
<td>7</td>
<td>CAN L line</td>
<td>GN/Ve</td>
<td>11 A</td>
<td>EBS X3-4</td>
<td>Connected to EBS control unit</td>
</tr>
</tbody>
</table>
Fuses and relays

Special fuses are reserved for use by the bodybuilder; their position is shown in the following figure.

![Figure 33](image-url)

### Table 5.25 - Fuses

<table>
<thead>
<tr>
<th>Connector</th>
<th>Pin</th>
<th>Maximum load</th>
<th>Locking</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST48</td>
<td>6</td>
<td>5 A</td>
<td>75000</td>
<td>F3</td>
<td>K15 (24 V) - for EM X3-13</td>
</tr>
<tr>
<td>72072D</td>
<td>1</td>
<td>10 A</td>
<td>75000</td>
<td>F41</td>
<td>Battery (24 V) - After TGC (Main Current Contactor)</td>
</tr>
<tr>
<td>ST48</td>
<td>13</td>
<td></td>
<td></td>
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<td>10 A</td>
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<td>F52</td>
<td>K30 (24 V) - After TGC (Main Current Contactor)</td>
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<td>K30 (24 V) - for EM X1-09</td>
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<td>3 A</td>
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<td>K15 (24 V) from BCM H04</td>
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### Table 5.26 - Relays

<table>
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<tr>
<th>Module</th>
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<tr>
<td>25775</td>
<td>R2</td>
<td>Ignition cut-out relay for tail lift</td>
</tr>
<tr>
<td>25775</td>
<td>R4</td>
<td>Relay for tail lift warning light</td>
</tr>
<tr>
<td>25775</td>
<td>R5</td>
<td>Relay for tail lift control</td>
</tr>
<tr>
<td>25780</td>
<td>R2</td>
<td>Acoustic indicator for ramp control EN 1501</td>
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<tr>
<td>25781</td>
<td>R1</td>
<td>Relay for EM - Safety</td>
</tr>
<tr>
<td>25781</td>
<td>R2</td>
<td>Relay for EM - Neutral</td>
</tr>
<tr>
<td>25781</td>
<td>R3</td>
<td>Relay for EM - EN 1501</td>
</tr>
<tr>
<td>25781</td>
<td>R4</td>
<td>Diode for EM - EN 1501</td>
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</tbody>
</table>
SECTION 6

ADBLUE AND SCRT SYSTEM
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ADBLUE AND SCRT SYSTEM

6.1 GENERAL INFORMATION
To comply with Euro VI requirements on engine gas emissions, IVECO has developed the "Hi-e SCR" system (High-efficiency Selective Catalytic Reduction), consisting of the combined action of a diesel particulate filter (DPF) and post-treatment of exhaust gases (SCR).
This post-treatment requires the use of an additive, commercially known as AdBlue (urea solution + water).

6.2 THE NITROGEN OXIDE CATALYTIC REDUCTION PRINCIPLE
The additive AdBlue, is sent from a dedicated tank by means of a SM (Supply Module) to a DM (Dosing Module) which injects AdBlue into the exhaust pipe. The mixture of exhaust gas and additive is then fed to the catalytic converter and chemically transforms NOₓ into nitrogen and water, harmless to the environment.
In order to comply with Euro VI, new assemblies (DOC, passive DPF, CUC) and sensors are used which act as parameter control functions.

Main components of SCRT system

1. Diesel Oxidation Catalyst
2. Diesel Particulate Filter
3. Selective Catalytic Reduction
4. Clean Up Catalyst
5. Dosing Module
6. Temperature sensors
7. DPF Δp sensors
8. NOₓ sensors
9. NH₃ Sensor
10. Mixer
11. PM sensor

DOC (Diesel Oxidation Catalyst): to oxidise the exhaust gas components through the use of oxygen
DPF (Diesel Particulate Filter): to eliminate the particulate before the SCR through passive regeneration.
SCR (Selective Catalytic Reduction): to reduce the NOₓ through the injection of AdBlue.
CUC (Clean Up Catalyst): to eliminate the ammonia residue (NH₃) so as to satisfy legal requirements.
6.3 INSTRUCTIONS

Note  The materials and layouts of normal IVECO production are specifically approved; all other circumstances of variation must be specifically authorized.

If changes are made to the chassis which also involve the AdBlue system, the following criteria must be observed:

- all post-treatment components must be installed under extremely clean conditions;
- the protection caps of the SM, DM and the AdBlue pipe bundle may only be removed just before assembly;
- the SM and DM fittings must be handled with care;
- the SM and DM fastening screws must be tightened to the torque specified in the relevant assembly diagrams;
- the seal of the DM flange on the ATS side must be replaced each time the DM is disassembled (the seal may only be used once);
- the "after-run" phase must not be interrupted using the battery manual switch or the ADR switch (the AdBlue pipes must always be emptied to prevent any crystallization or damage from freezing);

AdBlue tank

50, 60, 80 and 145 litres tanks are available depending on the required capacity.

