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Homologation, Technical Application & Regulation
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Printed 692.68.915 – 3rd Ed. 05/2019

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## UPDATE DATA

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INTRODUCTION

This publication provides information, features and instructions for transformation and fitting of the vehicle; considering the type of content, it is meant for qualified 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 force.

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Data and information contained in this publication may be outdated as a result of changes adopted by IVECO, at any time, for technical or commercial reasons or due to the need to adapt the vehicle to new legal requirements.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

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<td>General danger</td>
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Danger for persons
Failure to comply with these prescriptions can result in the risk of serious injury.

Risk of serious damage to the vehicle
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.

General danger
Includes the dangers of both above described signals.

Environmental protection
Indicates correct behaviour in order that vehicle use is as environmentally friendly as possible.

NOTE
Indicates an additional explanation for a piece of information.
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SECTION 1

GENERAL INFORMATION
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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 versions indicated in these Directives and carried out in full compliance of the instructions provided, do not require any specific authorisation.

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

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

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

Upon completion of the interventions the bodybuilder shall be responsible for attainment of definitive approval from the competent authority.

1.5 RESPONSIBILITIES

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

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

1.6 LEGISLATIVE REQUIREMENTS

The Bodybuilder must verify that the final product is compliant, without exception, to all applicable legal requirements, on the 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)

Annex XVII of Directive 2007/46/EC concerns Multi-stage Type Approval

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.
1. IVECO
2. Authorised workshop upon Dealer order
3. Bodybuilder
4. Customer

Based on this Directive, IVECO (main vehicle manufacturer) and a Bodybuilder intending to launch the multi-stage approval process must sign a specific Collaboration Contract, called Technical Agreement, which sets out the content and reciprocal obligations in detail.

Consequently:

1. IVECO has the responsibility of providing, in the agreed form, the approval documents (EC/ECE approvals) and the technical information necessary for the proper implementation of the fitting and/or transformation (manuals, drawings, specifications);
2. the Bodybuilder has the following responsibilities:
   - the design and implementation of modifications to the basic vehicle received from IVECO,
   - attainment of approvals of systems already approved in a previous stage when, due to changes on the basic vehicle the approvals need to be updated,
   - compliance with national/international laws and in particular the laws of the destination country, for all changes made,
   - presentation of the changes made to a technical service, for evaluation,
   - appropriate documentation of the changes made, in order to give objective evidence of compliance to the aforementioned provisions of law (e.g. approval documents/test reports).

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

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

### 1.8 WARRANTIES

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

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

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

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

IVECO therefore considers it appropriate for Bodybuilders to be equipped with:

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

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

1.10 ACCIDENT PREVENTION

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

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

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

All precautions dictated by technical knowledge must be taken to avoid damage and functional defects.

Compliance with these requirements must be overseen by the manufacturer of the structures and devices.

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

1.11 CHOICE OF MATERIALS TO USE: ECOLOGY - RECYCLING

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

To this regard, please note that:

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

> To comply with Directive 2000/53 EC (ELVs), IVECO prohibits the in-vehicle installation of components that contain lead, mercury, cadmium and hexavalent chromium; exceptions are made in cases allowed by Annex II of the above Directive.
I.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 STRALIS 480 E6) does not match the type approval name. A complete example is provided below.

Type approval name

<table>
<thead>
<tr>
<th>STRALIS X-WAY AS 260 X 51 Z/P</th>
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- **STRALIS X-WAY** – Vehicle name
- **AS** – Cab type
  - AD: Short cab
  - AT: Long cab
  - AS: Hi-Way Cab
- **260** – Total weight
  - 190: 4x2 trucks
  - 260: Trucks 6x2 - 6x4
  - 340: Trucks 8x2x6 and 8x4x4
  - 440: Tractors 4x2 - 6x2- 6x4
- **X** – Range code
- **51** – Engine power (no. x 10 = power in HP)
- **Z** – Model
  - T: Tractor 4x2
  - TZ: Tractor 6x4 (Tandem rear axle)
  - X: Chassis cab 8x2 (1+3)
  - Y: Chassis cab 6x2 (rear additional axle) - Chassis cab 8x2 (2+2)
  - Z: Chassis cab 6x4 (Tandem rear axle) - Chassis cab 8x4 (2+2)
  - ZY: Chassis cab 8x4 (1+3)
- **P** – Version
  - P: Vehicles with rear axle air suspensions
  - PS: Vehicles with rear axle air suspensions and steering liftale rear additional axle with single wheels
  - HR: Double reduction rear axle

1.14 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 chassis cab vehicle and its distribution on the axles.

Vehicle adaptability

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

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

The positioning of lights and 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.

![Diagram](image.png)

**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)**

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

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

- **A** = Front wheel axle or tandem centre line
- **W** = Payload plus superstructure
- **W1** = Measurement of payload on front axle
- **W2** = Measurement of payload on rear axle (or tandem)
- **L1** = Distance of centre of gravity from the centre line of the rear axle (or tandem centre line)
- **L** = Actual wheelbase

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"Printed 692.68.915 – 3 Ed. - Base 05/2019"
Example to verify compliance with the permitted axle masses (vehicles with 3 or more axles, with a constant ratio of weight distribution on the two rear axles, for which the "virtual" value of the wheelbase and the centre line between the axles, due to the weight distribution, are defined by the manufacturer)

\[
\begin{align*}
W_1 &= \frac{W \times L_1}{L} \\
W_2 &= \frac{W \times (L - L_1)}{L} \\
W_3 &= W_2 \times \frac{(A - L_2)}{A} \\
W_4 &= \frac{W_2 \times L_2}{A}
\end{align*}
\]

Note
For vehicles with three or more axles, 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 axles must be determined for the respective load condition realized, using the instructions on the vehicle cab diagram.

This way, in particular version fittings (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.
Even distribution of load

Uneven distribution of load

Even distribution of load

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

**Height of centre of gravity**

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

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

The following cases should be distinguished:

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

![Diagram of a truck with labels for Ht and Hs]

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

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

**Control at full load**

- \( H_v \) = Cab vehicle centre of gravity height (cab version)
- \( H_s \) = Payload centre of gravity height plus superstructure relative to ground
- \( H_t \) = Complete full-load vehicle centre of gravity height
- \( W_v \) = Cab version vehicle tare weight
- \( W_s \) = Payload plus superstructure tare weight
- \( W_t \) = Complete vehicle ground at full load

For any inspections with the vehicle set up without payload you can proceed similarly, assuming \( W_s \) is only the tare weight of the superstructure (considering for \( H_v \) a value appropriate for the load and between the no-load cab version trim and the full-load trim).

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 ECE 111, special attention should therefore be paid:

- in defining the height of the fitted vehicle’s centre of gravity and at full load;
- in assessing the dynamic forces and the lateral displacement of the centre of gravity;
- in considering (for liquids) the density;
- in prescribing the adoption 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 fittings characterised by high vertical and surface development (e.g.: advertising panelling), the height of the centre of thrust, determined in the case of cross-wind, must be evaluated very carefully.

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

Special attention must therefore be paid:

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

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

Adoption 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" (keh Page 33)) 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).

In vehicles with an added lifting rear axle, it must be considered that, in the case of a lifted axle, the actual wheelbase is reduced while the rear overhang increases, so it is advisable not to place the centre of gravity of the superstructure and the payload behind the centre line of the engine axle, installation of the axle lifting system in the case of concentrated rear loads is also discouraged.

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.
Variations on permitted masses

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

In the authorisation request, you must indicate:

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

Reduction of the permitted mass on the vehicles (downgrading) can lead to interventions on the suspensions and brakes; in these cases the necessary indications may be provided.

1.16 INSTRUCTIONS FOR PROPER FUNCTIONING OF THE VEHICLE PARTS AND ACCESSIBILITY

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

For example:

- free access must be guaranteed to the places 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;
<table>
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<th>STRALIS X-Way Cab AD: D = 445 mm R = 2397 mm</th>
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<tbody>
<tr>
<td>1</td>
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<tr>
<td>2</td>
<td>STRALIS X-Way Cab AT: D = 900 mm R = 2720 mm (R = 3033 mm with spoiler)</td>
</tr>
<tr>
<td>3</td>
<td>STRALIS X-Way Cab AS: D = 940 mm R = 3295 mm</td>
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</tbody>
</table>

- the possibility of disassembling the various groups for assistance operations must be maintained;
- in outfittings which include the tipping of the side boards, consider the size of the parts which protrude most from the vehicle, in order to avoid limitations to tipping or damage to the parts. These dimensions are shown on the diagrams for Bodybuilders available on the website [www.jbb.iveco.com](http://www.jbb.iveco.com);
- 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 also in the raised position: 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 Handbook";
- 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.

Stralis X-WAY has chassis side members with a constant cross-section, the dimensions of which are 289 x 80 x 7.7 mm.
SECTION 2

CHASSIS

INTERVENTIONS
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CHASSIS INTERVENTIONS

2.1 GENERAL CHASSIS MODIFICATION STANDARDS

Keep in mind that:

- **weldings on the supporting structures of the chassis are absolutely forbidden** (except as prescribed in Paragraph "Weldings" (⇒ Page 8) and in Chapters 2.4 (⇒ Page 14), and 2.5 (⇒ Page 16));
- **no holes may be drilled into the side members** (with exception to indications provided 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 M12 may not be used (maximum hole diameter of 15,5 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 - 1,000 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 34).

Braking and electrical systems

For additional details on the braking and electrical systems see Chapters 2.15 (⇒ Page 46) and 5.5 (⇒ Page 34).

Characteristics of the material used in chassis modifications

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

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

### Table 2.1 - Material to be used in chassis modifications

<table>
<thead>
<tr>
<th>Name of steel</th>
<th>Breaking strength [N/mm²]</th>
<th>Yield stress [N/mm²]</th>
<th>Elongation</th>
</tr>
</thead>
<tbody>
<tr>
<td>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 Q56500TM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IVECO Fe S10D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe S3570G3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany Q5652-3N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK BS50D</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 and stresses

<table>
<thead>
<tr>
<th>Model</th>
<th>Wheelbase [mm]</th>
<th>Cross-section [mm]</th>
<th>Static stress σ [N/mm²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>All</td>
<td>289 x 80 x 7.7</td>
<td>max. 130 (1)</td>
</tr>
</tbody>
</table>

(1) Only for ON-road use: max. 150 N/mm²

- It is strictly prohibited to exceed the permitted static stress value. In any case, respect any more restrictive limits placed by national standards.

**Note**  Welding causes material property deterioration; therefore, when checking stresses in thermally altered zones, a resistance reduction of 1.5% 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 wherever possible.

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

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

**Hole position and size**

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

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

The holes must be offset as in Figure 2.

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

![Figure 2](image)

**Screws and nuts**

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

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

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

Screw treatment allowed is Geomet or zinc coating. Geomet treated screws are discouraged when using them in welding operations.
Use flange headed screws and nuts if there is sufficient space.
Use nuts with an anti-unscrewing system and keep in mind that the tightening torque must be applied to the nut.

**Welds**

> When welding, drilling, milling and cutting near brake hoses and electrical wires, be sure to adopt appropriate precautions for their protection; disconnect these parts if necessary (respect the prescriptions in Chapters 2.15 and 5.5).

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).

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).

- 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).

- Arc weld the area with multiple steps and use base electrodes that are thoroughly dried. Avoid power overloads; the welds must be free of marginal incisions and slag.
- Start from the opposite end and weld as in the previous item.
- Let the side members cool slowly and in a uniform fashion. No cooling with air jets, water or other means is allowed.
- Grind off the excess material.
- Mount steel corner reinforcements that have the same characteristics as the chassis; the minimum indicative sizes are shown in Figure 3.
  Reinforcement anchorage must regard only the vertical rib of the side member and can be realised with a weld bead, staples, bolts or nails (even Huck nails).
  Area and length of the weld bead, number and distribution of staples, number of nails of bolts must be adequate to transmit the bending and shearing moments.
- Once work is complete, use anti-rust protection (see Paragraph "Added or Modified Parts" (☞ Page 12)).
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.

### 2.3 RUST AND PAINT PROTECTION

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

### 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 (i)</td>
<td>18-0506</td>
<td>A</td>
</tr>
<tr>
<td>Geomet (ii)</td>
<td>18-1101</td>
<td>B - B1 - B2</td>
</tr>
</tbody>
</table>

- yes
- –

---

(i) 18-0506
(ii) 18-1101

---

- Printed 692.68.915 – 3 Ed. - Base 05/2019
## 2.3 Rust and Paint Protection

<table>
<thead>
<tr>
<th>Type of protection</th>
<th>IVECO standard</th>
<th>Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Geomet (1)</strong></td>
<td>18-1101</td>
<td></td>
</tr>
<tr>
<td>GEO 500-5</td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>GEO 321-5 PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEO 321-5 PML</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEO 321-5 PL</td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>GEO 500-5 PL</td>
<td></td>
<td>Class B1 wheel studs</td>
</tr>
<tr>
<td><strong>Zinc coating (2)</strong></td>
<td>18-1102</td>
<td></td>
</tr>
<tr>
<td>Fe/Zn 12 II</td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>Fe/Zn 7 IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe/Zn 12 IV</td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>Fe/Zn 7 IV LUB</td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>Fe/Zn 7 IV S</td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>Fe/Zn 12 IV S</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Alloy Zn-Ni</strong></td>
<td>18-1103</td>
<td></td>
</tr>
<tr>
<td>Fe/Zn Ni 7 VII S</td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>Fe/Zn Ni 7 IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Aluminium</strong></td>
<td>18-1148</td>
<td></td>
</tr>
<tr>
<td>Anode oxidation</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Painting</td>
<td>See Table III</td>
<td>yes</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Cycle phase description</th>
<th>Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MECHANICAL SURFACE CLEANING (1)</strong></td>
<td>A B (3) B1 (3) B2 C D</td>
</tr>
<tr>
<td>Sandshot blasting</td>
<td>yes (3) – yes (3) yes (3) yes (3) yes (3)</td>
</tr>
<tr>
<td>Brushing</td>
<td>yes (3) yes (3) – yes (3) yes (3) yes (3)</td>
</tr>
<tr>
<td>Sandpapering</td>
<td>yes (3) yes (3) yes (3) yes (3) yes (3)</td>
</tr>
<tr>
<td><strong>PRE-TREATMENT</strong></td>
<td>–</td>
</tr>
<tr>
<td>Iron phosphating (only for non-precated ferrous materials)</td>
<td>yes (3) yes (3) yes (3) yes (3) yes (3)</td>
</tr>
<tr>
<td>Zinc phosphating (*2)</td>
<td>yes</td>
</tr>
<tr>
<td><strong>CATAPHORETIC PAINTING</strong></td>
<td>yes (3) – yes (3) yes (3) yes (3) yes (3)</td>
</tr>
<tr>
<td>High thickness (30-40 μm)</td>
<td>yes (3)</td>
</tr>
<tr>
<td>Medium thickness (20-30 μm)</td>
<td>yes (3)</td>
</tr>
<tr>
<td>Acrylic finishing (&gt;35 μm)</td>
<td>–</td>
</tr>
<tr>
<td><strong>RUST PREVENTER</strong></td>
<td>– yes – yes yes (3) yes</td>
</tr>
<tr>
<td>Bi-component (30-40 μm)</td>
<td>–</td>
</tr>
<tr>
<td>Single-component (30-40 μm)</td>
<td>– yes – yes – –</td>
</tr>
<tr>
<td><strong>ANTIROCK PRIMER</strong></td>
<td>yes (3) – – – –</td>
</tr>
<tr>
<td>Single (130 °C) or bicomponent (30-40 μm)</td>
<td>yes (3)</td>
</tr>
<tr>
<td><strong>VARNISH</strong></td>
<td>–</td>
</tr>
<tr>
<td>Single (130 °C) or bicomponent (30-40 μm)</td>
<td>yes (3)</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>– yes</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 l.C.  
(8) For fuel tanks in ferrous or pre-coated sheets.  
(9) Only parts to mount on the engine.  
(10) Alternative products and cycles for the same phase under the condition of comparability with the part to treat.  
(11) Specific phosphates must be used for zinc coated or aluminium sheets.

Added or modified parts

All vehicle parts (body, chassis, equipment, etc.) that are add-ons or subjected to modifications must be protected against oxidation and corrosion.  
Areas free of protection on ferrous materials are not accepted.  
Tables 2.7 and 2.8 indicate the minimal treatment that modified or added components must receive when it is not possible to have protection that is similar to that of original components. Different treatment is allowed if it ensures similar oxidation and corrosion protection.  
Do not use powder varnish directly after degreasing has been performed.  
Lightweight alloy, copper and brass parts must be protected.

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

(1) Modifications on rear axles, from axles and engine (classes B1 and C) not allowed  
(2) Preferably epoxy  
(3) Preferably polyurethane

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

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

(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 modification is allowed without IVECO authorisation only when:

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

**Note** 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.**

- **Wheelbases which can be technically realised depend on the vehicle type (model/version). For wheelbases which are longer or shorter than the standard wheelbases, availability of the ESP system setting parameters must be verified.**
**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 46) and 5.5 (⇒ Page 34).
- Follow the instructions in Chapter 2.8 (⇒ Page 35) 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 of the original wheelbase frame, assuming an evenly distributed load and considering the frame as a beam positioned in place of the suspension supports.

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

**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 35) for checks of modifications allowed.

2.5 REAR OVERHANG MODIFICATION

General information
When modifying the rear overhang, the limits set by national standards must be respected. This is also the case for the maximum distances from the rear structural edge and distance from the ground, defined for the tow hook and under-run protection. The distance from the tip of the frame to the rear edge of the superstructure must, as a rule, not exceed 350 ÷ 400 mm.

If it is necessary to move the rear crossbar fixed using screws, it is necessary to maintain the same type of union as in the series (number of screws, dimensions, strength class).

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

If all works are performed in a professional manner and according to the instructions contained herein, the original towing capacity may remain the same.

In all cases, the parties performing the work shall be liable thereof.

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

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

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Chassis Shortening

The last crossbar must be moved forward when shortening the rear overhang of the frame.
When the rear crossbar is too close to another crossbar, this last 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 ÷ 350 mm is shown in Figure 7. In this case, the corner reinforcements, which also serve as junction between cross member and frame, must have the same width and thickness of the original gusset plate. The union between the cross member and plate, originally performed using nails, can be done with screws class 8.8 having the next largest scale diameter and anti-unscrewing nuts.
When the connection between the cross member and gusset plate is made by welding, the gusset plate can be connected to the reinforcement by welding (see Figure 7).
The solution for elongations exceeding 350 mm is shown in Figure 8.

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 crossbar, it is important to take into account the action of the horizontal forces generated by the masses of the tractor and trailer, based on the following formula:

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

- **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 couplings 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 counter chassis profile section.

With mechanical coupling devices suitable for trailers with a central axle, the following formulas are valid:

\[ D_c = g \times (T \times C) / (T + C) \]

- **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 the towing vehicle [kg]
- **R** = maximum weight of trailer at full load [kg]
- **S** = vertical static load on the hook [kg], namely the mass part which in static conditions, is transmitted to the coupling point on the vehicle. \( S \leq 0.1 \times R \leq 1000 \) [kg]
- **C** = sum of maximum axial loads of the centre axle trailer at full load [kg]. 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 10)
- **L** = theoretical drawbar length, distance between the centre of the drawbar eye and the centre line of the trailer axles [m], (see Figure 10)
\( X^2 / L^2 \geq 1 \) if the result is less than the unit, use the value 1

**Figure 10**

\[ X \text{, Length of the trailer load bed} \]
\[ L \text{, Theoretical drawbar length} \]

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 cross members 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 counter chassis 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 transversal 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 counter chassis having a larger size than those normally provided.

**Subframe for centre-axle trailers**

Table 2.9 is useful for sizing the subframe section destined only to tow a centre-axle trailer.

However, when-as in most cases, the vehicle is to be fitted with a standard superstructure (fixed body, crane), the table relating to this superstructure must be referred to (see Section 3) and choose the table which provides the higher values of the section modulus \( W_c \).

In Table 2.9 the symbol "A" indicates that the section required for the trailer only, is less than that required by the superstructure.

