Foreword

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

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

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

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

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

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

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

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

In case of disagreement between the provisions included herein and the actual vehicle make-up, contact IVECO prior to carrying out any work.

Symbols – Warnings

⚠️ Danger for persons
Missing or incomplete observance of these prescriptions can cause serious danger for persons’ safety.

⚠️ Danger of serious damage for the vehicle
Partial or complete non observance of these prescriptions can cause serious damages to the vehicle and sometimes guarantee lapse too.

⚠️ General danger
It includes the dangers of above described signals.

🌳 Environment protection
It indicates correct behaviour in order that vehicle use is environmentally friendly as much as possible.
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I GENERAL SPECIFICATIONS
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## General Specifications

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1.1 Aim of bodybuilders instructions

The purpose of these instructions is to permit modifications and/or fitting genuine IVECO parts while safeguarding the operation, safety and reliability of the vehicle and its components.

1.2 IVECO approval for changes and fittings

Changes shall be made according to the criteria described in the following directives. The modifications below can only be made after approval from IVECO:

- wheelbase modifications, whereby the value of the newly obtained wheelbase does not fall within the minimum and maximum values available within the IVECO range for the same vehicle;
- work carried out on the braking system;
- work carried out on the suspension system;
- steering wheel modifications;
- changes to the stabiliser bars and suspensions;
- changes to the cab, cab supports, locking and tipping devices;
- engine intake and exhaust system modifications;
- engine cooling system modifications;
- power unit and driving component modifications;
- work carried out on front and rear axles;
- fitting additional axles;
- fitting decelerator brakes;
- fitting power take-offs;
- changing the tyre dimensions;
- coupling device (hooks, fifth wheels) modifications;
- electric/electronic unit modifications.

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

1.3 Liabilities

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

- project of the modification or fitting;
- choice and features of the products used;
- workmanship of the modification or fitting;
- compliance of the project and its implementation with all the instructions provided by IVECO;
- compliance of the project and its implementation with all the current regulations in the country where the vehicle is registered;
- operation, safety, reliability and generally the good handling of the vehicle as well as the effects the modifications and fitting may have on the performance and specifications of the vehicle.
1.4  Guarantees

The bodybuilder/chassis converter who has built the body or who has modified the chassis must guarantee that the work was undertaken in a professional manner in full compliance with the specifications contained in this manual. IVECO reserves the right to declare void its own warranties for the vehicles where:

- These specifications have not been adhered to or where unauthorised equipment was installed, or unauthorised modifications were carried out.
- The chassis was used in a way which is not suitable for the equipment or for the intended purpose of the vehicle.
- The specifications, standards or instructions issued by the Manufacturer for the flawless execution of the operations have not been heeded.
- Original spare parts or components which the Manufacturer has made available for specific interventions were not used.

1.5  Request for approval

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

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

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

1.6  IVECO technical documents available by means of computer

The following technical documents are available on the Internet at www.thbiveco.com:

- directives for transformation and equipping of vehicles;
- technical cards;
- chassis cab diagrams;
- chassis diagrams;
- other specifications concerning the vehicle range.

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

1.7  Trademarks and Logos

Trademarks, nameplates and denominations must not be modified or displaced in relation to the original design. The appearance of the vehicle must not be changed or modified. The application of trademarks tied to the transformation or trim levels must be authorised by IVECO. They must not be applied near to the IVECO tradenames or logos.

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

On completing the vehicle, the bodybuilder/chassis converter must check the work (modifications, body + equipment etc.) to ensure that the legal provisions required in the country of registration are observed (e.g. weights, dimensions, braking, noise, emissions etc.). Information regarding these matters may be obtained from the competent Authorities or the IVECO Area Network.

The vehicles manufactured at our plant (except some versions for Extra-European countries) comply with the EC directives. Converted vehicles must also comply with these directives. The only permissible exception is granted where local type approval differs from EC homologation.

1.9 Prevention of accidents

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

All the precautions dictated by technical awareness must be adopted to prevent malfunction and functional defects.

Compliance with these regulations will be the responsibility of the manufacturers of the structures and devices.

1.10 Choice of material to use: Ecology – Recycling

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

In this connection:

– Everyone must be aware of the prohibitions on using harmful or potentially hazardous materials, such as ones containing asbestos, lead, halogen additives, fluorocarbons, cadmium, mercury, hexavalent chrome, etc.
– Use materials whose processing produces limited waste and that permit easy recycling after their first use.
– With composite synthetic materials, use components that are compatible with each other, envisaging also their possible utilization with the addition of other salvaged components. Affix the markings required in compliance with the current regulations.