Since the AdBlue solution may be corrosive for ferrous steels, any specifically shaped tanks must be made out of polyethylene or stainless steel (code 1.4571 - 1.4541 - 1.4112 - 1.4310 - standard DIN 17440).

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

- the tank ventilation pipe is not closed;
- AdBlue is present in 10% of the volume;
- the AdBlue does not exceed the maximum volume indicated by the level sensor, even if additional volume is anticipated due to the expansion of the solution in the case of freezing.

6.4 MOVING ADBLUE SYSTEM COMPONENTS

In order to comply with Euro VI requirements, the positioning of the main components of the AdBlue system has been optimised.

In particular, the SM pump module and the DM dosing module have been introduced into the AdBlue tank and silencer respectively (see Figure 2), providing benefits in terms of space and reduced length of pipes (better pressure stability).
1. 4-axle vehicles
2. 2 or 3-axle vehicles
3. Direction of travel
4. Pumping module (SM)
5. Dosing module (DM)

A. Water inlet/outlet fittings
B. AdBlue intake and return coupling
C. AdBlue pressure line fitting to DM
D. AdBlue delivery union
E. Electrical connector
All modifications must be studied and authorised by IVECO.

**Moving the tank**

- **vertically:**
  The AdBlue tank can be moved provided that the new height of the SM module, to which it is secured, continues to comply with the conditions outlined in Figure 3.
  The position of the DM module is subject to that of the silencer/muffler assembly.

- **horizontally:**
  The AdBlue tank can be moved provided that the pipe between the SM and DM does not exceed 5035 mm in length.

---

**Figure 3**

1. **AdBlue tank**
2. **Pumping module (SM)**
3. **Dosing module (DM)**
4. **Siphon**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&lt; 1000 mm</td>
<td>B</td>
<td>&lt; 1000 mm</td>
</tr>
<tr>
<td>C</td>
<td>&gt; 0</td>
<td>S</td>
<td>≥ 10 mm</td>
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**Note** Distance (A) is to be considered as fixed since the SM is integrated into the AdBlue tank.

In the diagram shown in the Figure 3, it can be seen that the pipes provide an adequate siphoning system in order to prevent any damage due to possible AdBlue freezing.

The siphon should have an internal collection volume of 12 cm³ and is to be located below the reference distance of the DM (for example S = 10 mm).

**Note** After moving the AdBlue tank, contact the IVECO Service Network for the software upgrade connected to the management of the relative system.
Moving the muffler

- **vertically:**
  Height increases of up to 100 mm are permitted compared to the original installation distance. Since sufficient air circulation around the muffler must be ensured, there must be a distance of at least 80 mm between its upper surface and the superstructure.

- **horizontally:**
  Retractions are permitted which do not involve changes in the original trend of the exhaust gas temperature in the pipes connecting to the engine.
  The subsequent lengthening of this pipe must be carried out at the centre so as not to change the position of sensors A and B in relation to the end of the pipe (see Figure 4).

![Figure 4](image)

The new pipe must be installed so that between each end there is no loss of gas temperature greater than 15°C (relating to ambient $T = 25$°C, engine speed = 1200 rpm and engine with full load). There must also be suitable cladding since the better the insulation, the greater possibility there is for muffler retraction.

![Figure 5](image)

1. material in HTS fibre glass
2. ceramic fibre
3. external covering
4. total thickness of insulating material [mm]

Figure 5 shows the structure of the material to be used for insulation. The essential features of this are:

- stability at temperature: 550°C
- heat conductivity at 500°C: 0.125 W/mK
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 adoption of flexible materials allows not only interventions for lengthening or shortening but also interventions for bending.

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

**Note**  The pipes may be modified using specific equipment and couplings; to select and obtain these parts, contact the IVECO Service Assistance.

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 6 are available;
- mark the delivery and return pipes before separating them to ensure there is no confusion during subsequent reassembly;
- cut the pipes with the appropriate pipe cutting clippers in order to ensure an accurate cutting area;
- insert the aforementioned fittings in the sections obtained from the cut, using the designated tools indicated in Figure 7.

▶ It is compulsory to work in a completely dust-free environment to prevent dust from reaching the injectors and subsequently clogging them.
a. Supports for fittings NS6 for AdBlue pipes
b. Supports for fittings NS10 for water pipes
c. Tool for inserting the T fitting
d. Tool for inserting the female fittings