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

<table>
<thead>
<tr>
<th>Models</th>
<th>Wheelbase [mm]</th>
<th>Overhang chassis [mm]</th>
<th>Towable mass (R) and static load (S) on the hook of the centre axle trailer [kg]</th>
<th>Section modulus ( W_c ) [cm²] for longitudinal sections of the subframe with material with a yield limit of 360 [N/mm²] (Fe 510)</th>
</tr>
</thead>
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<td>3800</td>
<td>970</td>
<td>A</td>
<td>A</td>
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<td>Models</td>
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<td>Overhang chassis</td>
<td>Towable mass (R) and static load (S) on the hook of the centre axle trailer [kg]</td>
<td>Section modulus W, [cm²] for longitudinal sections of the subframe with material with a yield limit of 360 [N/mm²] (Fe 510)</td>
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<td>Rs9500 Ss 950</td>
<td>Rs12000 Ss 1000</td>
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<td>Models</td>
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<td>Overhang chassis [mm]</td>
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### STRALIS X-WAY – GUIDELINES FOR BODYBUILDERS

#### CHASSIS INTERVENTIONS

#### 2.6 INSTALLING THE TOW HOOK

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<th>Models</th>
<th>Wheel-base [mm]</th>
<th>Over-hang chassis [mm]</th>
<th>Towable mass (R) and static load (S) on the hook of the centre axle trailer [kg]</th>
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Section modulus Wₜ [cm³] for longitudinal sections of the subframe with material with a yield limit of 360 [N/mm²] (Fe S100)
### Table: Towable mass (R) and static load (S) on the hook of the centre axle trailer [kg]

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Section modulus W, [cm³] for longitudinal sections of the subframe with material with a yield limit of 360 [N/mm²] (Fe 510)
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Section modulus Wc [cm³] for longitudinal sections of the subframe with material with a yield limit of 360 [N/mm²] (Fe 510)

(1) not valid for versions /TN/PT, CT and GV
(2) Only with CCM I1954
(3) 5050 or 6040

**Note**  See Table 3.2 (profile dimensions).

**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 11 and 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.

![Diagram of rear crossbar](image)

1. Original rear cross member.
2. Additional strap
3. M14 threaded hole - 10.9 (111 kN)
4. Connecting corner

The outer corners should have a thickness of not less than that of the side members of the vehicle, they should extend in length for a distance of at least 2.5 times the height of the side member itself (max 600 mm) and should use a material with the minimum requirements set out in Chapter 3.3 - Paragraph "Choosing the type of connection" ( ➔ Page 12). The fastening to the vertical rib of the side members must be done with all the union screws of the crossbar to the chassis of the vehicle, integrating them with others whose number and positioning consider the greater time transmitted. In principle, in the lowerings equivalent to the height of the side member, an increase in the number of screws equal to about 40% is predicted.

In applying a supplementary crossbar (see Figure 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 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 (eg. 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 13;

![Figure 13](image-url)

1. Original rear cross member.
2. Reinfocing profile

3. Connecting plates or angles

- suitably sized box-shaped crossbar, fastened on the ends to the vertical rib of the side members and connected to the crossbar in the central part, as shown in Figure 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 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 of 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 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 Outfitter shall see to its manufacture and installation.
2.7 ASSEMBLING AN ADDITIONAL AXLE

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

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

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

General information

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

![Reinforcement Diagram]
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 31).

---

![Figure 16](image)

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).

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

Parabolic suspensions

Interventions are generally not allowed on this type of suspension.

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

In special cases and only after IVECO approval, the addition of supplemental sheets on the parabolic springs may be allowed; this must be carried out by a specialised spring manufacturer.
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 parking 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 to 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 2.1.5.*

**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.

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

Maximum allowed angularity

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

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

![Figure 19](image)

<table>
<thead>
<tr>
<th>LG</th>
<th>Length of sliding sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>LZ</td>
<td>Length of intermediate sections</td>
</tr>
<tr>
<td>LT</td>
<td>Total length</td>
</tr>
</tbody>
</table>

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:

\[ n_G = \frac{n_{max}}{r_G} \]

<table>
<thead>
<tr>
<th></th>
<th>maximum engine speed [rpm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n_G)</td>
<td>engine speed [rpm] at maximum output power, see Table 2-11</td>
</tr>
<tr>
<td>(r_G)</td>
<td>gear ratio at highest speed, see Table 2-12</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Engine Model</th>
<th>Engine code</th>
<th>Power [HP - kW]</th>
<th>(n_{max})</th>
</tr>
</thead>
<tbody>
<tr>
<td>CURSOR 9</td>
<td>F2CFE611D*</td>
<td>310 - 228</td>
<td>2200</td>
</tr>
<tr>
<td></td>
<td>F2CFE611C*</td>
<td>330 - 243</td>
<td>2200</td>
</tr>
<tr>
<td></td>
<td>F2CFE611B*</td>
<td>360 - 265</td>
<td>2200</td>
</tr>
<tr>
<td></td>
<td>F2CFE611A*</td>
<td>400 - 294</td>
<td>2200</td>
</tr>
<tr>
<td>CURSOR 11</td>
<td>F3GFE611F*</td>
<td>420 - 309</td>
<td>1900</td>
</tr>
</tbody>
</table>
## Table 2.11 - Gear ratio at highest speed

<table>
<thead>
<tr>
<th>Gearbox</th>
<th>i₀</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 S 1620 TD</td>
<td>1.00</td>
</tr>
<tr>
<td>16 S 2220 TD</td>
<td>1.00</td>
</tr>
<tr>
<td>16 S 2320 TD</td>
<td>1.00</td>
</tr>
<tr>
<td>16 S 1820 TO</td>
<td>1.00</td>
</tr>
<tr>
<td>16 S 2220 TO</td>
<td>0.84</td>
</tr>
<tr>
<td>16 S 2520 TO</td>
<td>0.84</td>
</tr>
<tr>
<td>12 TX 1410 TD</td>
<td>1.00</td>
</tr>
<tr>
<td>12 TX 1810 TD</td>
<td>1.00</td>
</tr>
<tr>
<td>12 TX 2010 TD</td>
<td>1.00</td>
</tr>
<tr>
<td>12 TX 2210 TD</td>
<td>1.00</td>
</tr>
<tr>
<td>12 TX 2420 TD</td>
<td>1.00</td>
</tr>
<tr>
<td>12 TX 2620 TD</td>
<td>1.00</td>
</tr>
<tr>
<td>12 TX 1810 TO</td>
<td>0.77</td>
</tr>
<tr>
<td>12 TX 2010 TO</td>
<td>0.77</td>
</tr>
<tr>
<td>12 TX 2210 TO</td>
<td>0.77</td>
</tr>
<tr>
<td>12 TX 2410 TO</td>
<td>0.77</td>
</tr>
<tr>
<td>12 TX 2610 TO</td>
<td>0.77</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></td>
<td></td>
<td>1800</td>
<td>1900</td>
</tr>
<tr>
<td>2040</td>
<td>100 x 4.5</td>
<td>3400</td>
<td>3150</td>
</tr>
<tr>
<td>2040</td>
<td>120 x 3</td>
<td>4450</td>
<td>4100</td>
</tr>
<tr>
<td>2045</td>
<td>120 x 4</td>
<td>4450</td>
<td>4050</td>
</tr>
<tr>
<td>2055</td>
<td>120 x 6</td>
<td>4400</td>
<td>4000</td>
</tr>
<tr>
<td>2060</td>
<td>130 x 6</td>
<td>4650</td>
<td>4250</td>
</tr>
<tr>
<td>2065</td>
<td>142 x 6</td>
<td>5000</td>
<td>4600</td>
</tr>
</tbody>
</table>

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

Positioning the sections

The transmissions that comprise several sections, each axle must be of approximately the same length. In general, between an intermediate shaft and sliding shaft (see Figure 20) there must not be a difference in width greater than 600 mm, while between two intermediate shafts this difference must not be greater than 400 mm. As regards sliding shafts, there must be a minimum margin of 25 mm between minimum operating length and maximum sealing length; on opening, a covering must be guaranteed between the shaft and the sleeve of approx. twice the diameter of the spline shaft.

1. Drive shaft, clutch, gearbox  
2. Intermediate shaft  
3. Intermediate shaft bearing  
4. Sliding shaft  
5. Rear axle casing tilt (static load)  
6. Rear axle casing tilt (max compression)  
7. Rear axle casing tilt (no load)  
8. Intermediate shaft, sliding articulated shaft and rear axle casing axis must have the same tilt.

The intermediate shaft and the axle casing axle must be aligned.  
Their tilt may vary up to 1° in regards to that of the engine-clutch-gearbox axle; which may be obtained by placing a wedge between the axle casing and the spring, or by means of adjusting the rear axle reaction bars.  
The inclination of the rear axle casing must be no more than 5.5° from the horizontal plane.
When in vehicle loading conditions, the flange of the rear axle is lower than that of the gearbox housing flange, it is necessary to make the inclination of the 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 21. In this case, make sure that the engine-gearbox axle, the second intermediate shaft and the rear axle casing axis when in static load are all aligned with the same tilt.

The application of flexible supports must be done using support plates with a thickness of at least 5 mm (see Figure 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 2.13 - Maximum permitted counterpressure at normal operating conditions and at full load

<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*</td>
<td>20</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>F2CFE611C*</td>
<td>20</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>F2CFE611B*</td>
<td>20</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>F2CFE611A*</td>
<td>20</td>
<td>6.3</td>
</tr>
<tr>
<td>CURSOR 11</td>
<td>F3GFE611F*</td>
<td>37</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>F3GFE611E*</td>
<td>37</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>F3GFE611D*</td>
<td>37</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>F3GFE611G*</td>
<td>30</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 °C, with short durations of 120 °C, without undergoing visible deformations or deteriorations. The compartment must keep airflow sections efficient for the entire circuit.

The holes that must be made in the box part of the van must have an area of about twice that of the cross-section of the pipe upstream of the filter; these openings (e.g. grille holes) must have minimal dimensions to prevent possible clogging.

The following are not allowed:

- alterations or replacement of the original air filter with one of lower capacity;
- modifications to the silencer body;
- interventions on equipment (injection pump, control valve, injectors, etc.) that may compromise good engine performance and affect exhaust gas emissions.

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

### Exhaust

Given the complexity of the "Hi-e SCR" exhaust system (see Section 6 (Page 5)) and the optimisation achieved by the layout of its components, no modifications of any kind are permitted on the engine exhaust pipes.

### 2.10 WORK ON THE ENGINE COOLING SYSTEM

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

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

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

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

2.11 Installing an additional heating system

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

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

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

In addition, be sure to:
• care for the proper operation of all other vehicle systems (e.g.: engine cooling system);
• check that the battery capacity and alternator power are sufficient for increased current draw (see Chapter 5.5 ( Page 34)) 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 41)), 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 42) and "Additional alternators" (👀 Page 43)) 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, including 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 (l.S. 18-1317 class ZINT/F/10/25 or l.S. 18-1318 class ZINT/10/25); both surfaces must undergo protective treatment.

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

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

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

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 54));

- requires the need to check compliance of the limit transversal 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 body-computer (speedometer, tachograph and speed limiter) must be subject to 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>
<thead>
<tr>
<th>Table 2.14 - Wheel tightening torque according to IVECO STD 17-9219</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CONNECTING ELEMENTS</strong></td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>CODI</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</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 the cantilever, the brake lines involved should preferably be replaced with new pipes and in one piece; if this is not possible, the couplings to be used must be of the same type as the original ones.

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

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

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

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

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

Plastic pipes

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

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

Operations must provide:

- materials and dimensions: Standard DIN 74324 (IVECO STD 18-0400) Maximum operating pressure 12.5 bar
- radii of curvature (referring to the centre line of the pipe):
  - Φ 6 to 35 mm
  - Φ 8 to 55 mm
  - Φ 12 to 85 mm
  - Φ 16 to 85 mm
Preparation and assembly (IVECO STD 17-2403)
Cut the pipe at right angles (15° maximum error), using a special tool in order to avoid imperfections that affect the sealing. Permanently mark the section of pipe (dimension L in Figure 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.

![Diagram](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.
**ABS electronic brake control devices**

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

**Withdrawing compressed air from the auxiliary pneumatic circuit**

In vehicles with a pneumatic braking system, it is possible to withdraw a small amount of air from the auxiliary pneumatic circuit. To protect the auxiliary users (vehicle side), the connection is only possible with an additional overpressure valve (IVECO 8169974 EZ) without reflux and with an opening pressure of 6.7 - 7.0 bar.

Withdraw the air directly from the 4-way safety valve (outlet 24) of the braking system or from the distribution plate, if it is not otherwise occupied (see Figure 25).

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.

**Maximum allowed air consumption**

The maximum allowed air consumption must be verified in extreme driving conditions, for example in stop-and-go traffic and / or with auxiliary pneumatic devices engaged. All devices which use air must be taken into account such as the braking system, air suspensions, trailer, gearbox, auxiliary devices, etc.

The maximum average operation of the compressor in one hour (duty-cycle) must not exceed 40%.
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 34) and 5.9 (⇒ Page 45).

2.17 PART RELOCATION AND ANCHORAGE OF ADDITIONAL UNITS AND EQUIPMENT

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

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

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

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

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

Spare wheel holder

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

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

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 perfect sealing, have technical features and internal dimensions not less than those provided for in the original system and be properly clamped.

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

### Moving the fuel tank

1. **Vertical** movements are permitted as long as the absolute minimum pressure at the inlet of the LP/HP pump is 500 mbar.

2. With the exception of vehicles already fitted with the specific opt. 76755 "Retraction of mobile case assemblies", **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

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

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

- Adopt optional fuel tanks for the left side;
- Reposition the urea tank on the basis of the possibilities stated in Chapter 6.4 ( Page 6), page. 7 and following.

On Stralis Hi-Street / Hi-Road 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 06 - attachment "B" of the Agreement ADR 2017 - Part 9 (Requirements relating to the construction and approval of vehicles) with regards to the paragraphs:

- 9.2.2.1 (Cables)
- 9.2.2.2 (Additional protection)
- 9.2.2.4 (batteries)
- 9.2.2.5 (Lighting)
- 9.2.2.6 (Electrical connection)
- 9.2.4.3 (Fuel tanks)
- 9.2.4.4 (Engine)
- 9.2.4.5 (Exhaust gas device)
- 9.2.5 (Speed limiting device)
- 9.2.6 (Devices for hooking vehicles with engines and trailers)

Note: 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 MUD GUARDS AND WHEEL ARCHES

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

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

- the free shaking of the wheels must be ensured even in the conditions of use with chains; any indications on limit values can be requested via the Support Service;
- the width of the fender must be greater than the maximum dimensions occupied by the tyres, within the limits set by the regulations;
- the support structure of the fender must have adequate strength and be able to limit the vibrations;
- the connection can be made to the vertical rip of the side members of the vehicle or to the longitudinal sections of the subframe. In the first case the connection must be made exclusively by screws or directly below the superstructure (see Figure 30). The first and the second point are also to be considered in the implementation of wheel arches.

![Figure 30](image-url)
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. tippers, interchangeable equipment, hook lifts) the connection can be made by means of suitable supports on the counter chassis 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

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APPLICATIONS OF SUPERSTRUCTURES

3.1 CONSTRUCTION OF THE SUBFRAME

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

Material

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

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

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

<table>
<thead>
<tr>
<th>Table 3.1 - Material to be used for the construction of superstructures Std IVECO 15-2110 and 15-2812</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of steel</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>IVECO</td>
</tr>
<tr>
<td>EUROPE</td>
</tr>
<tr>
<td>GERMANY</td>
</tr>
<tr>
<td>UK</td>
</tr>
<tr>
<td>IVECO</td>
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<tr>
<td>EUROPE</td>
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<td>GERMANY</td>
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<td>UK</td>
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<tr>
<td>IVECO</td>
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<td>EUROPE</td>
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<td>GERMANY</td>
</tr>
<tr>
<td>UK</td>
</tr>
</tbody>
</table>

Sizing of profiles

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

The indicated value Wc, 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 Wc, and inertia time J, of the new C section are not of a lesser value.

<table>
<thead>
<tr>
<th>Table 3.2 - Profile dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section modulus Wc, [cm²]</td>
</tr>
<tr>
<td>--------------------------------</td>
</tr>
<tr>
<td>16 ≤ W ≤ 19</td>
</tr>
<tr>
<td>20 ≤ W ≤ 23</td>
</tr>
<tr>
<td>24 ≤ W ≤ 26</td>
</tr>
<tr>
<td>27 ≤ W ≤ 30</td>
</tr>
<tr>
<td>31 ≤ W ≤ 33</td>
</tr>
</tbody>
</table>
While the form of resistance represents a decisive value for the stress of the material, the moment of inertia is important mainly for the flexural hardness and for the quota of the bending moment to be taken, depending on the connection used.

**Aluminium subframe**

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

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

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

Please note that in defining the minimum size of the reinforcement profiles in addition to the limit of the allowable stress for aluminium, reference must be made to the different Elastic Modulus with respect to steel (approx. 7,000 kg/mm² against 21,000 kg/mm² for steel) which involves greater dimensioning of the profiles.

<table>
<thead>
<tr>
<th>Section modulus $W_x$ [cm$^3$]</th>
<th>Recommended C profile [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$34 \leq W \leq 36$</td>
<td>$100 \times 60 \times 6$</td>
</tr>
<tr>
<td>$37 \leq W \leq 41$</td>
<td>$100 \times 60 \times 7$</td>
</tr>
<tr>
<td>$42 \leq W \leq 45$</td>
<td>$80 \times 80 \times 8$</td>
</tr>
<tr>
<td>$46 \leq W \leq 52$</td>
<td>$120 \times 60 \times 6$</td>
</tr>
<tr>
<td>$53 \leq W \leq 58$</td>
<td>$120 \times 60 \times 7$</td>
</tr>
<tr>
<td>$59 \leq W \leq 65$</td>
<td>$140 \times 60 \times 7$</td>
</tr>
<tr>
<td>$66 \leq W \leq 72$</td>
<td>$140 \times 60 \times 8$</td>
</tr>
<tr>
<td>$73 \leq W \leq 79$</td>
<td>$160 \times 60 \times 7$</td>
</tr>
<tr>
<td>$80 \leq W \leq 88$</td>
<td>$180 \times 60 \times 8$</td>
</tr>
<tr>
<td>$89 \leq W \leq 93$</td>
<td>$160 \times 70 \times 7$</td>
</tr>
<tr>
<td>$94 \leq W \leq 104$</td>
<td>$180 \times 60 \times 8$</td>
</tr>
<tr>
<td>$105 \leq W \leq 122$</td>
<td>$200 \times 80 \times 6$</td>
</tr>
<tr>
<td>$123 \leq W \leq 126$</td>
<td>$220 \times 60 \times 7$</td>
</tr>
<tr>
<td>$127 \leq W \leq 141$</td>
<td>$220 \times 60 \times 8$</td>
</tr>
<tr>
<td>$142 \leq W \leq 160$</td>
<td>$200 \times 80 \times 8$</td>
</tr>
<tr>
<td>$161 \leq W \leq 178$</td>
<td>$220 \times 80 \times 8$</td>
</tr>
<tr>
<td>$179 \leq W \leq 201$</td>
<td>$250 \times 80 \times 7$</td>
</tr>
<tr>
<td>$202 \leq W \leq 220$</td>
<td>$250 \times 80 \times 8$</td>
</tr>
<tr>
<td>$221 \leq W \leq 224$</td>
<td>$220 \times 80 \times 8$</td>
</tr>
<tr>
<td>$225 \leq W \leq 245$</td>
<td>$250 \times 100 \times 8$</td>
</tr>
<tr>
<td>$246 \leq W \leq 286$</td>
<td>$280 \times 100 \times 8$</td>
</tr>
<tr>
<td>$290 \leq W \leq 316$</td>
<td>$300 \times 80 \times 8$</td>
</tr>
<tr>
<td>$316 \leq W \leq 380$</td>
<td>$340 \times 100 \times 8$</td>
</tr>
<tr>
<td>$440$</td>
<td>$380 \times 100 \times 8$</td>
</tr>
<tr>
<td>$480$</td>
<td>$400 \times 100 \times 8$</td>
</tr>
</tbody>
</table>
Similarly, when the connection between the chassis and subframe is such as to ensure the transmission of the shear stresses (connection with plates), in checking the stresses at the two ends of the individual section, it is necessary to define the new neutral axis for this, on the basis of the different elastic modulus of two materials.

The collaboration requirement for aluminium means, in short, large and not very convenient dimensions.

### 3.2 ELEMENTS MAKING UP THE COUNTER CHASSIS

#### 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.

![Figure 1](image1)

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.

![Figure 2](image2)

The possibility of building a counter chassis 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 counter chassis 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).

![Diagram of C-shaped profiles](image)

**Figure 3**

A. L profile  
B. Alternative solution:  
C. C Profile

The shape of the profile section is defined taking into account the function of the counter chassis and the type of overlying structure. Open C profiles are advisable when the counter chassis needs to adapt elastically to the vehicle chassis and boxed sections when you require greater stiffness 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.
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 counter chassis 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 undercrawal element we recommend characteristics and thicknesses similar to those used for normal production (hardness 80 Shore, max thickness 3 mm). Its use can prevent abrasive actions that can cause corrosion in the joining between materials of different composition (e.g. aluminium and steel).

The dimensions prescribed for the side members of the various types of superstructures are the recommended minimum values and, as a rule, are valid for vehicles with wheelbases and rear overhangs provided as standard (see Tables 3.4, 3.5 and 3.7 to 3.11). 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.

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 7

1. Subframe
2. Diagonals

Figure 8

1. Subframe
2. Box profile
Self-supporting superstructures with subframe functions

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

3.3 CONNECTION BETWEEN CHASSIS AND COUNTER CHASSIS

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 counter chassis in terms of strength and stiffness.

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 3.9), 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 counter chassis, must be such as to ensure a good connection between the chassis and the counter chassis.

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 ca 250–350 mm from the front end of the counter chassis.

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 its wings.