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

Prior to delivering the vehicle, the body builder shall:

- verify that the work has been made correctly;
- perform vehicle and/or equipment set—up;
- check the operation and safety of the vehicle and/or equipment;
- prepare and deliver the necessary instructions for service and maintenance of the fitting and any additional units to the end customer;
- write the new data down on the special tags;
- confirm that the work carried out complies with the indications provided by the vehicle manufacturer and with the law regulations;
- carry out the checks included in the "IVECO Pre—Delivery inspection" list (available from the IVECO network) with regard to the items affected by the work done;
- provide a guarantee for the modifications made;
- in the event that the connections originally provided with screws have been mounted and restored, the same screws shall not be used. In such an instance, and in the event that nails have been replaced with screws, you must check again the closing of the connection after travelling approximately 500–1000 km.
- measure the battery voltage. Ensure there is a minimum charge of 12.5 V. If the voltage reading is between 12.1 and 12.49 V, recharge the battery (slow charge). If the voltage is less than 12.1 V, the battery must be scrapped and replaced with a new one.

1.12 Vehicle names

IVECO vehicle commercial names do not match with the approval name. Below are two examples of commercial names, with the meanings of the abbreviations used:

<table>
<thead>
<tr>
<th>Range</th>
<th>Model</th>
<th>Cab</th>
<th>Engine power</th>
<th>Version</th>
<th>Suspension</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML</td>
<td>150</td>
<td>E</td>
<td>28</td>
<td>R</td>
<td>/F/P</td>
</tr>
<tr>
<td>ML</td>
<td>80</td>
<td>E</td>
<td>18</td>
<td>D</td>
<td>K</td>
</tr>
</tbody>
</table>

EXTERNAL NAMEPLATE ON VEHICLE

RANGE/CAB
- ML = EuroCargoRestyling 2004
- E = Standard cab (short, long, 6+1)
- EL = Reduced height cab (short, long)

VERSIONE
- R = Drawbar
- K = Kipper
- D = 6+1 cab for ML
- R-sw = Sweeper
- W = 4x4

SUSPENSION
- = Mechanical
/F = Pneumatics
/P = Comprehensive pneumatics
1.13 Conventions

In these bodybuilders instructions, the wheelbase is taken as the distance between the centreline of the first steering axle and the centreline of the first rear axle (driven or non-driven). This definition differs from the definition of wheelbase in the CE Directives. The rear overhang is taken as the distance between centreline of the last axle and the rear end of the chassis runner. For dimensions A, B and t of the frame and counterframe section please refer to the figure below.

Figura 1.1
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2 Chassis modifications

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<th>Description</th>
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<td>Harness Modifications due to Changes to Wheelbase or Overhang</td>
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<td>2.21.9</td>
<td>Power Draw-off at a Voltage Different from that of the System</td>
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<td>Rear mudguards and wheel house</td>
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<td>2.29</td>
<td>Mudflaps</td>
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<tr>
<td>2.31</td>
<td>Chocks</td>
<td>2-88</td>
</tr>
</tbody>
</table>
2.1 General instructions for chassis modifications

Particular attention must be given to the following points:

- **Welding to the bearing structures of the chassis is explicitly prohibited** (with the exception of the items described at points 2.7, 2.8 e 2.9);
- **Holes in the flanges of the side members are not permitted** (except for the items described at point 3.4);
- Where riveted connections exist and can be modified as explained below, these can be replaced by flanged-head screws and nuts of min. class 8.8 or by hex screws of the next greater diameter and self locking nuts. Screws greater than M14 must not be used (max. diameter of hole 15 mm) unless otherwise specified.
- In cases where the original joints were detached and rejoined with bolts it is forbidden to reuse the same bolts. In this event and when rivets are replaced with bolts, the bolt torque must be checked after the vehicle has been driven approximately 500 – 1.000 kms.
- when carrying out welding, boring, milling or cutting operations in the vicinity of the braking system pipes, particularly those made of plastic, and electric cables, always take the necessary precautions to protect the pipes and cables, if necessary removing them first (following the indications given in points 2.7, 2.19 e 2.21).

Figure 2.1
2.2 Protection against Rust and Painting

2.2.1 Original components

Table 2.1 details the operations for protecting and painting the components of the original vehicle (Table 2.2 for painted parts, Table 2.3 for non–painted or aluminium parts).