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

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 $M$, must be subdivided proportionately between chassis and subframe at the moments of inertia of the sections:

\[
M_f = M + M_t
\]
\[
\frac{M_c}{M_t} = \frac{I_c}{I_t}
\]
\[
M_c = M_f \cdot \frac{I_c}{I_t + I_c}
\]
\[
M_t = M_f \cdot \frac{I_t}{I_t + I_c}
\]

\[
\sigma_c = \frac{M_c}{W_c} \leq \sigma_{\text{inm}}
\]
\[
\sigma_t = \frac{M_t}{W_t} \leq \sigma_{\text{inm}}
\]

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

$M_c$ = part of the static bending moment $M$, applied to the subframe [Nmm]

$M_t$ = part of the static bending moment $M$, applied to the chassis [Nmm]

$I_c$ = 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$^3$]

$\sigma_{\text{inm}}$ = maximum static stress allowed on chassis [N/mm$^2$] see chapter 2.1, Paragraph "Stresses on the chassis"

Connection with brackets

Some examples of achievements of this type of connection, are shown in Figure 10.
For the elasticity of the connection it is necessary that, before the closure of the clamping screws the distance between the brackets of the chassis and the counter chassis is \( 1 \div 2 \) mm; greater distances should be reduced by means of suitable spacers. At the closure of the screws, brackets must be brought into contact.

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

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

In order to better contain the loads in the transverse direction, the brackets are normally applied so that there is a slight protrusion perpendicular to the upper edge of the chassis. If instead the brackets must be applied exactly to the wire, the side guide for the superstructure must be assured with other devices (e.g. using guide plates connected only to the subframe, or only to the vehicle chassis, see Figure 13). When the front connection is elastic (see Figure 11), the lateral containment must be assured even in conditions of maximum torsion of the chassis (e.g. off-road applications).

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

When the connection needs greater flexibility (e.g. vehicles with high stiffness of the superstructure such as vans, tanks, etc., used on winding roads or in poor conditions, vehicles for special use, etc.), hardware of the type indicated in Figure 11 should be adopted in the area behind the driver’s cab. Brackets accompanied by rubber plugs (1) or coil springs (2) should be used.

1. Rubber block
2. Coil spring

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

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

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

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

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

Connections with clevis fasteners or clamps

Figure 12 shows the main constructions of this type.

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

In order to drive and better contain the transverse direction of the structure added to the chassis, this type of fixing can be completed with the addition of plates welded to the subframe as shown in Figure 13.

The characteristics of this connection advise against a general integral use on the vehicle; in any case, to give the added structure the suitable containment in the longitudinal direction as well as adequate stiffness, it is necessary to integrate the fastening to the rear part with longitudinal and transverse sealing plates.
For this purpose, it is also possible to use connections by means of screws at the rear end of the chassis as shown in Figure 14.

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

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

The type of mounting shown in Figure 13, made with plates that are welded or bolted to the subframe and fixed with nails or screws to the vehicle chassis, ensures a good capacity for reacting to longitudinal and transverse thrusts and the greatest contribution to the stiffness of the assembly.
For the correct use of these plates, please keep in mind that:

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

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

<table>
<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>
<th>Dimensions of the screws (2) (min. 3 screws per plate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 1.0</td>
<td>500</td>
<td>Thickness [mm] 8</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 counter chassis, it is advisable to connect by adopting spacer bushes, in order to use longer screws.

**Mixed connection**

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

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

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

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

Fixed bodies
The application on normal cab vehicles, valid only for road services, is normally made through a support structure consisting of longitudinal profiles and cross members. The minimum approximate dimensions of the longitudinal profiles are provided in the following table.

<table>
<thead>
<tr>
<th>Models</th>
<th>Wheelbase [mm]</th>
<th>Section modulus $W_z$ [cm$^2$] of the minimum reinforcement section (Yield point of the material used = 360 N/mm$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>190</td>
<td>all</td>
<td>89</td>
</tr>
<tr>
<td>260 Z, Z/P (6x4)</td>
<td>max. 4500</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>max. 5100</td>
<td>T.B.V.</td>
</tr>
<tr>
<td>260 (6x2P)</td>
<td>all</td>
<td>89</td>
</tr>
<tr>
<td>340 (8x4x4)(2+2)</td>
<td>4250</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>4750 - 5020</td>
<td>T.B.V.</td>
</tr>
<tr>
<td></td>
<td>5820</td>
<td>T.B.V.</td>
</tr>
<tr>
<td>340 (8x2x6)(2+2)</td>
<td>5100</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>6050</td>
<td>89</td>
</tr>
</tbody>
</table>

**Note** The indications described above are suitable for front axle loads of $\leq 8000$ kg

**Note** For the dimensions of the profiles see Table 3.2.
Fastening is achieved through specially crafted brackets along the vertical rib of the side members; if such connections have not already been specified by IVECO, they must be made according to the instructions in Paragraph "Connection with brackets" (Page 13). To achieve adequate longitudinal containment, in the case of connections with brackets or clamps it is good practice to provide a rigid connection on the end of the rear overhang (one per side), obtained with screws or plates on the upper flange of the side member (see Figures 13 and 14).

In no other case should new holes be made on the wings of the main side members.

In cases in which the body uses elevated supports above the subframe (e.g. crossbars), it is necessary to suitably stiffen such supports, to contain the longitudinal thrusts, as shown in Figure 15.

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

![Diagram of container application](image)

**Figure 15**

1. Counter chassis
2. Brackets
3. Containment elements

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

**Tipper 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 counter chassis must be:
   - suitable for the type of vehicle and conditions of use,
   - with appropriately sized cross members and side members,
   - with the rear end stiffened with boxing and crossbraces (see Figure 6 and Figure 7). The connections to the chassis must be elastic (brackets or supports) at the front end, whereas the rear section requires stiff connections (cleat plates) (see Figure 13) to allow the additional structure to contribute more effectively towards the rigidity of the assembly. Omega shelves can be used on vehicles on where these are originally fitted.
3. The rear tipping hinge must be fitted on the subframe; its position must be as near as possible to the rear support of the rear suspension. In order not to 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 pneumatic 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 stiffness of the rear end. Where long bodies are needed to transport large volumes, it is advisable to lengthen the wheelbase of the vehicle.
4. Great care must be given to the positioning of the lifting device both in terms of providing support of adequate strength and in order to correctly position the mountings. In any case, it is advisable to place the ram to the front of the centre of gravity of the body and payload so as to reduce the extent of the localized load.
5. In rear tipping it is recommended that a stabiliser is fitted to guide the container, particularly when the lifting cylinder is located behind the cab.
6. The lifting device hinge must be mounted on the counter chassis. The useful volume in the body must conform with the maximum permissible load on the axles, to the density of the material to be transported (a density mass of approximately 1600 kg/m³ is to be used for excavated material). In the case of transporting freight with a low density, the useful volume may be increased within the limits established for the maximum height of the centre of gravity of the payload (plus the fixtures).
7. The Bodybuilder must ensure the functioning and safety of all parts of the vehicle (e.g., the positioning of lights, towing hook etc.) and ensure that, following the addition of the structure, vehicle stability is guaranteed during tipping operations.

**Note**: To ensure stability on vehicles equipped with air suspensions, the air springs need to be fully discharged. See also Specification 01 in Chapter 5.2 (Page 9).
3.4 CONTAINER APPLICATION

1. Counter chassis
2. Brackets
3. Plates
4. Joint cover

Figure 18
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 "Light service").

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

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".

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

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

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 position

The position of the fifth wheel depends only on the load/maximum permitted mass on each axle for any axle configuration. 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 ensure safe coupling of the semi-trailer, in accordance with current Regulations, particularly if the fifth wheel has been repositioned.

The position of the fifth wheel can be measured:

- from the centre of the rear axle for tractors 4x2 (Figure 20) and 6x2C (Figure 21);
- from the centre rear axles for tractors 6x2P (Figure 22);
- from the centre of the tandem axle for tractors 6x4 (Figure 23).

To calculate the furthest forward/furthest retracted position of the fifth wheel and the maximum theoretical mass at full load without exceeding the maximum permitted theoretical mass on the axles, the criteria indicated below can be used.

4x2 Vehicles

\[ R_{\text{max}} = L \cdot \frac{W_2}{L} \]

\[ R_{\text{min}} = L - (L \cdot \frac{W_2}{L}) \]

\[ W = \text{Load on fifth wheel} \]
\[ W_1 = \text{Load on front axle} \]
\[ W_2 = \text{Load on rear axle} \]

\[ L = \text{Wheelbase} \]
\[ R = \text{Fifth wheel advancement} \]
Vehicles 6x2C

(* ) Formulas: If necessary, contact IVECO Technical Application

- \( W \) = Load on fifth wheel
- \( W_1 \) = Load on front axle
- \( W_2 \) = Load on first rear axle
- \( W_3 \) = Load on second rear axle
- \( L \) = Wheelbase
- \( L_v \) = Virtual wheelbase
- \( L_p \) = Rear axle centreline
- \( R_v \) = Fifth wheel advance in relation to the virtual wheelbase
- \( R \) = Fifth wheel advancement from rear axle

6x2P Vehicles

(* ) Formulas: If necessary, contact IVECO Technical Application

- \( W \) = Load on fifth wheel
- \( W_1 \) = Load on front axle
- \( W_2 \) = Load on first rear axle
- \( W_3 \) = Load on second rear axle
- \( L \) = Wheelbase
- \( L_v \) = Virtual wheelbase
- \( L_p \) = Rear axle centreline
- \( R_v \) = Fifth wheel advance in relation to the virtual wheelbase
- \( R \) = Fifth wheel advancement from rear axle centreline
**6x4 vehicles**

\[
R_{\text{max}} = L v \cdot W_1 / W
\]

\[
R_{\text{min}} = L v \cdot (L v \cdot W_2 / W)
\]

- \(W\) = Load on fifth wheel
- \(W_1\) = Load on front axle
- \(W_2\) = Load on rear tandem
- \(L\) = Wheelbase
- \(L v\) = Virtual wheelbase (from front axle to tandem centre line)
- \(L t\) = Tandem length
- \(R\) = Fifth wheel advancement from tandem centre line

---

**Example 1 - Furthest forward/furthest retracted position of the fifth wheel on a tractor 4x2**

<table>
<thead>
<tr>
<th>Maximum fully laden weight (in Europe)</th>
<th>18,000 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum permitted mass on front axle 1</td>
<td>7,500 kg</td>
</tr>
<tr>
<td>Maximum permitted mass on rear axle 2</td>
<td>11,500 kg</td>
</tr>
<tr>
<td>Vehicle mass in running order</td>
<td>7,700 kg</td>
</tr>
<tr>
<td>Vehicle mass in running order weighing on the front axle 1</td>
<td>5,500 kg</td>
</tr>
<tr>
<td>Vehicle mass in running order weighing on rear axle 2</td>
<td>2,200 kg</td>
</tr>
<tr>
<td>Wheelbase (L)</td>
<td>3,790 mm</td>
</tr>
</tbody>
</table>

Check that the permitted limits do not exceed the theoretical limits.

<table>
<thead>
<tr>
<th>Maximum load on fifth wheel</th>
<th>(W) = 18,000 - 7,700</th>
<th>= 10,300 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum load on axle 1 ((W_1))</td>
<td>7,500 (^\circ) - 5,500</td>
<td>= 2,000 kg</td>
</tr>
<tr>
<td>Maximum load on axle 2 ((W_2))</td>
<td>11,500 (^\circ) - 2,200</td>
<td>= 9,300 kg</td>
</tr>
<tr>
<td>The furthest retracted position <em>(L_{\text{line}})</em> (= L - L \cdot W_2 / W)</td>
<td>3,790 - 3,790 \times 9,300 / 10,300</td>
<td>= 368 mm</td>
</tr>
<tr>
<td>Furthest forward position <em>(L_{\text{line}})</em> (= L \cdot W_1 / W)</td>
<td>3,790 \times 2,000 / 10,300</td>
<td>= 736 mm</td>
</tr>
</tbody>
</table>
(*) minimum between the permitted and theoretical limit

**Example 2 - Maximum load on the fifth wheel of a tractor 4x2 and corresponding GVW for a given point (for example 700 mm)**

With the same previous start data:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Formula</th>
<th>Calculation</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum load on fifth wheel so as not to exceed the limit on front axle 1</td>
<td>(H) = L / W • W₁</td>
<td>= 3,790 / 700 × 2,000</td>
<td>= 10,829 kg</td>
</tr>
<tr>
<td>Maximum load on fifth wheel so as not to exceed the limit on rear axle 2</td>
<td>(K) = L / (L - W) • W₂</td>
<td>= 3,790 / (3,790 - 700) × 9,300</td>
<td>= 11,407 kg</td>
</tr>
<tr>
<td>Maximum load on the fifth wheel so as not to exceed the limit on axles 1 and 2</td>
<td>(Y) = Min. value between (H) and (K)</td>
<td></td>
<td>= 10,829 kg</td>
</tr>
<tr>
<td>Maximum load on fifth wheel</td>
<td>= Y + Vehicle running mass</td>
<td>= 10,829 + 7,700</td>
<td>= 18,529 kg</td>
</tr>
</tbody>
</table>

**Tractor and semi-trailer combination**

The semi-trailers construction characteristics must be suitable to avoid negative effects on the articulated truck handling (e.g.: an over flexible 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 24) is requested.
Consult the Standard ISO 1726 for details.

![Diagram of a truck with annotations E, E1, F, F1 indicating the tractor and semi-trailer front and rear clearances.](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;
- securing the structure to the tractor must be carried out on the connecting corners, where present, or as specified otherwise.

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.

Application of simple plate structure
As a general rule, for tractors destined for use on normal roads and unless otherwise envisaged by IVECO, the structure for fitting the fifth wheel may be of the “ribbed plate” type, to be connected to the chassis via longitudinal sections and designated brackets or by direct assembly.

The plate is supplied with the vehicle and installed temporarily for transport; the final assembly must be carried out before assembly of the fifth wheel.

The plate represents a safety device subject to specific type-approval; therefore, it must not be modified and must be installed strictly following the indications provided by the manufacturer.

<table>
<thead>
<tr>
<th>Fifth wheel support</th>
<th>4x2 Tractors</th>
<th>6x4 Tractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fifth wheel H = 150 mm + plate 50 mm</td>
<td>☒</td>
<td>–</td>
</tr>
<tr>
<td>Fifth wheel H = 150 mm + plate 100 mm</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>Fifth wheel H = 185 mm + plate 50 mm</td>
<td>☒</td>
<td>–</td>
</tr>
<tr>
<td>Fifth wheel H = 185 mm + plate 100 mm</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>Fifth wheel without plate H = 190 mm</td>
<td>☒</td>
<td>–</td>
</tr>
<tr>
<td>Fifth wheel without plate H = 225 mm</td>
<td>☒</td>
<td>–</td>
</tr>
</tbody>
</table>

O = Optional
Application of a collaborating structure to the vehicle chassis

The application of a suitable structure of subframe type (see Figure 25) 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 consequent to high fifth wheel advancements and for particularly demanding use in some markets.

The typical application is that of Hi-Way 440TZ 6x4 vehicles with tandem axle.

The longitudinal reinforcement sections must be connected by a suitable number of cross members arranged in correspondence with the fifth wheel supporting area and by other two cross members 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 cross members). Use fastening elements already provided by IVECO (plates and/or shelves) 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 25).

---

S1. Solution 1
S2. Solution 2
1. Fifth wheel axis
2. Tandem axle centre line
3. Fifth wheel advancement
4. Corner reinforcements - Screws Φ 14 mm
5. Front shelves - Screws Φ 16 mm
6. Plates - Screws Φ 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 also has variable height fifth wheels, to make the connection between lowered tractors (Low tractor) and the various types of semi-trailer possible.

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 outfitting 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 counter chassis 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 3.7.

Table 3.7 - Installation of tanks

<table>
<thead>
<tr>
<th>Model</th>
<th>Modulus of resistance $W_t$ [cm$^3$] (Ultimate tensile strength of the material equal to 360 N/mm$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>190</td>
<td>89</td>
</tr>
<tr>
<td>260</td>
<td>89 (1)</td>
</tr>
<tr>
<td>340</td>
<td>59 (1) (2)</td>
</tr>
</tbody>
</table>

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

(2) Maximum load on front axle 8,000 kg.

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 frame, 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 26) 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; flexible connections are to be arranged near the front suspension rear mount.

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

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

For road vehicles, it should be considered that the first front flexible connection must provide a detachment of approximately 10 mm between the counter chassis and the chassis during the torsional phase of the chassis.

b) Installation without a subframe

The application 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 (see Figure 27) and with bracing to contain longitudinal and transverse forces;
- anchoring must be of approximately 600 mm in length and be arranged near the suspension coupling points (maximum distance 400 mm).

The front anchoring must provide flexibility so as to permit the necessary torsional movements of the vehicle chassis;

- other anchoring solutions must be authorised by IVECO.

Self-supporting tanks can be arranged directly onto the vehicle chassis with adequate supports, positioned directly behind the cab and in the area of the rear axle(s). The amount and direction of these supports depend on the number of axles and the wheelbase, notwithstanding that a minimum of two supports is recommended on each side of vehicles with 2 axles and a short wheelbase and a minimum of three on 3 or 4-axle vehicles and a short wheelbase.
A suitable counter chassis which ensures good distribution of load and suitable torsional stiffness for the frame-counter chassis assembly must be ensured by means of shearing resistant connections when two or more separate containers are applied on the vehicle. A good solution consists in a stiff connection which joins the containers.

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

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

In tanks and containers for liquids, transversal and longitudinal partitions are to be used in. 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 (e.g. CUNA, DIN) and international standards (e.g. ISO, CEN) and verifying those required for the vehicle.
In order to ensure stability while the crane is operating, stabilizers must be used and must be in contact with the ground. On vehicles with air suspensions, the air springs must be discharged (see 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 the general specifications (see Chapter 3.1 (Page 5)), and with the dimensions of the sections given in Tables 3.8, 3.9 and 3.10.

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

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

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

---

**Figure 28**

\[
M_0 [\text{kNm}] = \frac{g(W_c \times L + W_L \times I)}{1000}
\]

- $g = \text{acceleration of gravity equals } 9.81 \text{ m/s}^2$
- $W_c = \text{mass applied to crane extremity} [\text{kg}]$
- $L = \text{horizontal distance between the payload application point } W_c \text{ and vehicle centre line} [\text{m}]$
- $W_L = \text{mass of the crane at its centre of gravity} [\text{kg}]$
- $I = \text{horizontal distance between centre of gravity of crane and vehicle centre line} [\text{m}]$

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

The fastening of the reinforcement sections to the chassis must be carried out using the standard brackets (see Figure 29), supplementing them, if necessary, with other fasteners of elastic type (brackets or clamps) in order to keep the flexural and torsional characteristics of the chassis as unchanged as possible.

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

On vehicles for road use only, shearing resistant connections may be used for fastening the subframe to reduce the subframe section height (see Figure 30). The minimum reinforcement section dimensions for all these applications are given in Table 3.9.

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

The section of the crane subframe (Figure 29) can be integrated towards the rear end with that envisaged for another possible superstructure; the length "L<sub>v</sub>" must in no case be less than 35% of the wheelbase if the superstructure section diameter is smaller.

Figure 29

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

<table>
<thead>
<tr>
<th>Models Frame section [mm]</th>
<th>Wheelbase [mm]</th>
<th>Ultimate tensile strength of counter chassis material [N/mm²]</th>
<th>Total torque $M_c$ max [kNm]</th>
<th>Minimum value of the modulus of resistance of the counter chassis section $W_x$ [cm³] (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>190 289×80×7.7</td>
<td>5700</td>
<td>360</td>
<td>A 190 200 210 220 230 240 250 260 270 280 290 300</td>
<td></td>
</tr>
<tr>
<td></td>
<td>420</td>
<td></td>
<td>A 190 200 210 220 230 240 250 260 270 280 290 300</td>
<td></td>
</tr>
<tr>
<td>260 289×80×7.7</td>
<td>4800</td>
<td>360</td>
<td>A 190 200 210 220 230 240 250 260 270 280 290 300</td>
<td></td>
</tr>
<tr>
<td></td>
<td>420</td>
<td></td>
<td>A 190 200 210 220 230 240 250 260 270 280 290 300</td>
<td></td>
</tr>
<tr>
<td>340 289×80×7.7</td>
<td>5820</td>
<td>360</td>
<td>A 190 200 210 220 230 240 250 260 270 280 290 300</td>
<td></td>
</tr>
<tr>
<td></td>
<td>420</td>
<td></td>
<td>A 190 200 210 220 230 240 250 260 270 280 290 300</td>
<td></td>
</tr>
</tbody>
</table>

A = The reinforcement section specified for the relevant superstructure on the chassis is sufficient (eg. Table 3.4 for normal bodies). Close the reinforcement section in the frame 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 (for example, body applications), use the latter also 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 lifting device supports and the tipper rear hinges which must be as limited as possible.

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

<table>
<thead>
<tr>
<th>Models Frame section [mm]</th>
<th>Wheelbase [mm]</th>
<th>Ultimate tensile strength of counter chassis material [N/mm²]</th>
<th>Total torque M₀ max [kNm]</th>
<th>Minimum value of the modulus of resistance of the counter chassis section Wₗ [cm³] (¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>190 289x80x7.7</td>
<td>5700</td>
<td></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 289x80x7.7</td>
<td>4800</td>
<td></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 289x80x7.7</td>
<td>5820</td>
<td></td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>420</td>
<td>A</td>
</tr>
</tbody>
</table>

(¹) This is also valid for the chassis section (lower flap of the section assembly).

A = The reinforcement section specified for the relevant superstructure on the chassis is sufficient (e.g., Table 3.4 for normal bodies). 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 (for example, body applications), use the latter also 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 3.10.

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 7)) box sections and cross bracings in line with the rear suspension and along the entire length Lᵥ (see Figure 3.1).

The passage between boxed sections 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 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 stiffness is insufficient, the Bodybuilder will adopt suitable precautions so as to obtain correct realisation.

The rear overhang of the crane (measurement Lf see Figure 31) must be as limited as possible (never exceed 50% of the wheelbase) to maintain good vehicle drive characteristics and acceptable stress regimes for the chassis.

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

---

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

---

**Table 3.10 - Crane fitted on the rear overhang (subframe secured with shear resistant plates)**

<table>
<thead>
<tr>
<th>Models Frame section [mm]</th>
<th>Wheelbase [mm]</th>
<th>Ultimate tensile strength of counter chassis material [N/mm²]</th>
<th>Total torque Mₐ max [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>190 289x80x7.7</td>
<td>5700</td>
<td></td>
<td>360</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>420</td>
</tr>
</tbody>
</table>

Minimum value of the modulus of resistance of the counter chassis section Wₖ [cm⁴] **(1)**

<table>
<thead>
<tr>
<th>Models Frame section [mm]</th>
<th>Wheelbase [mm]</th>
<th>Ultimate tensile strength of counter chassis material [N/mm²]</th>
<th>Total torque Mₐ max [kNm]</th>
</tr>
</thead>
</table>
### 3.9 INSTALLATION OF TAIL LIFTS

**Note**  The installation of tail lifts must be carried out with due regard for the maximum permissible weights on the rear axle (or rear axles) of the vehicle and of the minimum load established for the front axle (see Chapter 1.15 (Page 11)). If this is not possible, the rear overhang will have to be reduced.

Installation of the tail lift must be performed either with a structure which enables adequate distribution of the forces, especially in the case of specific versions with no subframe.

To ensure the necessary strength and rigidity, the connection between the chassis and the subframe must be made using shear-resistant plates (spaced no further than 700 mm from one another) in the area of the rear overhang, and must continue up to the front support of the rear suspension (see Figure 28).

The dimensions of the sections to be used for the subframe can be defined using:

- Table 3.11, in the presence of trucks with rear overhangs as standard;
- using the specifications of Figure 28, with trucks with non-standard overhangs or specific tail lifts (for example, in aluminium) and noting that the flexing moments on the chassis, depending on the board capacities, must be calculated each time.

Table 3.11 can be used to size the section of a subframe intended to support only the tail lift.

### Table of Ultimate Tensile Strength of Counter Chassis Material

<table>
<thead>
<tr>
<th>Models Frame section [mm]</th>
<th>Wheelbase [mm]</th>
<th>Ultimate tensile strength of counter chassis material [N/mm²]</th>
<th>Total torque Mₐ max [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>260 289x80x7.7</td>
<td>4800</td>
<td>360 A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A</td>
<td>57 71 110 135 173</td>
</tr>
<tr>
<td></td>
<td>420</td>
<td></td>
<td>320 420 71 57 71 110 135 110</td>
</tr>
<tr>
<td>340 289x80x7.7</td>
<td>5820</td>
<td>360 A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A</td>
<td>57 71 110 135 135</td>
</tr>
<tr>
<td></td>
<td>420</td>
<td></td>
<td>320 420 71 57 71 110 110 110</td>
</tr>
</tbody>
</table>

(*) This is also valid for the chassis section (lower flap of the section assembly).

**A** = The reinforcement section specified for the relevant superstructure on the chassis is sufficient (eg. Table 3.4 for normal bodies). In the crane area, brace the reinforcement profile sections which have a thickness of less than 5 mm.

(*) When a higher modulus of resistance 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.

### 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.
However when, as in most cases, the vehicle is to be fitted with a standard superstructure (fixed body, crane), the table relating to this superstructure must be referred to, choosing the table which provides the higher values of the section modulus \( W_s \).

**Table 3.11 - Installation of tail lifts**

<table>
<thead>
<tr>
<th>Models</th>
<th>Wheel-base [mm]</th>
<th>Overhang chassis [mm]</th>
<th>Max overhang superstructure [mm]</th>
<th>Tail lift capacity in kN (kg)</th>
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</table>
### 3.9 INSTALLATION OF TAIL LIFTS

<table>
<thead>
<tr>
<th>Models</th>
<th>Wheel-base</th>
<th>Overhang chassis</th>
<th>Max overhang superstructure</th>
<th>Tail lift capacity in kN (kg)</th>
<th>Minimum value of subframe section modulus of resistance ( W_s ), ( [\text{cm}^2] ) with ultimate tensile strength of the material equal to 360 N/mm²</th>
</tr>
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<tr>
<td>340 X ... ZYP 8x4x4 (2+2) rear axle 19 t</td>
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<td>A</td>
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<td></td>
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<td>1719</td>
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<tr>
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<td>A</td>
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<td>2477</td>
<td>A</td>
<td>46</td>
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<td></td>
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<td>1983</td>
<td>2477</td>
<td>A</td>
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<td>2478</td>
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<td></td>
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<tr>
<td></td>
<td>5100</td>
<td>2388</td>
<td>2882</td>
<td>46</td>
<td></td>
</tr>
</tbody>
</table>

**A** = The reinforcement section specified for the relevant superstructure on the chassis is sufficient (eg. Table 3.4 for normal bodies).

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

The possibility of using materials with superior mechanical characteristics requires verification of the total moment of resistance of the chassis plus subframe.
Procedure for calculating the bending moment on the chassis with overhangs not provided as standard

\[ W_T = \text{Weight of tail lift} \]
\[ W_c = \text{Tail lift capacity} \]

The bending moment on the chassis may be obtained using the following ratio:

\[ M \ [\text{Nm}] = W_c \ A + W_L \ B \quad \text{for tail lifts without stabilizers} \]
\[ M \ [\text{Nm}] = W_c \ C + W_L \ D \quad \text{for tail lifts with stabilizers} \]

To compensate for frame flexing, which is inevitable when the tail lift is in operation, the bodybuilder may use reinforcement sections with larger dimensions than those indicated in Table 3.11.

The stability of the vehicle in all tail lift operating conditions must be tested in compliance with applicable legislation.

Stabilizers

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

Vehicles with liftable third axle, the use of a tail lift when the third axle is lifted is only allowed using stabilizers.

The stabilizers must be attached to the support structure of the tail lift, and should be preferably hydraulically operated.

- The stabilisers must be put into operation in all tail lift loading conditions.

When installing electro-hydraulic tail lifts, ensure that the capacity of the batteries and the power of the alternator are adequate (see Chapter 5.5 (Page 34)).

The bodybuilder is also responsible for:
any modifications to the under-run cross member or the arrangement of another new type (see Chapter 2.20 (⟲ Page 54));
• the observance of the visibility of the rear lights,
• the observance of the overhang angles,
• the positioning of the tow hook,

based on the various national legislation.

**VEHH configuration for tail lifts**

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

The VEHH configuration consists of the following:

• temporary rear under-run bar. This is a simple bar with side marker lights, rear lights and a licence plate mount which the bodybuilder must remove and replace with a definitive under-run bar with its own fastening (see Figure 37);
• specific rear light wiring for connection to definitive under-run bar;
• specific wiring with 7-pin connector located on the right side member at the end of the rear overhang (see also Chapter 5.4 - Paragraph "TAIL LIFT" (⟲ Page 29));
• specific switch on the dashboard for tail lift and warning light activation (see Figure 38) is requested.

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

---

1. **Temporary rear under-run bar**
2. **7-pin connector 72096**

Before operating the tail lift, press switch (A) on the central module of the dashboard.

When the green warning light (B) activates, this indicates that the control system is ON and that the engine is off; when the red warning light activates, this indicates that the tail lift is open.

Once the movement of the load has completed and after having correctly closed the platform, press the switch (A) again to deactivate the system and allow engine start-up.
3.10 INTERCHANGEABLE OUTFITS

The interchangeable outfits can be separated from the vehicle and positioned on four supports while awaiting subsequent handling. As a rule this involves use 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.

A. Switch

B. Red/green warning light
3.11 CONCRETE MIXER INSTALLATION

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 31);
- rear semi-elliptic leaf springs;
- rear stabilizer bars of suitable dimensions;
- parking brake on front axle;
- Multipower PTO (see Chapter 4.5 (⇒ Page 10)).

On vehicles not prepared for the Multipower PTO from production, the application of a concrete mixer requires the previous specifications as well as the adoption of an independent motor to actuate the drum (see Figure 33).

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 (Wx) and a moment of inertia (Jx) not less than the values given in Table 3.12, 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 32).

**Table 3.12 - Minimum dimensions of the subframe profile**

<table>
<thead>
<tr>
<th>Models</th>
<th>Approximate capacity of the drum [m³]</th>
<th>Section modulus Wx [cm²] of the minimum reinforcement section with a yield point of the material used = 360 N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>190</td>
<td>4 – 5</td>
<td>66</td>
</tr>
<tr>
<td>260</td>
<td>6 – 7</td>
<td>66</td>
</tr>
<tr>
<td>340 (1)</td>
<td>7 – 9</td>
<td>81</td>
</tr>
</tbody>
</table>

(1) Up to a wheelbase of 5020 mm.

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 for 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.
1. Chassis
2. Reinforcement section with normal channel
3. Reinforcement section with upturned upper wing
4. Relative drum positions

- The subframe must be reinforced (e.g. crossbar, cross brace at rear part - see Chapter 3.2 - Paragraph "Crossmembers" (⇒ Page 10)) to reduce stress on the vehicle chassis caused by the forces generated during vehicle operation (due to the specific geometric configuration of the structure). 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 31).
• 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 10).
SECTION 4

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POWER TAKE-OFFS

4.1 GENERAL SPECIFICATIONS

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

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

The characteristics and performances are given in the paragraphs which follow and in the relevant documentation which will be supplied upon request.

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

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

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

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

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

\( P \) = Available power

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

\( n \) = Engine revolutions per minute

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

**Type of use**

The maximum torque take-off values refer to continuous usage of up to 60 seconds.

Torque take-off values exceeding the maximum values indicated for occasional, limited usage (less than 30 s), must be approved on a case by case basis in relation to the type of application.

In the case of continuous usage exceeding 60 seconds, where the function is comparable to that of a stationary motor, the necessity of reducing torque take-off in relation to other, peripheral conditions (such as engine and transmission cooling necessities) must also be evaluated.

In the case of continuous usage which may lead to high oil temperatures, it is advisable to contact the PTO supplier to determine whether the installation of a dedicated external oil circuit kit is necessary.

The scheduled take-off values are also applicable for uses which do not involve large variations of torque either in frequency or magnitude.

In other cases, to avoid 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:

- 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 that 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 φ (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 φ and if equal conditions are respected between the angles at the extremities X₁ and X₂.

For transmissions employing multiple sections, please refer to the indications provided in Chapter 2.8 (⇒ Page 35).

![Solution Z](image1.png)

![Solution W](image2.png)

Electric system

On Stralis Euro6 vehicle range all the PTO are managed exclusively by EM, also when PTO fitted in AfterSales. Therefore vehicle order shall contain related OPT 4572.

The VCM and EM electrical/electronic systems (see Figure 1 - Section 5) make available innovative methods and processes for the control of power take-offs able to significantly improve safety and reliability. Activation takes place by connecting the power take-off control switch to connector ST14A.
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 16).

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 P.T.O. 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>Internal PTO ratio</th>
<th>Final PTO ratio output</th>
<th>Available torque (*) [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 S 1620 TO 16 S 2220 TO 16 S 2320 TO</td>
<td>5202</td>
<td>NH/1b</td>
<td>central</td>
<td>1</td>
<td>0.77</td>
<td>0.91</td>
</tr>
<tr>
<td></td>
<td>5205</td>
<td>NH/1c</td>
<td>central</td>
<td>1</td>
<td>0.77</td>
<td>0.91</td>
</tr>
<tr>
<td></td>
<td>5209</td>
<td>NH/4b</td>
<td>right</td>
<td>1.28</td>
<td>0.98</td>
<td>1.17</td>
</tr>
<tr>
<td></td>
<td>5210</td>
<td>NH/4c</td>
<td>right</td>
<td>1.28</td>
<td>0.98</td>
<td>1.17</td>
</tr>
<tr>
<td></td>
<td>5258</td>
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<td>above</td>
<td>1.48</td>
<td>1.14</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td>5260</td>
<td>N22/1/10b</td>
<td>above</td>
<td>1.91</td>
<td>1.47</td>
<td>1.75</td>
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<tr>
<td></td>
<td>5264</td>
<td>N22/1/10b</td>
<td>above</td>
<td>2.19</td>
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<td>2.00</td>
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<tr>
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<td>5259</td>
<td>N22/1/10c</td>
<td>above</td>
<td>1.48</td>
<td>1.14</td>
<td>1.35</td>
</tr>
</tbody>
</table>

<p>| 16 S 1820 TO 16 S 2220 TO 16 S 2520 TO | 5202 | NH/1b | central | 1 | 0.91 | 1.09 | 1000 |
| | 5205 | NH/1c | central | 1 | 0.91 | 1.09 | 1000 |
| | 5209 | NH/4b | right | 1.28 | 1.17 | 1.40 | 430 (♦) |
| | 5210 | NH/4c | right | 1.28 | 1.17 | 1.40 | 430 (♦) |
| | 5258 | N22/1/10b | above | 1.48 | 1.35 | 1.62 | 730 |
| | 5260 | N22/1/10b | above | 1.91 | 1.75 | 2.09 | 560 |
| | 5264 | N22/1/10b | above | 2.19 | 2.00 | 2.40 | 470 |
| | 5255 | N22/1/10c | above | 1.23 | 1.13 | 1.35 | 870 |
| | 5259 | N22/1/10c | above | 1.48 | 1.35 | 1.62 | 730 |</p>
<table>
<thead>
<tr>
<th>Gearbox</th>
<th>Option no.</th>
<th>PTO type</th>
<th>Assembly side</th>
<th>Internal PTO ratio</th>
<th>Final PTO ratio output</th>
<th>Available torque (*) [Nm]</th>
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<tr>
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<td>5202</td>
<td>NH/1b</td>
<td>central</td>
<td>1</td>
<td>0.76</td>
<td>1000</td>
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<tr>
<td></td>
<td>5209</td>
<td>NH/4b</td>
<td>right</td>
<td>1.28</td>
<td>0.97</td>
<td>430 (1)</td>
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<td>400</td>
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<td></td>
<td>78736</td>
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<td>1.78</td>
<td>400</td>
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<td>78742</td>
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<td>1.19</td>
<td>630</td>
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<td></td>
<td>78745</td>
<td>N TX / 10c+b double output</td>
<td>above/L/pump</td>
<td>1.48</td>
<td>1.12</td>
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<td>lower/H/flange</td>
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<td>1.78</td>
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<tr>
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<td>0.93</td>
<td>690</td>
</tr>
<tr>
<td></td>
<td>78745</td>
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<td>1.40</td>
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<td>1</td>
<td>0.72</td>
<td>1000</td>
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<td>1.28</td>
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<tr>
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<td>NH/1c</td>
<td>right</td>
<td>1.28</td>
<td>0.93</td>
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<td>1.14</td>
<td>630</td>
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<td>above/L/pump</td>
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<td>1.07</td>
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<tr>
<td></td>
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<td>lower/H/flange</td>
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<td>1.70</td>
<td>400</td>
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<td>above/L/pump</td>
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<td>N TX / 10c+b double output</td>
<td>lower/H/flange</td>
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<td>1.34</td>
<td>430</td>
</tr>
<tr>
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<td>5202</td>
<td>NH/1b</td>
<td>central</td>
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<td>1.26</td>
<td>1000</td>
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<td></td>
<td>78732</td>
<td>NH/4b</td>
<td>right</td>
<td>0.9</td>
<td>1.14</td>
<td>430 (1)</td>
</tr>
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<td></td>
<td>78733</td>
<td>NH/4c</td>
<td>right</td>
<td>0.9</td>
<td>1.14</td>
<td>430 (1)</td>
</tr>
<tr>
<td></td>
<td>78735</td>
<td>N TX/10b flange</td>
<td>above / H</td>
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<td>2.01</td>
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<td>1.62</td>
<td>580</td>
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<td></td>
<td>78743</td>
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<td>1.15</td>
<td>720</td>
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<td>720</td>
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<tr>
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<td>N TX / 10c+b double output</td>
<td>lower/H/flange</td>
<td>1.28</td>
<td>1.62</td>
<td>580</td>
</tr>
<tr>
<td>16 TX 2440 TO</td>
<td>5202</td>
<td>NH/1b</td>
<td>central</td>
<td>1</td>
<td>1.08</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>78732</td>
<td>NH/4b</td>
<td>right</td>
<td>0.9</td>
<td>0.97</td>
<td>430 (1)</td>
</tr>
<tr>
<td></td>
<td>78733</td>
<td>NH/4c</td>
<td>right</td>
<td>0.9</td>
<td>0.97</td>
<td>430 (1)</td>
</tr>
<tr>
<td></td>
<td>78735</td>
<td>N TX/10b flange</td>
<td>above / H</td>
<td>1.59</td>
<td>1.71</td>
<td>490</td>
</tr>
<tr>
<td></td>
<td>79709</td>
<td>NTX/10c+b</td>
<td>–</td>
<td>0.91</td>
<td>1.15</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>78744</td>
<td>NTX/10c</td>
<td>lower / L / pump</td>
<td>1.09</td>
<td>1.18</td>
<td>710</td>
</tr>
<tr>
<td></td>
<td>78747</td>
<td>NTX/10c+b</td>
<td>above/L/pump</td>
<td>1.09</td>
<td>1.18</td>
<td>710</td>
</tr>
</tbody>
</table>
### 4.3 POWER TAKE-OFF FROM TRANSFER BOX

**Note** Not present on STRALIS.

### 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 power absorption form 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 35));
- 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.

---

<table>
<thead>
<tr>
<th>Gearbox</th>
<th>Option no.</th>
<th>PTO type</th>
<th>Assembly side</th>
<th>Internal PTO ratio</th>
<th>Final PTO ratio output</th>
<th>Available torque ((^*)) [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 TX 2440 TO 16 TX 2640 TO</td>
<td>78747</td>
<td>NTX/10c+b</td>
<td>lower/Hi/flange</td>
<td>1.59</td>
<td>1.71</td>
<td>490</td>
</tr>
<tr>
<td>Allison 3200</td>
<td>415</td>
<td>870</td>
<td>above</td>
<td>0.60</td>
<td>–</td>
<td>660</td>
</tr>
</tbody>
</table>

\(^*\) Available torque with PTO at 1500 rpm

\(^1\) Sporadic operation < 1 hour of service
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 take-off from the front of the engine

The low torque take-off, which tends to be constant from the front part of the engine (only a 310 CV Cursor 9, without air conditioning), is possible thanks to the drive shafts. It does however require a specific pre-installation (optional 5151) relating to the crankshaft, radiators, bumpers and chassis front cross member.

Particular attention must be paid to:

- 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 (cross member, 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).

Note For the installation of a PTO on the front of the vehicle, check that the design complies with local Regulations.

Power take-off on the engine flywheel

a) Multipower

Vehicles with the Cursor 9 engine, mechanical gearbox and without interoler, can be fitted, upon request, with the IVECO Multipower power take-off, designed to take-off higher torques than other types of PTO. Mounted on the rear of the engine, it takes drive from the flywheel and is independent of the clutch control. It is suitable for use from stationary or with the vehicle moving (for example, municipal applications, concrete mixers etc.) and is combined with an oil cooling radiator fitted on the vehicle chassis.

Some precautions:

- the PTO must be engaged only with the engine at a standstill (the EM control unit (Expansion Module) has a configuration that prevents engagement while the engine is running);
- the unit may be disengaged with the engine running but only if not any power is absorbed by BB. The torque shall be 0 Nm.
during engine start-up, torque taken must be zero.

**Note** To guarantee correct engagement, the static moment of connected units must not exceed 35 Nm.

<table>
<thead>
<tr>
<th>Table 4.2 - Technical specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ratio revolutions - rpm</strong></td>
</tr>
<tr>
<td><strong>Max. torque available</strong></td>
</tr>
<tr>
<td><strong>Output flange</strong></td>
</tr>
<tr>
<td><strong>Control</strong></td>
</tr>
<tr>
<td><strong>Direction of rotation</strong></td>
</tr>
<tr>
<td><strong>Installation on engines</strong></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
</tr>
<tr>
<td><strong>Oil capacity</strong></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).
b) High Performance ("Sandwich")

Reserved for Cursor 11 and 13 engines, this power take-off is similar to the previous one in terms of the position, its dependency on the flywheel and use, but it is suitable to for high torque take-off (pumps for aggregate, wood crushing, sewer cleaning vehicles, fire-prevention applications).

To take off torque, one of the three ratios indicated in Table 4.3 can be selected.

<table>
<thead>
<tr>
<th>Table 4.3 - Technical specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio revolutions - rpm</td>
</tr>
<tr>
<td>Output revolutions</td>
</tr>
<tr>
<td>Max. torque available</td>
</tr>
<tr>
<td>Direction of rotation</td>
</tr>
<tr>
<td>Type of drive output</td>
</tr>
<tr>
<td>Type of engagement/release control</td>
</tr>
<tr>
<td>Oil capacity</td>
</tr>
<tr>
<td>Weight (without flywheel)</td>
</tr>
</tbody>
</table>
Power take-off on the camshaft

With the exception of tractors, 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 5).

Engagement is only possible when the vehicle is stationary and with an engine speed of no more than 1000 rpm, while torque take-off can occur when the vehicle is moving and when it is stationary.

Note The installation of this power take-off must be requested when ordering the vehicle; retrofitting in AfterSales would require the replacement of the whole engine.
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>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CURSOR 9</td>
<td>800 (peak 820)</td>
<td>1.14</td>
<td>3200</td>
<td>Opposite to engine</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>CURSOR 11</td>
<td>800 (peak 1050)</td>
<td>1.12</td>
<td>3200</td>
<td>Opposite to engine</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>CURSOR 13</td>
<td>800 (peak 1050)</td>
<td>1.12</td>
<td>3200</td>
<td>Opposite to engine</td>
<td>8</td>
<td>13</td>
</tr>
</tbody>
</table>
Max. torque available depending on engine speed

![Graph showing Nm vs rpm for different engine speeds.]

A. CURSOR 9  

A) Vehicle stationary - PTO mode ON
- The maximum torque take-off is permitted at engine speeds exceeding 1100 rpm.

B) Vehicle running - PTO mode ON
- No torque limitation available in relation to rpm.
- The engine idle speed is set at 800 rpm (CURSOR 9) or at 700 rpm (CURSOR 11/13).
- The air supply system pressure for PTO clutch engagement must exceed 8.5 bar.

When the maximum permitted torque take-off is required, 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.
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 from 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**

Hi-MUX indicates the set of two control units: Body Computer module (BCM) and Frame Computer Module (FCM). They are connected to the other electronic systems (EDC, VCM, ECAS etc.) in the vehicle.

Information and messages are exchanged by means of Bus CAN lines

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

Located in the middle of the dashboard, this is used to request an action relating to a given PTO (for example, depending on EM programming, PTO engagement/disengagement, "Intermediate Speed Control" activation).

Since EM and VCM can control up to three PTOs, up to three switches may be fitted; each switch is connected to connector ST14A (respectively to pins 18, 19, 20).
1. PTO 1 switch
2. PTO 2 switch
3. PTO 3 switch

**Connector ST14A**

More detailed information is given in Chapter 5.2 (⇒ Page 9).

**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),
- an "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 activation of the PTO is stored in the EM.
"Intermediate Speed Control" mode \(x \in \{1, 2, 3\}\)

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

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

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.

**Configurations**

Depending on the planned use of the vehicle, Bodybuilders are required to contact IVECO Service in order to carry out the necessary programming of the controls involved (EM, VCM, etc.) for operation of each individual power take-off.

**EM - PTO 1, 2, 3 Programming**

PTO programming includes the following function groups:

1. PTO switch function
2. PTO hardware
3. Conditions for the mechanical engagement of the PTO
4. Conditions for the mechanical activation of the PTO
5. Extended functions

Adjustments within the five function groups may be defined separately for each PTO mode \(x \in \{1, 2, 3\}\).

**1) PTO switch function**

The EM control unit controls the PTO modes and speeds by means of switches located on the dashboard and connected to the relevant pin of the connector STI4A.

Operating the switch may determine one of the following actions:

- Mechanical engagement of the PTO (in conjunction with a given PTO configuration)
- Activation of the "Intermediate speed Control" mode
- Mechanical engagement of the PTO (in conjunction with a specific PTO configuration) and activation of the "Intermediate speed control" mode after successful engagement
- No effect

Activation of a PTO by the EM is always connected to a switch operation. However, activating the switch should not necessarily lead to engagement of a PTO (see the list above).
Each switch may be allocated its own PTO configuration. If switch operation also activates "Intermediate speed control" mode, then when different switches are operated simultaneously a selection needs to be made. The following priority must be observed:

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

2) PTO hardware

Vehicles can be fitted with and simultaneously manage up to three of the PTOs described in Chapters 4.2 (☞ Page 7), 4.4 (☞ Page 9) and 4.5 (☞ Page 10).

3) Conditions for PTO engagement

The selection determines which conditions must be satisfied in order to engage the PTO mechanically (electrical activation by means of the electromagnetic valve).

All the configured conditions should be met within a certain time (20s standard). If this does not happen, the EM control unit generates a warning message on the IC display (Instrument Cluster) and stops the engagement procedure. PTO engagement must be requested again (deactivation and reactivation of the PTO switch).

Table 4.5 - Example of configuration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating brake</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Parking brake</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Clutch status output</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Clutch Timeout</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connector ST91/92/93 3 Pin</td>
<td>Open</td>
<td>Earthed</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>40-100 °C</td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Clutch slip limit</td>
<td></td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Expansion module pressure switch (inactive)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. rpm for engagement</td>
<td>650 rpm</td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Max. rpm for engagement</td>
<td>700 rpm</td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Min. vehicle speed</td>
<td>0 km/h</td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Max. vehicle speed</td>
<td>1 km/h</td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Lowest speed engaged</td>
<td></td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Highest speed engaged</td>
<td></td>
<td></td>
<td>Not controlled</td>
</tr>
<tr>
<td>Gear in neutral</td>
<td>In neutral</td>
<td>Gear engaged</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Reverse gear</td>
<td>Operated</td>
<td>Not operated</td>
<td>Not controlled</td>
</tr>
</tbody>
</table>

4) Conditions for mechanical engagement of the PTO

The selection determines the conditions and the limit values which must not be exceeded or which must at least be reached.

With reference to Table 4.5, if any condition is violated, the PTO will be deactivated and a warning is displayed on the IC (Instrument Cluster).

5) Extended functions

a. Timing behaviour of PTO Mode request
The EM control unit expects that certain PTO engagement conditions are met within a certain time period (standard 20 seconds) after the PTO request. Once this period has elapsed, the PTO mode request is rejected and an error is displayed. The time interval is programmable (0 - 25 seconds). The PTO switch must then be cycled (switched off and on again).

b. **Timing behaviour of physical PTO engagement monitoring**

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

c. **Timing behaviour of PTO deactivation condition monitoring**

If any of the defined deactivation conditions are not met for a period exceeding a specified time period (generally 10 seconds as the default setting) during the physical engagement of a PTO, the configured actions (physical deactivation of the PTO, sending of an ISC OFF command, sending of an ISC RESUME command) are initiated and an error is displayed. The time interval is programmable (0 - 10s).

d. **Timing behaviour of physical PTO deactivation**

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

e. **Timing behaviour between clutch activation and PTO engagement**

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

f. **Timing behaviour of error identification**

Time that elapses before an error activates Degraded Mode.

<table>
<thead>
<tr>
<th>Table 4.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
</tr>
<tr>
<td>Timeout at activation</td>
</tr>
<tr>
<td>Timeout at PTO activation conditions</td>
</tr>
<tr>
<td>Timeout at activation via switch</td>
</tr>
<tr>
<td>Timeout at PTO deactivation conditions</td>
</tr>
<tr>
<td>Timeout for error identification</td>
</tr>
</tbody>
</table>

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

**PTO mode 0 (driving mode)**

With a speed below 25 km/h, it is possible to activate intermediate engine rpm.

The intermediate rpm is set at 900 rpm and can be modified as follows:

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

The adjustment field with the gearbox in neutral is set at 100 rpm, but can be increased up to 200 rpm.

For safety reasons, it is not possible to modify the following settings:
### Table 4.7

<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></td>
<td>- CCCoff activation on control lever or on ST14A</td>
</tr>
<tr>
<td></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>
<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>

### PTO modes 1, 2, 3 (configurable)

Through IVECO Service, three different and independent PTO maps can be set. Since the engine can only operate with one PTO mode at a time, the following priorities are assigned to the modes:

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

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

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

### Table 4.8

<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></td>
<td>550 - 1800 rpm</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) (5)</td>
<td></td>
<td>1 km/h</td>
</tr>
<tr>
<td>Speed deactivation with parking brake not engaged</td>
<td>Yes</td>
<td>No</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></td>
<td>1 km/h</td>
</tr>
<tr>
<td>Speed deactivation by operating brake pedal (8)</td>
<td>Yes</td>
<td>No</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 (10)</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 (11)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation if this is lower than minimum speed setting (12)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation if this is greater than maximum speed setting (13)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation due to an error in the CC module (14)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Parameter</td>
<td>Option 1</td>
<td>Option 2</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Speed deactivation in the event of service brake and parking brake switch error (8)</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 (9)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation in the event of speed sensor error (9)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation in the event of exceeding coolant temperature (8)</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 (10)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Speed deactivation with reverse gear engaged (11)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Activation for control of lowest speed for PTO engagement/disengagement (11)</td>
<td>Yes, by selection</td>
<td>No</td>
</tr>
<tr>
<td>Lower speed for speed activation/deactivation (11)</td>
<td>1st - 5th gear</td>
<td></td>
</tr>
<tr>
<td>Activation for control of the highest gear for PTO engagement/disengagement (11)</td>
<td>Yes, by selection</td>
<td>No</td>
</tr>
<tr>
<td>Highest speed for speed activation/deactivation (11)</td>
<td>1st - 5th gear</td>
<td></td>
</tr>
<tr>
<td>CC adjustment and Memo function (12)</td>
<td>See description</td>
<td>See description</td>
</tr>
<tr>
<td>Engine speed via Memo (13)</td>
<td>Final speed 550-LL</td>
<td></td>
</tr>
<tr>
<td>Maximum speed via Set+ (14)</td>
<td>1 km/h</td>
<td></td>
</tr>
<tr>
<td>Temporary activation of engine speed increase by another control device (15)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Temporary activation of speed increase by driver (16)</td>
<td>Yes</td>
<td>No</td>
</tr>
<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>
<tr>
<td>Increase/reduction of speed with SET+ / SET- (rpm/min) activation (18)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time required to reach selected speed (19)</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 (4).
(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 (9).
(12) Three adjustment options are available in this case:
• Option 1: No possibility of calibration. The speed set at Note (16) 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 +/Set - on the basis of the adjustment range shown in Notes (1) and (3);
• 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 (3) 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.

(17) If a power take-off is used on the propeller shaft (N90 - Omsi - etc.), it is possible to engage a speed higher than 90 km/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.

(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.

**Modifications to the torque curve, maximum engine speed and slope of speed limiter of maximum engine speed**

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

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

The diagram in Figure 8 shows this qualitatively by means of a torque/engine speed curve (defined by 16 points), a horizontal section (representing torque limitation) and a sloping section (representing over-rev adjustment).
When a maximum limit has been set for the engine speed and a variation mode (incline 3), we have an intersection point "X" with the straight line of the set torque and therefore, in abscissa, the maximum engine speed compatible with this torque.

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.

We will take a look at the example in Figure 9:

• max. engine torque 600 Nm;
• standard power take-off operation is specified at 900 rpm;
• engine rpm must not exceed 1100 rpm;
• rpm must be calculated for all over-revving rpm regulator gradients;
• variable over-revving rpm regulator curve gradient: 0 - 0.2 rpm/Nm.

The corresponding power at 1100 rpm and a torque of 600 Nm gives (see equations on page 4-3):

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

The overreving 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

Note: The conditions described below can be modified by IVECO Customer Service.

No PTO installed or pre-installations

Only the engine speed programming is requested by the VCM.
The switches select the following three speed modes:

<table>
<thead>
<tr>
<th>PTO SW 1</th>
<th>PTO Mode 1</th>
<th>900 [tr/min]</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTO SW 2</td>
<td>PTO Mode 2</td>
<td>1100 [tr/min]</td>
</tr>
<tr>
<td>PTO SW 3</td>
<td>PTO Mode 3</td>
<td>1300 [tr/min]</td>
</tr>
</tbody>
</table>

PTO Multipower

Only the engine speed programming is requested by the VCM.
The switches select the following three speed modes (see Table 4.9).

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

<table>
<thead>
<tr>
<th>Vehicle status</th>
<th>not stationary (PTO3)</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>

PTO 1,2 and manual gearbox

Activation conditions

<table>
<thead>
<tr>
<th>Engine status</th>
<th>ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clutch status output</td>
<td>deactivated</td>
</tr>
<tr>
<td>Vehicle status</td>
<td>stationary</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>&lt; 120 [°C]</td>
</tr>
</tbody>
</table>

Deactivation conditions

<table>
<thead>
<tr>
<th>Engine status</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle status</td>
<td>not stationary (PTO3)</td>
</tr>
<tr>
<td>Vehicle speed</td>
<td>&gt; 25 [km/h] (PTO1, PTO2)</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>&gt; 120 [°C]</td>
</tr>
</tbody>
</table>
## PTO 1,2 and gearbox 12TX

**Activation conditions**

<table>
<thead>
<tr>
<th>Gearbox status</th>
<th>consent</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>Vehicle status</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coolant temperature</td>
<td>&gt; 120 [°C]</td>
</tr>
</tbody>
</table>

## PTO 1,2 and automatic gearbox

**Activation conditions**

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

**Deactivation conditions**

<table>
<thead>
<tr>
<th>Engine status</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle speed</td>
<td>&gt; 20 [km/h]</td>
</tr>
<tr>
<td>Coolant temperature</td>
<td>&gt; 120 [°C]</td>
</tr>
</tbody>
</table>

## Engine PTO

**Activation conditions**

<table>
<thead>
<tr>
<th>Engine status</th>
<th>ON (engine speed &lt; 1000 rpm)</th>
</tr>
</thead>
<tbody>
<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>Vehicle status</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coolant temperature</td>
<td>&gt; 120 [°C]</td>
</tr>
</tbody>
</table>
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 10 shows the wiring diagram, while Figure 11 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 23)) must be made as indicated in Figure 10; the Table below describes the functions available at the terminals of these connectors.

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

<table>
<thead>
<tr>
<th>Pin</th>
<th>PTO feedback</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>

ST7072A  
Basic BB

ST7072B  
Advanced BB

ST7072B only w/ opt 0384  
CANopen supported

ST14A  
Vehicle BB

CiA 413  
CABIN

CiA 413  
FRAME
SECTION 5

ELECTRONIC SUB-SYSTEMS
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ELECTRONIC SUB-SYSTEMS

5.1 ELECTRONIC SYSTEM

An innovative electronic system, called Hi-MUX, checks and controls the vehicle subsystems.

This system consists of the BCM (Body Computer Module) and FCM (Frame Computer Module) control units, which communicate with each other via the BCB CAN line.

The BCM receives information on the state of charge of the batteries via the LIN 1 and LIN 2 communication lines. The IC instrument block (Instrument Cluster) communicates with the other control units via the VDB CAN line.

![Diagram of electronic system]

1. Input signals
2. Output signals
3. Input signals
4. Output signals

- 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. BCM Body Computer Module
2. EM Expansion Module
3. VCM Vehicle Control Module
4. ECAS Electronic Control Air Suspension
5. EBS Electronic Brake System
6. EDC Engine Diesel Control
7. BM Bed Module
8. IC Instrument Cluster
9. SWI Steering Wheel Interface
10. FCM Frame Computer Module
11. MC Mirror controller (optional)
12. CC Climate Control

Body Computer Module (BCM)

The Body Computer Module is the vehicle's central control unit, in which important signals are processed for the interaction with individual systems.

Located in the cab, below the dashboard in front of the passenger, this module also controls various equipment (interior lights, switches on dashboard, door locking, windscreen wiper … …) and manages the front light assembly.
Frame Computer Module (FCM)

The Frame Computer Module (FCM) processes information from the subsystems (rear light assembly, EC-APU, fuel tank...) and the Bodybuilder connectors located in the rear part of the chassis, as well as those coming from the trailer and semi-trailer. This information is then forwarded to the BCM.

Located inside the right side member, it is located behind the rear axle on trucks and near the fifth wheel coupling on tractors.

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.
Expansion Module (EM)

The EM (Expansion Module) control unit, located in the cab control unit compartment (passenger side), controls the power take-offs and makes it possible to carry out complex applications such as:

- control of the transmission (gearbox) from external sources (TC1 message);
- control of the engine from external sources such as engine speed requests and limits, vehicle speed limit, start up and engine stop;
- safety rules for waste collection applications;
- optimisation of the brake system for waste collection applications;
- control of additional lights;
- interface with CAN_open network.

For a more in-depth analysis of the operating logic of the EM, it is possible to access the specific EM WP 2.2 Bodybuilder Manual, by making a request at www.ibb.iveco.com.
5.2 BODYBUILDER CONNECTORS

The standard vehicle outfitting requires connectors ST14A, ST14B, ST52, ST64, ST77, ST78.

Optional connectors are: ST14C, ST40, 72072A, 72072B, 72072C, 72072D, ST91, ST92, ST93.

Each is described below depending on its location in the cab (see Paragraph "Connectors in the cab" (Page 9)) or on the chassis (see Paragraph "Connectors on the chassis" (Page 23)).

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

| Table 5.1 - Connectors ST14A, ST14B, ST14C, ST40, 72072A, 72072C |
|----------------------------------|-------------|
| **Cable section** | **Contact code** |
| 0.35 mm²    | 41200694 EZ   |
| 0.5 mm² - 1.0 mm² | 41200695 EZ   |
| 1.0 mm² - 2.5 mm² | 41200696 EZ   |
| 2.5 mm² - 4.0 mm² | 41200697 EZ   |

| Table 5.2 - Connector 72072B |
|----------------------------------|-------------|
| **Cable section** | **Contact code** |
| 0.35 mm² - 0.5 mm² | 500314820 EZ |
| 0.75 mm² - 1.5 mm² | 500314821 EZ |

| Table 5.3 - Connectors ST52, ST64, ST77, ST78, ST91, ST92, ST93 |
|----------------------------------|-------------|
| **Cable section** | **Contact code** |
| 0.35 mm² - 0.5 mm² | 9845 7375 EZ |
| 0.75 mm² - 1.5 mm² | 9843 5370 EZ |

A) Connectors in cab

The following connectors are located inside the cab:

- ST14A (standard connector for Bodybuilder)
- ST14B (standard connector for Bodybuilder)
- ST14C (Allison automatic gearbox)
- 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 member above the driver’s side sun visor.
### a) Standard connector ST14A: 21 pin, blue

![Diagram](image)

**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>
</table>
| 1   | Engine Start           | 8892      | Input 10 mA | VCM X3-27   | Ground = start engine  
   |                         |           |           | (the signal must be permanently active while the engine is turning)  
   |                         |           |           | (i)          | Open wire = no action |
| 2   | Engine stop            | 0151      | Input 10 mA | VCM X3-26   | Ground = stop engine  
   |                         |           |           | (brief activation with V < 6 km/h, sufficient to stop the engine; with V > 6 km/h it does not work)  
   |                         |           |           | (i)          | Open wire = no action |
| 3   | Service brake          | 1165      | Output 200 mA | VCM XI-13   | 0 V = service brake not pressed  
   |                         |           |           |              | +24 V = service brake pressed |
| 4   | Vehicle standstill     | 5515      | Output 200 mA | BCM G36     | +24 V = vehicle stationary (V < 1 km/h)  
   |                         |           |           |              | 0 V = vehicle moving (V > 5 km/h) |
| 5   | Parking brake          | 6656      | Output 200 mA | VCM XI-10   | 0 V = not engaged  
<p>|                         |           |           |              | +24V = engaged |
| 6   | Not connected          |           |           |              |         |</p>
<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>7</td>
<td>Vehicle speed</td>
<td>5540</td>
<td>Output 10 mA</td>
<td>DTCO - B7</td>
<td>Pulse signal (1)</td>
</tr>
<tr>
<td>8</td>
<td>Engine status</td>
<td>7778</td>
<td>Output 200 mA</td>
<td>BCM G6</td>
<td>0 V = engine stopped (&lt; 50 rpm) +24 V = engine running (&gt; 800 rpm)</td>
</tr>
<tr>
<td>9</td>
<td>Gearbox neutral</td>
<td>8050</td>
<td>Output 200 mA</td>
<td>VCM X1-07 / EM X1-07</td>
<td>0 V = neutral not engaged +24 V = neutral engaged Signal controlled by EM, when installed; Else input driven by VCM</td>
</tr>
<tr>
<td>10</td>
<td>Reverse gear</td>
<td>2268</td>
<td>Output 200 mA</td>
<td>BCM G35</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>Output 5 A</td>
<td>BCM H04</td>
<td>K15</td>
</tr>
<tr>
<td>12</td>
<td>CC Set+</td>
<td>8156</td>
<td>Input 10 mA</td>
<td>VCM X3-33</td>
<td>Input signal (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Open wire = Set + not activated Ground = Set+ activated</td>
</tr>
<tr>
<td>13</td>
<td>CC Set-</td>
<td>8157</td>
<td>Input 10 mA</td>
<td>VCM X3-32</td>
<td>Input signal (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Open wire = Set - not activated Ground = Set- activated</td>
</tr>
<tr>
<td>14</td>
<td>CC OFF</td>
<td>8154</td>
<td>Input 10 mA</td>
<td>VCM X3-30</td>
<td>Input signal (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Open wire = Off not activated Ground = Off activated</td>
</tr>
<tr>
<td>15</td>
<td>Cruise Control RES</td>
<td>8155</td>
<td>Input 10 mA</td>
<td>VCM X3-31</td>
<td>Input signal (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Open wire = RES not activated Ground = RES activated</td>
</tr>
<tr>
<td>16</td>
<td>CC Driver/BB</td>
<td>0152</td>
<td>Input 10 mA</td>
<td>VCM X3-49</td>
<td>Selection of CC activation by driver or Bodybuilder (BB) Open wire = CC controlled by driver Ground = CC controlled by BB</td>
</tr>
<tr>
<td>17</td>
<td>Ground</td>
<td>0000</td>
<td>Output 10 A</td>
<td>Wiring</td>
<td>Ground</td>
</tr>
<tr>
<td>18</td>
<td>PTO 1 sw</td>
<td>0131</td>
<td>Input 10 mA</td>
<td>VCM X3-47 / EM X3-05</td>
<td>Input signal (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Open wire = PTO mode 1 not activated Ground = PTO mode 1 activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Signal controlled by EM, when installed; Else input driven by VCM</td>
</tr>
<tr>
<td>19</td>
<td>PTO 2 sw</td>
<td>0132</td>
<td>Input 10 mA</td>
<td>VCM X3-46 / EM X3-06</td>
<td>Input signal (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Open wire = PTO mode 2 not activated Ground = PTO mode 2 activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Signal controlled by EM, when installed; Else input driven by VCM</td>
</tr>
<tr>
<td>20</td>
<td>PTO 3 sw</td>
<td>0123</td>
<td>Input 10 mA</td>
<td>VCM X3-45 / EM X3-07</td>
<td>Input signal (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Open wire = PTO mode 3 not activated Ground = PTO mode 3 activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Signal controlled by EM, when installed; Else input driven by VCM</td>
</tr>
<tr>
<td>21</td>
<td>K30</td>
<td>7772</td>
<td>Output 10 A</td>
<td>K30 (downstream of fuse F52)</td>
<td></td>
</tr>
</tbody>
</table>

(1) The engine only starts when the key is turned in the Immobilizer block (K15 ON); otherwise the engine turns but will not start. When the engine is stopped by the Bodybuilder through the signal of pin 2 of connector ST14A, while driving at speeds exceeding the threshold of the VCM of 6 km/h, it is not possible to restart the engine by the Bodybuilder but the K15 cycle (off-on) must be repeated with the key.
### 5.2 BODYBUILDER CONNECTORS

#### (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></td>
<td></td>
<td>1,5</td>
<td>V</td>
<td>$I = 1 \text{ mA}$</td>
</tr>
<tr>
<td>Voltage $U_{\text{HIGH}}$</td>
<td>5,5</td>
<td></td>
<td></td>
<td>V</td>
<td>$I = -1 \text{ mA}$</td>
</tr>
<tr>
<td>Frequency</td>
<td></td>
<td></td>
<td>$&lt;1,6$</td>
<td>kHz</td>
<td></td>
</tr>
<tr>
<td>Pulse duration</td>
<td>0,64</td>
<td>2</td>
<td>4</td>
<td>ms</td>
<td>Square wave</td>
</tr>
</tbody>
</table>

The Tachograph B7 output provides the speed pulse according to ISO16844-2.

![Figure 9]

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 $\mu$s delay ± 10 $\mu$s jitter.
- (3) Input monitored only when ST 14A/pin 16 CC driver/bodybuilder connected to ground, else input ignored.
- (4) Cyclical passage between the int. inputs PTO_x must be not faster than 500ms. Switching faster may ignore the request. The input will activate physical PTO - when configured - and VCM intermediate Speed Control Mode 1,2,3. With simultaneous 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 PTO device during driving operation and/or with a gear engaged is not permitted as 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.
Specification 01 - Vehicles with ECAS system (Electronically Controlled Air Suspension)

On the rear axle with air suspensions, it is recommended that there is a residual pressure of no more than 0.5 bar to prevent dislodging of the air bellow rubber from the piston.

The residual pressure can be programmed with E.A.S.Y. on vehicles with a liftable axle or when equipped with opt. 7306 "Axle load indication".

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:

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

<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>2nd speed-limiter</td>
<td>8223</td>
<td>Input 10 mA</td>
<td>VCM X3-13</td>
<td>2nd speed limiter activation, Open wire = not activated +24V = engaged</td>
</tr>
<tr>
<td>Pin</td>
<td>Description</td>
<td>Wire code</td>
<td>Max. Load</td>
<td>Connected to</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>--------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 3   | Clutch status output         | 9963      | Output 200 mA | VCM X1-12 | Clutch activated (switch 10%)
Ground = clutch closed                                                                                                               |
| 4   | PTS                          | 5542      | Output 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      | Input 10 mA | BCM E19     | Input signal (2)                                                                                                                           
|     |                              |           |           |              | Open circuit = off                                                                                                                        
|     |                              |           |           |              | Ground = on                                                                                                                               |
| 6   | Inhibition of TGC OFF        | 8879      | Input 10 mA | BCM F-25    | Input signal (3)                                                                                                                           
|     |                              |           |           |              | Open circuit = Inhibition of TGC OFF not activated                                                                                         
|     |                              |           |           |              | Ground = inhibition of TGC OFF activated                                                                                                 |
|     |                              |           |           |              | **Note** The TGC does not disengage. If the TGC is disengaged, it opens at the end of the after-run.                                      |
| 7   | Tail lift                    | 0257      | Input 10 mA | IC B04      | Input signal (with Opt. 75182 installed)                                                                                                  
|     |                              |           |           |              | Open circuit = tail lift not activated                                                                                                     
|     |                              |           |           |              | Ground = tail lift open                                                                                                                   |
| 8   | Engine speed signal          | 5587      | Output 10 mA | ECM 1-34   | Pulse signal                                                                                                                                 |
| 9   | External lights              | 3333      | Output 5 A  | BCM A07     | 0 V = lights off                                                                                                                           
|     |                              |           |           |              | +24 V = lights on (parking, low and high beam)                                                                                              |
|     |                              |           |           |              | **Note** The signal is not activated by flashing the high beam lights. The signal is also supported with K15 OFF. After an error, the signal remains deactivated until the next request. |

(1) VCM default vehicle speed is 3 km/h. The value must not be modified in the case of certain Refurbishing Near Market requirements for RCV (please contact the IVECO market manager)  
(2) Vehicles with electrically activated main battery switch (OPT 2532)  
(3) The Service Network can change the signal to "K15 Remote Activation"  
Open circuit = K15 Remote not activated  
Ground = K15 Remote activated

**Note** The Bodybuilder must comply with the safety requirements.

**WARNING: SAFETY REQUIREMENTS**

*When the K15 Remote control was activated and the operator removed the ignition key with the engine running, the engine would not stop and it would be possible to move the vehicles with the steering locked.*

*For safety reasons, engine operation with K15 Remote control is therefore only to be activated in the following conditions:*

- With the vehicle stationary and the parking brake engaged;
- With the gearbox in neutral.

*If even one of these conditions is not present, the K15 Remote control is automatically disabled.*

*Remember that, due to the immobilizer, the engine cannot be started unless the ignition key is inserted.*
One possible solution is shown in Figure 12 and must be implemented by the bodybuilder to meet all the safety requirements.

Note that all the Bodybuilder controls must be disabled in a condition of K15. For this reason, a ShutOff relay with timed delay must be used.

![Figure 12](image)

1. K15 activation request switch
2. ShutOff relay with timed delay of 5 s

All the safety aspects, as well as their implementation, are the direct responsibility of the Bodybuilder.

c) Optional connector ST14C: 12 pin, grey

![Figure 13](image)

A. 41118329 Counterpart to be coupled (female)  
B. 41118310 Existing part on vehicle (male)

Table 5.6 - Basic functions of connector ST14C (Allison Automatic gearbox)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Neutral indicator for Extra PTO</td>
<td>5555</td>
<td>Output 500 mA</td>
<td>ALL 45</td>
<td>Gearbox in neutral. Ground for neutral engaged. This output function is activated by the TCM when Neutral is attained and a programmable combination of engine speed and transmission output speed has been detected.</td>
</tr>
<tr>
<td>Pin</td>
<td>Description</td>
<td>Wire Code</td>
<td>Max. Load</td>
<td>Connected to</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>--------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 2   | Multi-state switch           | 123888    | Input 15 mA | ALL 23       | Limitation 1st gear and inhibition reverse gear  
Open wire = function active  
+24V = function not engaged  
Ground = function active  
This function is normally enabled with an operator-controlled momentary switch.  
When the function is enabled, the transmission is limited to operation in only Neutral and (selectable*) low forward range(s).  
Operator requests to upshift beyond the maximum* gear range or to shift into Reverse are ignored by the TCM.  
If the function is enabled with Reverse selected on the shift selector, the transmission will shift to Neutral.  
If the function is enabled in a forward drive range higher than the maximum specified gear range*, the TCM will invoke preselect downshifts until the specified gear range is attained.  
The function is disabled when the enabling switch is released.                                                                                                     |
| 3   |                              | 1422222   | ALL 42     |              | For special applications - Input from PTO switch .  
Open wire = inactive  
+24V = active  
Ground = inactive  
Enabling this function alerts the TCM that PTO operation has been requested by the operator.  
When the input function is enabled, the TCM disrupts the “modulated main pressure” feature in the transmission, resulting in transmission operation at full main pressure.  
When the function is enabled and all of the following conditions exist, the TCM activates Output Function G (PTO Enable Output).  
Required operating conditions for enabling of this function are:  
• accelerator position is “low”,  
• engine speed and output speed are within Customer Modifiable Constant limits.                                                                                      |
| 4   | PTO active                   | 1431111   | Input 15 mA | ALL 43       | For special applications - 24V output to activate the PTO  
This output function is activated when use of the PTO has been requested and all operating conditions required to enable the PTO have been satisfied.                                                                 |
| 5   | PTO control                  | 1302222   | Output 500 mA | ALL 30     | For special applications - Logic mode "and" mode with pin 9  
Open wire = function inactive  
+24 V = function active  
Ground = function active  
The TCM determines this function enable request to be valid only after receiving two separate input signals.  
When properly integrated into the vehicle system, the enabled function automatically commands the transmission to Neutral when a supplementary vehicle brake is engaged.                                                                 |
| 6   | Reserved                     |           |           |              |                                                                                                                                             |
| 7   | Reserved                     |           |           |              |                                                                                                                                             |
| 8   | Double Automatic Neutral Input | 1171111   | Input 5 mA | ALL 17       | For special applications - Logic mode "and" mode with pin 9  
Open wire = function inactive  
+24 V = function active  
Ground = function active  
The TCM determines this function enable request to be valid only after receiving two separate input signals.  
When properly integrated into the vehicle system, the enabled function automatically commands the transmission to Neutral when a supplementary vehicle brake is engaged.                                                                 |

*switches & relays
<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>9</td>
<td>Double Automatic Neutral Input</td>
<td>1011111</td>
<td>Input 5 mA</td>
<td>ALL 1</td>
<td>For special applications - Logic mode &quot;and&quot; mode with pin 8 &lt;br&gt;Open wire = function inactive &lt;br&gt;+24 V = function inactive &lt;br&gt;Value close to digital ground = function active &lt;br&gt;The TCM determines this function enable request to be valid only after receiving two separate input signals. &lt;br&gt;When properly integrated into the vehicle system, the enabled function automatically commands the transmission to Neutral when a supplementary vehicle brake is engaged.</td>
</tr>
<tr>
<td>10</td>
<td>Digital ground</td>
<td>1033333</td>
<td></td>
<td>ALL 3</td>
<td>It must be used as return for &quot;closed on digital ground&quot; inputs. &lt;br&gt;Do not connect to the battery negative or to other grounds.</td>
</tr>
<tr>
<td>11</td>
<td>Range indicator</td>
<td>1132222</td>
<td>Output 500 mA</td>
<td>ALL 13</td>
<td>Gearbox: ground for neutral not engaged &lt;br&gt;This output function is activated by the TCM when the specified gear (or gears) is being commanded by the TCM.</td>
</tr>
<tr>
<td>12</td>
<td>&quot;Almost&quot; Neutral</td>
<td>1028049</td>
<td>Input 15 mA</td>
<td>ALL 23</td>
<td>Open wire = function inactive &lt;br&gt;+24 V = function active &lt;br&gt;Ground = function inactive &lt;br&gt;When the transmission is in first range and this function is enabled, the TCM automatically commands transmission operation at a reduced load state which is similar to Neutral. &lt;br&gt;Required conditions for enabling the function are:  &lt;br&gt;  • Vehicle is stationary;  &lt;br&gt;  • service brakes are applied;  &lt;br&gt;  • throttle position is &quot;low&quot;.</td>
</tr>
</tbody>
</table>

Contact Customer Service for any modifications.

**d) Optional connector ST40: 12 pin, blue**

![Diagram A](image1.png) ![Diagram B](image2.png)

**Table 5.7 - 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>Output 5 A</td>
<td>75000 / F31</td>
<td>Protected by fuse 20 A</td>
</tr>
<tr>
<td>2</td>
<td>K15</td>
<td>8871</td>
<td>Output 7.5 A</td>
<td>75000 / F19</td>
<td>Protected by fuse 10 A</td>
</tr>
</tbody>
</table>
Table 5.8 - 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>
<tr>
<td>2</td>
<td>Request gearbox in neutral Gearbox activation</td>
<td>6983</td>
<td>Output 500 mA</td>
<td>EM X4-05</td>
<td>Only with automatic gearbox Indicated that Driver requested Neutral gear &amp; Neutral gear being physically engaged Ground = ON Open circuit = OFF</td>
</tr>
</tbody>
</table>

The FMS CAN line is enabled with OPT. 14569.
For further information please see Chapter 5.3 (Page 28)
### 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) | Relay wiring: Activated via 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 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)  
- Automatic gearbox (when installed)  
- Body Computer System  
- Tachograph  
- Instrument panel

Detailed information for each system are available via CANopen – see EMCY object 0x1014
f) Optional connector 72072B: 20 pin, black

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

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

Table 5.9 - Basic functions of connector 72072B

<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 opt 6821 (Std. EN 1501) and AutoGbox. 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 (ENI501)</td>
<td>0994</td>
<td>Input 10 mA (1)</td>
<td>EM X3-20</td>
<td>Only supported with 6821 (Std. EN 1501) (1) Input to activate the Stopping brake (V &lt; 6 km/h) Ground = active, low side switch</td>
</tr>
<tr>
<td>4</td>
<td>Stop brake signal return (ENI501)</td>
<td>0995</td>
<td>Input 10 mA</td>
<td>EM X3-21</td>
<td>Reserved for IVECO exclusively Input to monitor the stop brake pressure Ground = active, low side switch</td>
</tr>
<tr>
<td>5</td>
<td>Stepper swt req. (ENI501)</td>
<td>0996</td>
<td>Input 10 mA (1)</td>
<td>EM X4-06</td>
<td>Only supported with 6821 (Std. EN 1501) (1) Input to activate the Refuse stepper switch Ground = active, low side switch Not available with ABS-HSA (opt 14861) installed</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 X1-03</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 X1-08</td>
<td>Left turn signal light 0 V = not engaged +24V = engaged</td>
</tr>
<tr>
<td>8</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Reserved</td>
<td>6988</td>
<td>1 A</td>
<td>EM X4-02</td>
<td>For future IVECO applications Keep EM alive &quot;output&quot; 0 V = not engaged +24V = engaged</td>
</tr>
</tbody>
</table>
### Table: 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>10</td>
<td>Brake lights EN1501</td>
<td>6989</td>
<td>Output 1 A</td>
<td>EM X4-03</td>
<td>Only supported w/ opt 6821. Output EN1501 Reverse protections brake active 0 V = not engaged +24 V = engaged after K15 active for 2 sec (w/o brake activated) Not available with ABS-HSA (opt 14861) installed</td>
</tr>
<tr>
<td>11</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Request <em>gearbox in neutral</em></td>
<td>6991</td>
<td>Output 1 A</td>
<td>EM X4-22</td>
<td>Reserved Contact IVECO for further details Supported with Automatic Gearbox 0 V = not engaged +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) Contact IVECO Customer Service for the adjustment 0 V = chassis not ready +24 V = chassis 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 0 V = OFF - low idle switch not active + 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 Signal based on PTO feedback signal/s 0 V = OFF - no PTO engaged + 24 V = ON - at least one PTO engaged</td>
</tr>
<tr>
<td>16</td>
<td>Bodybuilder fluid level</td>
<td>5981</td>
<td>Input 0-500 Ohm (1)</td>
<td>EM X4-14</td>
<td>Analogue input for IC display of bodybuilder fluid level (3) n.d. with CANopen enabled 0×6167</td>
</tr>
<tr>
<td>17</td>
<td>Bodybuilder pressure</td>
<td>5982</td>
<td>Input 0-32 V (1)</td>
<td>EM X4-15</td>
<td>Analogue input for IC display of bodybuilder pressure (5) n.d. with CANopen enabled 0×6167</td>
</tr>
<tr>
<td>18</td>
<td>Bodybuilder Thermal Temperature</td>
<td>5983</td>
<td>Input 0-500 Ohm (1)</td>
<td>EM X4-29</td>
<td>Analogue input for IC display of Bodybuilder temperature (4) n.d. with CANopen enabled 0×6167</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 of the Bodybuilder.

(2) Requirements for Functional Safety

- In case of an emergency during operation of the Bodybuilder application, the vehicle goes into the "Vehicle StoppedState" independently via activation of the Bodybuilder Emergency input (IVECO can offer pre-configured "StoppedState" settings). This feature is only available when the Bodybuilder application is in operation and not during vehicle movement; therefore, the Bodybuilder Enable input (72072A, pin 3) is simultaneously switched to ground.
- The "Vehicle Stopped State" values are transmitted via CAN to the other vehicle subsystems, therefore the output "Vehicle with full CAN operation" must be active. When this output is not active the application must not implement actions which rely on the EM nor on the entire Bodybuilder interface functioning properly. The Bodybuilder is responsible for initiating measures to ensure that the "Safe State" of the application activates independently.
- If the application also requires a "recovery" strategy while the "Vehicle with full CAN operation" output is passive, contact IVECO.
- The "Vehicle StoppedState" signal values will be transmitted directly after the Bodybuilder Emergency has been activated and will remain active until:
5.2 BODYBUILDER CONNECTORS

- $K15$ is switched off or
- the CANopen NMT 'Start Node' command is received or
- the CANopen NMT 'Start all Nodes' command is received
- the CANopen NMT 'Start via HW input' is configured and the signal is reactivated.

**Note:** During the 'Stopped State' phase, the relevant CANopen signals received on BB-CAN are ignored.

1. The stop brake can only be activated with vehicle speed below 6 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. An input on the waste compactor footboard (occupied footboard) activates the following actions on the actuated footboard switch, as described in Standard EN 1501-1 - Directives for occupied footboard:

- speed limiting
- reverse gear for rear loaded compactor. In the case of reverse gear engaged, protection by:
  - brakes activation;
  - torque limit set at 0% (only regulator at idle speed);
  - reverse gear is only prevented with automatic gearboxes if the input 72072A/03 is connected to ground by the Bodybuilder.

5. It is possible to display information relating to the vehicle load on the Instrument Panel, but only for the comfort functions. To enable this function, contact the IVECO Assistance Service. If wiring is added to the input(s), the relative CANopen objects regarding vehicle load information are no longer available. On the Stralis EVO range the trailer load information via ISO 1992-3 is not supported on the Euro 6 range.

(Pictures are by way of example only)

By using this function, alarm thresholds can be set for each type of load.
g) Optional connector 72072C: 9 pin, yellow

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

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

Table 5.10 - 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>Ground</td>
<td></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) 10A can be used in combination with the "Vehicle with full CAN operation" signal, connector 72072A pin 4.

B) Connectors on the chassis

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

- ST52 (for Bodybuilder specific solutions)
- ST64 (for Bodybuilder specific solutions)
- 72072D (EM)
- ST91 (PTO 1)
- ST92 (PTO 2)
- ST93 (PTO3)
Location of chassis connectors

**Figure 19**

A. Truck

B. Tractor

a) Connectors ST52 and ST64: 3 pin, black

A. 98435344 Existing part on vehicle (male)

B. 98435331 Counterpart to be coupled (female)

**Table 5.11 - Basic functions of connector ST52**

<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>Positive +15 for fitters</td>
<td>8871</td>
<td>Output 10 A</td>
<td>FCM A24</td>
<td>Also connected to ST64-2</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
<td>0000</td>
<td>Output 10 A</td>
<td>Wiring</td>
<td>Ground</td>
</tr>
<tr>
<td>Pin</td>
<td>Description</td>
<td>Wire code</td>
<td>Max. Load</td>
<td>Connected to</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>--------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>3</td>
<td>Side lights</td>
<td>3333</td>
<td>Output 5 A</td>
<td>BCM A07</td>
<td></td>
</tr>
</tbody>
</table>

(1) +24 V when:
- K15 OFF and side lights on
- K15 ON and side lights on
- K15 ON and lights on (low and/or high beam)

**Table 5.12 - 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>72010-11</td>
<td>Connection with 15-pin Trailer socket - Pin 11</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Positive +15 for fitters</td>
<td>8075</td>
<td>Output 10 A</td>
<td>FCM A24</td>
<td>Also connected to ST52-1</td>
</tr>
<tr>
<td>3</td>
<td>15-pin trailer socket</td>
<td>6021</td>
<td>72010-10</td>
<td>Connection with 15-pin Trailer socket - Pin 10</td>
<td></td>
</tr>
</tbody>
</table>

For general use by Bodybuilder: allows the use of 3 terminals of the 15 pole connector for the trailer.

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

A. 504411928 Counterpart to be coupled (female)  
B. 41118387 Existing part on vehicle (male)

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

**Table 5.13 - Basic functions of connector 72072D**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>K30</td>
<td>7795</td>
<td>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>
</tbody>
</table>
| 3   | CO enable (CANopen)       | 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 the IVECO Technical Service  
Open circuit = CANopen not operational  
0 V = CANopen operational                                      |
| 4   | Bodybuilder CAN           | CAN H     | EM X4-17  | EM X4-17     | CANopen Truckgateway                                                     |
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>5</td>
<td>CAN line Ground</td>
<td>0999</td>
<td></td>
<td>EM X4-09</td>
<td>HF Ground (High Frequency), capacitive coupled</td>
</tr>
<tr>
<td>6</td>
<td>Bodybuilder CAN</td>
<td>CAN L</td>
<td></td>
<td>EM X4-19</td>
<td>CANopen Truckgateway</td>
</tr>
<tr>
<td>7</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

A. 98435341 Existing part on vehicle (male)  
B. 98435337 Counterpart to be coupled (female)

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

### Table 5.14 - Basic functions of connector ST91

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PTO1 feedback</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</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>electromagnetic</td>
<td></td>
<td></td>
<td></td>
<td>ON = +24V = valve activated</td>
</tr>
<tr>
<td>3</td>
<td>PTO1 pressure</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>switch</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</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>consent</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td></td>
<td>Ground</td>
<td></td>
</tr>
</tbody>
</table>

(1) During the K15 OFF phase, the input will not be activated so as to avoid an increase in the sleep current of "m".

### Table 5.15 - Basic functions of connector ST92

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PTO2 feedback</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</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>electromagnetic</td>
<td></td>
<td></td>
<td></td>
<td>ON = +24V = valve activated</td>
</tr>
<tr>
<td>3</td>
<td>PTO2 pressure</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>switch</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</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>consent</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td></td>
<td>Ground</td>
<td></td>
</tr>
</tbody>
</table>
(1) During the K15 OFF phase, the input will not be activated so as to avoid an increase in the sleep current of **m**.

**Table 5.16 - Basic functions of connector ST93**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Wire code</th>
<th>Max. Load</th>
<th>Connected to</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PTO3 feedback signal</td>
<td>6133</td>
<td>Input 10 mA (1)</td>
<td>EM X3-10</td>
<td>Connect to ground to read the PTO3 feedback</td>
</tr>
</tbody>
</table>
| 2   | PTO3 activation via electromagnetic valve | 9123   | Output 1.5 A | EM X1-06    | OFF= 0V =valve not activated
ON = +24V = valve activated                         |
| 3   | PTO3 pressure switch                 | 0393      | Input 10 mA (1) | EM X3-16    | Connected to ground if active
Used for Multipower and engine PTO
It could also be used to monitor the Bodybuilder consent |
| 4   | Ground                               | 0000      |           | Ground      |                                                   |

(1) During the K15 OFF phase, the input will not be activated so as to avoid an increase in the sleep current of **m**.

### 5.3 SPECIAL INSTRUCTIONS

#### a) Smart Auxiliaries

On C11 and C13 engine variants IVECO offers a highly sophisticated fuel saving package, making use of smart auxiliaries. These auxiliaries can be ordered via:

- CCP 78467 – Smart Auxiliaries
- CCP 78387 – Smart Auxiliaries + Smart EGR

Vehicles equipped with such an option reduce fuel consumption also by:

- **Regenerative braking** = recharging batteries using vehicle kinetic energy (charging voltage may reach 31V).
- **Passive boost** = suspending battery charging at high engine loads.
- **Steady state charging** = keeping StateOfCharge (SOC) in an optimum phase: SOC between 65% and 85%, instead of being always 100% charged.
- **Quick charge** = increased charging voltage 29V.

Please note that these smart functions may affect the electric/electronic components the BodyBuilder has designed or chosen.

- Supply voltage range is still within 32V limit, but Smart charging frequently reaches 31V. BodyBuilder systems must be compatible.
- Batteries StateOfCharge (SOC) might be reached only 65% during operation, some applications using battery power supply at engine standstill might be affected since available overall electric energy is being reduced.
- Special batteries are needed to guarantee lifetime also with the increased charges cycles of a smart alternator system; typically this is offered by carbon batteries, which are also used by IVECO.

IVECO is developing a programming at Customer Service, which converts Smart alternator to a conventional alternator. (28.3V max and always charge to 100%).

Please respect that this modification will partially reduce the smart auxiliaries fuel savings.
b) Operating supply voltage range

Electric/electronic components adopted by the BodyBuilder are designed for the following minimum and maximum supply voltage range.

<table>
<thead>
<tr>
<th>Temperature range [°C]</th>
<th>Voltage supply range limits [V]</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>T_{min}</td>
<td>T_{max}</td>
<td>U_{min}</td>
</tr>
<tr>
<td>-40</td>
<td>75</td>
<td>1.2</td>
</tr>
<tr>
<td>-40</td>
<td>80</td>
<td>16</td>
</tr>
<tr>
<td>-40</td>
<td>85</td>
<td>22</td>
</tr>
</tbody>
</table>

It is the responsibility of the BodyBuilder to design his electric/electronic components to withstand the voltage supply range limits. Typical operation voltage is as follows:

<table>
<thead>
<tr>
<th>Engine status</th>
<th>Without Smart Auxiliary</th>
<th>With Smart Auxiliary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine off [max]</td>
<td>25 V</td>
<td>25 V</td>
</tr>
<tr>
<td>Engine running [max]</td>
<td>28.5 V</td>
<td>31 V</td>
</tr>
</tbody>
</table>

If components are not compatible, the BodyBuilder is to take appropriate measures (such as installing a voltage stabilizer / suppressor diode and/or Zener diodes) correctly dimensioned for the individual devices.

IVECO cannot accept any warranty for components, malfunctions or resulting damages.

c) Load dump protection

The BodyBuilder is to prevent battery disconnection while the engine is running. In particular, disconnecting a discharged battery while the alternator is generating charging current with other loads remaining may lead to load dumps.

It is the responsibility of the BodyBuilder to keep the vehicle owner / operators / workshops informed accordingly. IVECO cannot accept any warranty for components, malfunctions or resulting damages.

d) 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.

In the case of Stralis Euro VI the main information can be displayed directly on the radio screen, if this is the type designed for this 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 windshield;
- 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>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical level</td>
<td>Unshielded twisted pair cable compliant with ISO std. 11898 (SAE J1929/11).</td>
</tr>
<tr>
<td></td>
<td>Termination of internal bus to cable with 120 Ω resistor.</td>
</tr>
<tr>
<td>Application level</td>
<td>Messages and parameters compliant with SAE J1939/71.</td>
</tr>
</tbody>
</table>

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

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

### 5.4 TAIL LIFT

To attain compliance with the VEHH standard (Association of European tail lift manufacturers), opt. 75182 is also available as described in Chapter 3.9 "VEHH configuration for tail lifts" (≈ Page 45)) for mechanical aspects.

Information regarding the connector and wiring diagrams is provided below.

**Optional connector 72096: 7 pin, black**

![Diagram of connector and wiring](image)

A. 504111928 Counterpart to be coupled (female)  
B. 41118387 Existing part on vehicle (male)
# Table 5.19 - Basic functions of connector 72096

<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>
| 1   | Tail lift activation from dashboard switch | 6881       | Output    | Wiring       | $U_{t.lift} = \text{tail lift activated}$  
$0 \, \text{V} = \text{tail lift not activated}$  
**Note:** Also prevents engine start-up. Requires the signal $U_{t.lift}$ on pin 7 |
| 2   | Tail lift indication on instrument panel  | 0258       | Input     | IC X-xx      | If pin 6 = NOT Ground AND pin 5 = NOT $U_{t.lift}$ then:  
Ground = no indication on the instrument panel  
Open circuit = no indication on the instrument panel  
If pin 6 = Ground AND pin 5 = $U_{t.lift}$ then:  
Ground = indication on the instrument panel of tail lift open  
Open circuit = no indication on the instrument panel |
| 3   | Tail lift indication on instrument panel  | 0259       | Input     | IC X-xx      | If pin 6 = NOT Ground AND pin 5 = NOT $U_{t.lift}$ then:  
Ground = indication on the instrument panel of tail lift activated  
Open circuit = no indication on the instrument panel  
If pin 6 = Ground AND pin 5 = $U_{t.lift}$ then:  
Ground = no indication on the instrument panel  
Open circuit = no indication on the instrument panel |
| 4   | K15 for tail lift                        | 8871       | Output 10 A | 75000 / F20 |                                                                 |
| 5   | Tail lift control *open*                  | 8135       | Input     |              | Main power supply $U_{t.lift}$ when the tail lift is open |
| 6   | Tail lift control *activated*             | 0395       | Input     |              | Connected to ground when the tail lift is activated |
| 7   | $U_{t.lift}$ signal from tail lift        | 9841       | Input     |              | $U_{t.lift} = \text{tail lift activated}$  
Open circuit = tail lift not activated |
Tail lift for STRALIS Hi-Way

8000 Starter motor
20000 Starter battery
25200 Ignition contactor
25550 Contactor for preventing tail lift start-up engaged
25571 Contactor for VEHH tail lift control
25576 Contactor for tail lift warning light
25775 Contactor and fuse holders (module 6)

50005 Switch with built-in warning light for heated rear-view mirrors
52219 Switch for activating tail lift
52502 Key switch for services with start-up
72096 7-pole junction for tail lift connection
75000 Interconnection control unit
B6132 VCM (Vehicle Control Module) control unit
Tail lift for STRALIS Hi-Road / Hi-Street

8000  Starter motor
20000  Starter battery
25200  Ignition contactor
25550  Contactor for preventing tail lift start-up engaged
25571  Contactor for VEHH tail lift control
25576  Contactor for tail lift warning light
25775  Contactor and fuse holders (module 6)

50005  Switch with built-in warning light for heated rear-view mirrors
52219  Switch for activating tail lift
52502  Key switch for services with start-up
72096  7-pole junction for tail lift connection
75000  Interconnection control unit
86132  VCM (Vehicle Control Module) control unit
5.5 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.

Note  For any exception to mounting instructions, IVECO’s written authorisation is necessary.

Lock of observance of above described prescriptions involves guarantee lapse.

Disconnecting electronic control units

Follow the instructions below carefully before disconnecting an electronic control unit:

- turn the ignition key to OFF and remove it;
- switch off the additional heaters and wait for the end of the cooling down cycle (the warning light of the corresponding key will go out);
- open the DGC (Main Current Switch, see Chapter 5.9 (☞ Page 45));
- 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.
5.6 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 Repair Manual, print 692.68.512 (STRALIS Hi-Way) and print 692.68.498 (STRALIS Hi-Road and Hi-Street).

These are available through the Service Network and can also be requested from sales bodies.

---

Precautions for work on the system

- **Electrical work (e.g. removing cables, adding circuits, replacing equipment or fuses, etc.), performed in a manner inconsistent with the IVECO instructions or by unqualified personnel, can cause serious damage to electronic control units and compromise driving safety.**

- **Any electrical work which does not comply with regulations may cause significant damage (e.g. short circuits with the possibility of fire and destruction of the vehicle) and authorises IVECO to annul the warranty.**

Before removing any electrical/electronic equipment, disconnect the ground cable from the battery negative terminal.

---

**Note** Whenever an electrical connection is opened, the two counterparts must be protected (for example, with sticky paper) to avoid infiltration of water or dirt.

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 cables which differ in the signal and negative:
  - placed at a distance of at least 100 mm (reference value = 150 mm) from high heat sources (turbine, engine, exhaust manifold, etc.);
  - placed at least 50 mm from containers of chemical agents (batteries, etc.);
  - placed at least 50 mm from moving parts.
- The path of the cables must be defined with dedicated and reconciled brackets and clamps, to avoid hanging parts and to allow the installation to be restored after repairs or interventions.
- The passage of cables through holes and on the edges of metal sheets must be protected by cable gaskets in addition to the corrugated tube. It is not possible to specially drill the chassis to allow the cables path.
- The corrugated tubing must completely protect the entire cable and be connected (with heat shrinking or taping) to the rubber caps on the terminals.
- All the positive terminals and cable terminals must be protected by rubber caps (air-tight in areas exposed to weathering or with possible stagnation of water).
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).

Use only fuses with the features prescribed for the specific function. NEVER USE FUSES WITH A CAPACITY HIGHER THAN THE PRESCRIBED. Replace using only keys and disconnected users.

When the operations have been completed, restore the original conditions of the wiring (paths, protections, strips), making sure that the cables are not in contact with metallic surfaces which could affect their integrity.

Precautions for work on the chassis

For work on the chassis, to protect the electrical system, its equipment and ground connections, respect the precautions shown in Chapter 2.1 - Paragraph "Special Precautions" (⇒ Page 5) and Chapter 2.3 - Paragraph "Welding" (⇒ Page 8).

If required by the application of additional devices, diodes must be fitted to protect against any inductive current peaks.

The ground signal from the analogue sensors must only be wired on the specific receiver; additional ground connections may distort the output signal from this sensor.

The cable bundles for low signal intensity electronic components must be arranged parallel to the reference metal plane, namely adherent to the chassis / cab structure, in order to minimise parasitic capacities; space the path of the cable bundle added to the existing one as much as possible.

The added systems must be connected to the ground of the system with the utmost care (see Paragraph "Ground Points" (⇒ Page 35)); the related wiring harnesses should not be coupled to the electronic circuits that already exist on the vehicle in order to avoid electromagnetic interference.

Ensure that the wiring of the electronic devices (length, type of conductor, position, strips, cable shielding connection, etc.) comply with indications provided by IVECO.

Carefully restore the original system after any operations.

Ground points

The original earth connections of the vehicle should never be altered; in cases where these connections must be moved or new connections added, use the holes present on the chassis to the extent possible, taking care to:

- mechanically remove - either by filing and/or with a suitable chemical based solution - the paint on both the chassis and terminal side, thus creating a contact surface free of indentations and edges;
- paint the area between the terminal and metal surface with a suitable high conductivity paint.
- connect to earth within 5 minutes after application of the paint.

As regards the signal related ground connections (e.g. sensors or low-absorption devices), do not use the standardized points Under no circumstances use standardized points for engine ground connection and chassis ground connection.

Additional signal grounds must be positioned at different points from the power ground.
1. **Ground connections:** (A) connection is correct; (B) connection is incorrect

2. Correct cable fastening to the ground point using: (A) screw, (B) cable terminal, (C) washer, (D) nut

3. Cable connected to ground

---

**Figure 26**

---

**Figure 27**

---

- **M1**: Battery ground
- **M2**: Starter motor ground
- **M3**: Upper cab ground
- **M4**: Right inner cab ground

- **M5**: Left inner cab ground
- **M6**: Front right chassis ground
- **M7**: Engine ground
- **T1**: Equipotential braid
- **T2**: Equipotential braid
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.
- With junction connectors (Figure 29) the unshielded sections "a" must be short as possible;
- The cables must be routed in such a way as to be parallel to the reference plane, as close as possible to the chassis/body.

"STELLA" connections of various negatives with the system ground

Shielding by means of a metal braid of a cable leading to an electronic component
Electromagnetic compatibility

It is recommended that electrical, electro-mechanical and electronic devices which comply with the following immunity requirements for electromagnetic emissions, (both irradiated and conducted) are used.

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

- 50 V/m immunity for devices performing secondary functions (not impacting on direct vehicle control), for frequencies varying from 20 MHz to 2 GHz;
- 100 V/m immunity for devices primary secondary functions (not impacting on direct vehicle control), for frequencies varying from 20 MHz to 2 GHz;

The maximum excursion allowed for transition voltage for equipment powered at 24 V is +80 V measured on the terminals of the artificial network (L.I.S.N.) if tested at the bench. Alternatively, if tested on the vehicle, the excursion must be identified in the most accessible location close to the interference device.

Note: Devices powered at 24 V must:
- be immune to interferences such as -600 V negative spikes, +100 V positive spikes, bursts of ±200 V;
- operate correctly during the phase when voltage drops to 8 V for 40 ms and to 0 V for 2 ms;
- resist the load dump phenomena up to 58 V.

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

**Table 5.20 - 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 dBrV/m</th>
<th>Unit of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>150-300 kHz</td>
<td>dBµV/m</td>
</tr>
<tr>
<td></td>
<td>Aerial at a distance of 1 metre</td>
<td>Broadband</td>
<td>almost peak</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td></td>
<td>radiated</td>
<td></td>
<td></td>
<td>54</td>
<td></td>
</tr>
<tr>
<td></td>
<td>radiated</td>
<td>Broadband</td>
<td>peak</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td></td>
<td>radiated</td>
<td>Narrow band</td>
<td>peak</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>conduit</td>
<td>Broadband</td>
<td>almost peak</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>conduit</td>
<td>Broadband</td>
<td>peak</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td></td>
<td>conduit</td>
<td>Narrow band</td>
<td>peak</td>
<td>70</td>
<td></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.
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.

5.7 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 32);
   • 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 31).
   Installation on the centre of the roof is to be considered the best by far, as the grounding is proportional in all directions.
5. The quality of the antenna, the mounting position and a perfect connection to the vehicle structure (ground) are factors of fundamental importance to guarantee the best performance of the transmitter equipment.
1. Antenna support
2. Gasket
3. Fixed joint cover

4. Fastening screw M6x8.5 (tighten to a tightening torque of 2 Nm)
5. Antenna
6. Roof panel
7. Antenna extension cable

1. Antenna connector
2. Ground wire
3. Insulator
4. Signal wire
5. Condenser (100 pF)
6. Cable RG 58 (characteristic impedance = 50 Ω)
7. Clamp
8. Protection cap

9. Connector (N.C. SO - 239) transceiver side
10. Test executed sticker
11. The 100 pF condenser must be soldered on the lower pin and crimped to the ground braid
12. The lower pin must be soldered to the core conductor of the cable
13. Nut

Power for the equipment, when the voltage required is different to that for the system, must be obtained using a suitable DC/DC 12-24V converter if not already provided. The power cables must be as short as possible, avoiding any twists (coils) and maintaining the minimum distance from the reference plane.

In addition to indications provided in this Use and Maintenance Manual (Section: Controls and devices), below are some specific indications 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.

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 least 1 meter away from other devices.

- The ROS value (Stationary Wave Ratio) must be as close as possible to the unit (the recommended value is 1.5), while the maximum acceptable value must never be greater than 2.
- The ANTENNA GAIN values must be as high as possible and guarantee a sufficient level of spatial uniformity, characterised by deviations in relation to the average value to the order of 1.5 dB in the 380-460 MHz band and 870-960 MHz and 2 dB in the 1710-2000 MHz band.
- The IRRADIATED FIELD in cab value must be as low as possible, and however < 1 V/m.

In any case, limits set by the applicable European Directive must never be exceeded.

The optimal position of the aerial is at the front of the cab roof, at a distance of 30 cm from other aerials.

GPS reception and satellite navigation equipment

Install the transmitting part in a flat, dry area, separate from the electronic components of the vehicle, away from humidity and vibrations. If the transmission is impulsive it must be at a distance of at least 1 meter away from other devices. The GPS antenna must be installed so as to have the maximum visibility possible of the sky.

In fact, as the signals received from the satellite are at very low power (approximately 136 dBm), almost any obstacle can influence the quality and performance of the receiver. The following should therefore be guaranteed:

- an absolute minimum angle of vision of the sky of 90°;
- a distance no less than 30 cm from any other antenna;
- a horizontal position and never underneath any metal which makes up part of the cab structure.

Moreover:

- the ROS value (Stationary Wave Ratio) must be as close as possible to the unit (the recommended value is 1.5), while the maximum must never be greater than 2 in the GPS frequency range (1575.42 ± 1.023 MHz).
- the ANTENNA GAIN values must be as high as possible and guarantee a sufficient level of spatial uniformity, characterised by deviations in relation to the average value to the order of 1.5 dB in the 1575.42 ± 1.023 MHz band.
5.8 ADDITIONAL EQUIPMENT

The vehicle system is set up to supply the necessary power to the equipment provided, for each of which, as part of their function, the specific protection is assured as well as the correct 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.
1. Standard batteries  
2. Additional batteries  
3. Alternator with built-in regulator  
4. Starter motor  
5. Ignition switch  
6. Contactor switches  
7. Instrument panel  
8. BCM

⚠️ All the lines downstream of all batteries are to be adequately protected, under any fault condition. Failure to ensure adequate protection may pose a fire hazard and a danger to persons.

**Additional alternators**

The installation of additional batteries involves the verification of the ability of the alternator to charge. If the results of this verification are negative, an alternator with more power must be used, or an additional alternator must be adopted; in this case, connection must be made as indicated in the following Figure.
The installation of additional equipment must include suitable protections and should not overload the vehicle system. The additional alternators must be the type with Zener diode rectifiers to avoid damaging electric/electronic equipment due to accidental battery disengagement. Each alternator must also have a light or LED indicating low battery charge.

The additional alternator must have electrical features identical to those of the standard alternator and the cables must be correctly sized.

If you need to modify the system in a way other than described in this manual (for example, adding batteries in parallel), it is necessary to share the operation with IVECO.

Additional electrical units

Particular attention must be paid when installing cooling units that use a second alternator, mounted on the engine (additional generator), as a power source.

These generators provide, depending on the number of turns, a voltage of the order of 270 ÷ 540 V which goes through the wiring to the cooling unit installed on the vehicle.

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

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

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

In case of a standard alternator malfunction (e.g. low voltage, no signal) on the 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.
5.9 CURRENT DRAWS

- It is not permitted to connect additional electrical systems directly to the positive pole of the battery assembly, as this is reserved for cables directed to the fuse holder. The fuse holder must not be changed or moved.

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

Current draws are possible from the main current switch DGC (standard equipment) or the TGC main current contactor (if fitted), or (under certain conditions) the PDU unit.

A) Main current switch (DGC)

It is generally located on the battery casing and functions automatically. It is a two-pole switch that disconnects the battery from the chassis, allowing the operation of the tachograph, body computer, cooling unit, bed module and instrument panel.

For special modifications (e.g. transport of fuel, transport of dangerous substances) it may be necessary to use a safety switch that isolates the batteries and the alternator from the rest of the system.

Note: Parallel connection is permitted with the output of the switch, provided that the current draw does not exceed 150A, suitable fuses are used and the necessary precautions are taken. If other draws are in progress, an additional strong one may generate difficulties.

Specific solutions must be authorised by IVECO.

B) Main current contactor (TGC)

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.

c) Power distribution unit (PDU)

The PDU is a junction box which, on the vehicle wiring diagram, is inserted between the DGC and the starter motor (see Fig. 35).

If it is combined with a 150A fuse (“megafuse”), this constitutes a safe point for drawing current.

The PDU combined with a fuse, is part of the standard equipment of trucks with right-hand drive (due to technical constraints), while it is available as an optional on trucks with left-hand drive (no. 78388).

For tractors, it is possible to adopt just the PDU.
1. PDU Control unit
2. Positive cable from the battery cutoff switch to the PDU control unit 70 mm²
3. Cable from the PDU to the starter motor 70 mm²
4. Cable from the PDU to the fusebox on the roof (RH drive vehicles only) 50 mm²
5. Cable from the PDU to the 150A fuse (if fitted) 50 mm²
Current draws exceeding 250 A are not permitted.

Provided there is a 150A fuse present, currents exceeding 150A can be supplied for a period which in any case does not exceed the maximum period indicated in the graph of Figure 37.

Therefore, by way of example, a supply of 200A can be provided for 120 seconds while a supply of 250A can be supplied for 2 seconds.
Time-current characteristic curve for the 150 A fuse @ 23 °C

A  Time [s] in a logarithmic scale

B  Electric current [A]
Base: ISO Standard 8820

Voltage reducer

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

Do not power the unit directly by taking 12V voltage from a single battery.

⚠️ The voltage reducer is arranged for a maximum current absorption of 20 A at a temperature of 30°C (measured in the device compartment on the upper cross member). Therefore, it must not be used if other devices indicate higher absorption.
5.10 MISCELLANEOUS

a) Additional circuits

They must be separated and protected from the vehicle main circuit by means of a specific fuse. The cables used must be a size that is suitable for the relative functions and must be well insulated. They must also be suitable protected in sheaths (not PVC) or routed though flexible conduits in the case of a plurality of functions (the use of polyamide type 6 plastic is recommended) and they must be correctly installed in a place where they are protected from impact and heat sources. Take care to avoid any chaffing with other components, particularly with live edges of the bodywork.

The passage of these cables through structural components (cross members, profiles, etc.) must be executed using suitable cable glands or protections; they must be secured separately with insulated cable clamps (e.g. made of nylon) at adequate intervals (approx. 200 mm). Do not make any holes in the chassis and/or bodywork for the passage of cables.

In case of external panels, use a specific sealant both on the cable and on the panel to prevent water, dust and fumes from infiltrating.

Establish suitable distance between electrical wiring harnesses and other components as follows:

- 10 mm from static components;
- 50 mm from moving components (minimum distance = 20 mm);
- 150 mm from components which generate heat (e.g. engine exhaust).

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

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

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

<table>
<thead>
<tr>
<th>Max. continuous current (A)</th>
<th>Cable cross-section (mm²)</th>
<th>Fuse capacity (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4</td>
<td>0.5</td>
<td>5</td>
</tr>
<tr>
<td>4 - 8</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>8 - 16</td>
<td>2.5</td>
<td>20</td>
</tr>
<tr>
<td>16 - 25</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>25 - 33</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>33 - 40</td>
<td>10</td>
<td>50</td>
</tr>
<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 the lower heat dispersal capacity current intensity must be reduced with respect to the nominal value of a single cable.
- In vehicles with frequent engine start-ups, with limited current drawn and engine rotations (e.g. vehicles with refrigeration chambers), provide for periodic battery charging to maintain efficiency.
- 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.

b) Interventions for modifying the 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.

c) 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 5.22 - 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>EM X1-05</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>
<tr>
<td>3</td>
<td>EN1501</td>
<td>6989</td>
<td>1 A</td>
<td>EM X4-03</td>
<td>Output EN1501 Reverse protections brake active</td>
</tr>
<tr>
<td></td>
<td>Brake lights</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>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>after K15 active for 2 sec (w/o brake activated)</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>0266</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>External stop brake request (EN1501)</td>
<td>0994</td>
<td>10 mA</td>
<td>EM X3-20</td>
<td>Input signal to activate the Stopping brake (V&lt;2km/h)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ground = active, low side switch</td>
</tr>
<tr>
<td>6</td>
<td>EN1501</td>
<td>6989</td>
<td>1 A</td>
<td>EM X4-03</td>
<td>Output EN1501 Reverse protections brake active</td>
</tr>
<tr>
<td></td>
<td>Brake diagnostics warning light</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>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>after K15 active for 2 sec (w/o brake activated)</td>
</tr>
<tr>
<td>7</td>
<td>K30</td>
<td>7795</td>
<td>10 A</td>
<td>K30</td>
<td>Protected by 10A fuse F41 via ST48/I ( )</td>
</tr>
<tr>
<td>8</td>
<td>Ramp switch request (EN1501)</td>
<td>0996</td>
<td>10 mA</td>
<td>EM X4-06</td>
<td>Input to activate the Refuse stepper switch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ground = active, low side switch</td>
</tr>
<tr>
<td>9</td>
<td>Buzzer (EN1501)</td>
<td>6987</td>
<td>1 A</td>
<td>EM X4-01</td>
<td>reserved for IVECO exclusively</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Output EN1501 Warning sound indicator</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>

**d) 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 cross member of the chassis (trucks).
### 15-pole connector (72010) for trailer

![Image of 15-pole connector](image-url)

**Figure 39**

#### Table 5.23 - Basic functions of the 15-pole connector (72010) for the trailer

<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>Left trailer indicator</td>
<td>1180</td>
<td>2.3 A</td>
<td>FCM A01</td>
<td>The FCM control unit is able to manage current peaks of up to 4.5 A for a limited time; beyond this threshold, output is disabled.</td>
</tr>
<tr>
<td>2</td>
<td>Right trailer indicator</td>
<td>1185</td>
<td>2.3 A</td>
<td>FCM A33</td>
<td>The FCM control unit is able to manage current peaks of up to 4.5 A for a limited time; beyond this threshold, output is disabled.</td>
</tr>
<tr>
<td>3</td>
<td>Trailer rear fog light</td>
<td>2283</td>
<td>4.6 A</td>
<td>FCM A07</td>
<td>The FCM control unit is able to manage current peaks of up to 6 A for a limited time; beyond this threshold, output is disabled.</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 left side marker/side lights</td>
<td>3339</td>
<td>6 A</td>
<td>FCM A09</td>
<td>Beyond the value indicated, the FCM control unit will disable the relative output.</td>
</tr>
<tr>
<td>6</td>
<td>Trailer right side marker lights/side lights</td>
<td>3330</td>
<td>6 A</td>
<td>FCM A28</td>
<td>Beyond the value indicated, the FCM control unit will disable the relative output.</td>
</tr>
<tr>
<td>7</td>
<td>Trailer stop lights</td>
<td>1179</td>
<td>4.6 A</td>
<td>FCM A13</td>
<td>The FCM control unit is able to manage current peaks of up to 6 A for a limited time; beyond this threshold, output is disabled.</td>
</tr>
<tr>
<td>8</td>
<td>Trailer reverse light</td>
<td>2226</td>
<td>4.6 A</td>
<td>FCM A19</td>
<td>The FCM control unit is able to manage current peaks of up to 6 A for a limited time; beyond this threshold, output is disabled.</td>
</tr>
<tr>
<td>9</td>
<td>Power supply for trailer socket after fuse for T.M.P. users</td>
<td>7790</td>
<td>10 A</td>
<td>25770 / F8</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>15-pole socket power supply</td>
<td>6021</td>
<td>10 A</td>
<td>ST64-3 (FCM A24)</td>
<td>The FCM control unit is able to manage current peaks of up to 11 A for a limited time; beyond this threshold, output is disabled.</td>
</tr>
<tr>
<td>11</td>
<td>Power supply for trailer interlocking positive +15</td>
<td>8075</td>
<td>10 A</td>
<td>ST64-1 (FCM A24)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Trailer axle in raised position signal</td>
<td>6442</td>
<td>5 A</td>
<td>75000 A12 / F12</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Ground</td>
<td>0000</td>
<td>11 A</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Spare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Spare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7-pole connector (72006) for trailer

![7-pole connector](image)

Table 5.24 - Basic functions of the 7-pin connector (72006) for the trailer

<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>Battery positive connected to fuse for trailer EBS</td>
<td>7772</td>
<td>30 A</td>
<td>75000-B25 / F47</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 / F8</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ground</td>
<td>0000</td>
<td>10 A</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td>30 A</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Trailer EBS fault signal</td>
<td>6671</td>
<td></td>
<td>BCM E22</td>
<td>Inlet of the BCM control unit with dry current of the 10 mA contact</td>
</tr>
<tr>
<td>6</td>
<td>CAN H line</td>
<td>W5/Bi</td>
<td></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></td>
<td>EBS X3-4</td>
<td>Connected to EBS control unit</td>
</tr>
</tbody>
</table>

e) Side marker light installation (Side Marker Lamps)

EC regulations require that vehicles are provided with side and clearance lights when the total length exceeds 6 m.

Installation of the side lights must be carried out on the additional structures (containers, vans, etc.), while the electric power supply is obtained by the specific connectors ST77 and ST78 on the chassis (trucks only).

Below is an illustration of the position for these terminals.

**Note**  It is not possible to draw current from side marker lights.
# Table 5.25 - Basic functions of connector ST77

<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>Sidelights</td>
<td>3330</td>
<td>6 A</td>
<td>FCM A28</td>
<td>Common with 15-pin Trailer socket - Pin 6</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
<td>0000</td>
<td>5 A</td>
<td>Wiring</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sidelights</td>
<td>3330</td>
<td>6 A</td>
<td>FCM A28</td>
<td>Common with 15-pin Trailer socket - Pin 6</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td>5 A</td>
<td>Wiring</td>
<td></td>
</tr>
</tbody>
</table>

# Table 5.26 - Basic functions of connector ST78

<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>Sidelights</td>
<td>3339</td>
<td>6 A</td>
<td>FCM A09</td>
<td>Common with 15-pin Trailer socket - Pin 5</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
<td>0000</td>
<td>5 A</td>
<td>Wiring</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sidelights</td>
<td>3339</td>
<td>6 A</td>
<td>FCM A09</td>
<td>Common with 15-pin Trailer socket - Pin 5</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
<td>0000</td>
<td>5 A</td>
<td>Wiring</td>
<td></td>
</tr>
</tbody>
</table>
f) Fuses and relays

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

**Table 5.27 - 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>
<td></td>
<td></td>
</tr>
<tr>
<td>ST14A</td>
<td>21</td>
<td>10 A</td>
<td>75000</td>
<td>F52</td>
<td>K30 (24 V) - After TGC (Main Current Contactor)</td>
</tr>
<tr>
<td>72072C</td>
<td>1</td>
<td>10 A</td>
<td>75000</td>
<td>F53</td>
<td>Battery (24 V) - After TGC (Main Current Contactor)</td>
</tr>
<tr>
<td>ST48</td>
<td>4</td>
<td>15 A</td>
<td>75000</td>
<td>F54</td>
<td>K30 (24 V) - for EM X1-02</td>
</tr>
<tr>
<td>ST48</td>
<td>5</td>
<td>15 A</td>
<td>75000</td>
<td>F66</td>
<td>K30 (24 V) - for EM X1-09</td>
</tr>
<tr>
<td>ST14A</td>
<td>11</td>
<td>3 A</td>
<td>75000</td>
<td></td>
<td>K15 (24 V) from BCM H04</td>
</tr>
</tbody>
</table>

**Table 5.28 - Relays**

<table>
<thead>
<tr>
<th>Module</th>
<th>Relay</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<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>
</tr>
<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 - EN1501</td>
</tr>
<tr>
<td>25781</td>
<td>R4</td>
<td>Diode for EM - EN1501</td>
</tr>
</tbody>
</table>
5.11 SAFETY ELECTRONIC DEVICES

Note  It is recommended that the following information is integrated with information provided in the Use and Maintenance in terms of the detail of the features of the systems described, the operating modes and restrictions.

Radar sensor

The radar sensor is installed on the front bumper. It takes various measurements and integrates the data with the following safety systems of the vehicle:

- AEBS emergency braking (Advanced Emergency Braking System)
- ACC speed control system (Adaptive Cruise Control)

The main function of the radar sensor is to perform ensure constant monitoring of the following:

- the distance from vehicles in front, according to the value set by the driver
- detection of obstacles on the road to allow activation of a gradual alarm, partial braking or complete braking

⚠️ Since the device carries out processing operations which are fundamental for safety, installation and calibration procedures are required which can only be carried out by IVECO during the first equipment: After-sales installation is not permitted.

For compliance with the safety specifications and functional performance of the vehicle, strictly observe the following instructions:

- no additional structure, accessory or metal panel for signalling purposes can be installed within the "main radiation cone" of the radar (red zone in Figure 43, the dimensions of which are shown in Table 5.29)

Table 5.29

<table>
<thead>
<tr>
<th>Distance [mm]</th>
<th>Width [mm]</th>
<th>Height [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>113</td>
<td>61</td>
</tr>
<tr>
<td>20</td>
<td>117</td>
<td>63</td>
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<tr>
<td>30</td>
<td>121</td>
<td>66</td>
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<tr>
<td>40</td>
<td>125</td>
<td>68</td>
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<tr>
<td>50</td>
<td>130</td>
<td>71</td>
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<tr>
<td>60</td>
<td>142</td>
<td>73</td>
</tr>
<tr>
<td>70</td>
<td>154</td>
<td>76</td>
</tr>
<tr>
<td>80</td>
<td>166</td>
<td>78</td>
</tr>
<tr>
<td>90</td>
<td>178</td>
<td>81</td>
</tr>
<tr>
<td>100</td>
<td>190</td>
<td>83</td>
</tr>
</tbody>
</table>
no metal component, electrical device or wiring is to be installed in a semispherical area of 300 mm radius, centred on the rear surface of the radar casing (yellow zone in Figure 43 and Figure 44)
- the radar, mounting bracket and all the relative fixing points must not be modified, replaced or tampered with
- the original radar cover must not be modified, changed or painted, nor must any stickers or masking be applied
Note Changes to one or more than one of these parameters requires specific authorisation from IVECO as well as new deliberation and calibration of the device; any financial cost will be charged to the Bodybuilder.

⚠️ It is mandatory for the radar to be recalibrated if the original geometry of the output cone of the radio waves is not maintained.

Note Recalibration can only be carried out by the IVECO Service Network.

⚠️ To prevent unnecessary braking, the AEBS system must be deactivated when it is not possible to keep the area in front the radar completely free (tests on roller bench, vehicle being towed, the use of snow plough blades, etc.).

⚠️ Permanent or automatic disabling of the system is not permitted. The interruption can only be temporary password and will be cancelled after each start (refer to the Use and Maintenance Handbook for further details).

⚠️ Also in the case of AEBS, whenever an electrical connection is opened, the two counterparts must be protected (for example, with gummed paper) to prevent the infiltration of water or dirt. Then, when the connection is restored, check that the coupling of the counterparts is complete and make sure that they work correctly and are secure.

**Requirements for installation of additional parts on the front of the vehicle**

In addition to the presence of the radar sensor and the implications described, it is possible that, where compatible with local regulations local, additional structures (winch, snow plough blade, bull-bar) will have to be fitted to the front of the vehicle.

In this case:

1. accessibility must be guaranteed to existing components behind the front grille and the complete forward tilting of the cab with the front grille open (also see Chapter 1.16)
2. additional assemblies must not limit the opening for the cooling provided for in the front grille and in the bumper (also refer to Chapter 1.16)
3. a possible additional structure:
   - must be equipped with a tow hook or must allow for access to the original tow hook of the vehicle
   - must comply with the same Regulations to which the FUP device (Front Underrun Protection) is subjected, both as a stand-alone unit and when the original FUP is used
   - must not cause damage to the FUP structural if it is supported by this device
   - must ensure safe access to the upper part of the cab for maintenance and/or cleaning operations
5.12 OPTIMISED TRACTION ON VEHICLES 6x2

In addition to the lifting function of the 3rd axle, the ECAS (Electrically Controlled Air Suspension) system automatically controls the level of the rear air suspension established for the specific use.

When required by the operating and road grip conditions, the system automatically distributes the load installed (equipment plus payload) giving priority to the drive axle, with the aim of obtaining better traction conditions (optimised traction).

The diagram in Figure 45 shows the distribution of the load between the drive axle and the third axle as a function of the overall increase (in the version 11.5 t + 7.5 t).

Table 30 shows the maximum values of the possible loads depending on the version of the vehicle / suspension or the optional installed.

The braking forces are automatically adjusted for the load on the ground.

Fittings with load distribution mainly on the rear axles (for example, waste collection vehicles with rear loading, cranes on rear overhang, etc.), it is possible to vary the load distribution on the rear axles originally provided using Modus.

![Figure 45](image)

A2. Drive axle
A3. 3rd axle

<table>
<thead>
<tr>
<th>Table 5.30 - Available versions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Models</strong></td>
</tr>
<tr>
<td></td>
</tr>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>
SECTION 6

ADBLUE AND
SCRT SYSTEM
Contents

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6.3 INSTRUCTIONS .............................. 6
   AdBlue tank ............................... 6

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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. Pumping module (SM)
2. Dosing module (DM)

A. Water inlet/outlet fittings
B. AdBlue intake and return coupling
C. AdBlue pressure line fitting to DM
D. AdBlue delivery union
E. Electrical connector

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

**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).
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 $\tau = 25^\circ C$, 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.

![Diagram of pipe installation](image)

Figure 4

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.

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

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

- ensure that the fittings indicated in Figure 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.
APPENDIX A

Hi-TRACTION SYSTEM
Contents

GENERAL INFORMATION .................. 5
Hi-traction system

General Information

The optional "Hi-Traction" system consists of a hydrostatic transmission, applied to the front axle of the vehicle and designed to improve traction and steering on disconnected or uneven road surfaces. It is made up of:

1. Oil cooling system on the chassis
2. Hydraulic pump on engine PTO
3. Two front axle variants (ON and OFF)
4. Specific stub axle
5. Hydraulic engine

Table A.1 - Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum torque on the front axle</td>
<td>Up to 12500 Nm</td>
</tr>
<tr>
<td>System mass</td>
<td>Approx. 400 kg</td>
</tr>
<tr>
<td>Speed range</td>
<td>from 0 to 22 km/h</td>
</tr>
<tr>
<td>Gearbox</td>
<td>Automatic</td>
</tr>
<tr>
<td>Power take-off</td>
<td>on the engine</td>
</tr>
</tbody>
</table>
1. Hydraulic engine
2. Hydraulic pump on engine PTO
3. Valve block

The complexity of the "Hi-Traction" system requires installation and calibration methods which can only be implemented during production. For this reason it is not possible to authorise the use on vehicles which have already been produced, or to make changes to the layout of the system, to the groups or to the hydraulic lines.