Table 2.1 – Protection classes

<table>
<thead>
<tr>
<th>Class</th>
<th>Features of the part</th>
<th>Examples of the type of part</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Parts in direct contact with atmospheric agents</td>
<td>Cab, rear view mirrors, cab fixing components</td>
</tr>
<tr>
<td>B</td>
<td>Parts in direct contact with atmospheric agents with mostly structural characteristics, directly visible</td>
<td>Chassis and related parts, including fixing components and parts under the hood</td>
</tr>
<tr>
<td>B1</td>
<td>Parts in direct contact with atmospheric agents, not directly visible</td>
<td>Rear and front axles</td>
</tr>
<tr>
<td>C</td>
<td>Parts not in direct contact with atmospheric agents</td>
<td>Engine and related parts</td>
</tr>
<tr>
<td>D</td>
<td>Parts in direct contact with atmospheric agents</td>
<td>Pedals, seat frames, fixing components, internal cab pillars</td>
</tr>
</tbody>
</table>

Table 2.2 – Painted parts

<table>
<thead>
<tr>
<th>Description of the cycle phase</th>
<th>Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Mechanical surface cleaning (including the removal of burrs / rust and cleaning of modified parts)</td>
<td>Sand blasting</td>
</tr>
<tr>
<td></td>
<td>Brushing</td>
</tr>
<tr>
<td></td>
<td>Sanding</td>
</tr>
<tr>
<td>Pre–treatment</td>
<td>Degreasing</td>
</tr>
<tr>
<td></td>
<td>Phosphate degreasing</td>
</tr>
<tr>
<td></td>
<td>Phosphating of the heavy iron</td>
</tr>
<tr>
<td></td>
<td>Phosphating of the zinc</td>
</tr>
<tr>
<td>Cataphoretic treatment</td>
<td>High thickness (30–40 µm)</td>
</tr>
<tr>
<td></td>
<td>Low thickness (15–25 µm)</td>
</tr>
<tr>
<td></td>
<td>Acrylic to finish (&gt;35 µm)</td>
</tr>
<tr>
<td>Anti–rust</td>
<td>Bicomponent (30–40 µm)</td>
</tr>
<tr>
<td></td>
<td>Monocomponent (30–40 µm)</td>
</tr>
<tr>
<td>Chip–resistant base</td>
<td>Mono (130 °C) or Bicomponent (30–40 µm)</td>
</tr>
<tr>
<td>Paint</td>
<td>Mono (130 °C) or Bicomponent (30–40 µm)</td>
</tr>
<tr>
<td></td>
<td>Powders (50–60 µm)</td>
</tr>
<tr>
<td></td>
<td>Monocomponent at low temperature (30–40 µm)</td>
</tr>
</tbody>
</table>

(1) = Cycle for two–coat preparation.
(2) = Cycle for three–coat preparation.
(3) = Alternative to the mono or bicomponent paint, only for cab parts (windscreen wipers, rear view mirrors, etc.)
(4) = Excluding parts that cannot be immersed in pre–treatment and paint baths, due to their geometry (air tanks), their large size (castings) or where this would compromise their functionality (mechanical parts).
(5) = For ferrous steel or pre–coated fuel tanks, refer to Table 2.3.
(6) = Only parts fitted on the engine.
(7) = Parts that cannot be treated cataphoretically (4).
* = Alternative products and cycles for the same class, as long as they are compatible with the part being treated.
### Table 2.3 – Various unpainted and/or aluminium parts and components

<table>
<thead>
<tr>
<th>Type of protection</th>
<th>Class</th>
<th>A</th>
<th>B – B1</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless steel</td>
<td></td>
<td>yes</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Dacromet</td>
<td></td>
<td>DAC 320/8/PL, DAC 500/8/PL</td>
<td>DAC 320/5</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Zinc treatment</td>
<td>Fe/Zn 12 III</td>
<td>–</td>
<td>–</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>Fe/Zn 12 V</td>
<td>–</td>
<td>yes</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Fe/Zn 25 V</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Aluminium</td>
<td>Anodizing</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>Painting</td>
<td>yes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 2.2.2 Added or modified painted parts

All parts of the vehicle (cab, chassis, bodywork, etc.) which are added or subjected to modification must be protected from rust and corrosion. There must be no unprotected areas on ferrous materials.

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

Never use powder enamels directly after degreasing.

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

---

### Table 2.4 – Added or modified painted parts

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

(1) = Modifications to rear axles, front axles and engine (Classes B1 and C) are not allowed.

(2) = Preferably epoxy.

(3) = Preferably polyurethane.

---

### Table 2.5 – Added or modified unpainted and/or aluminium parts

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

(1) = Modifications to rear axles, front axles and engine (Classes B1 and C) are not allowed.
2.2.3 Precautions

Suitable precautions must be taken to protect those parts whose preservation and operation could be damaged by paints such as:

- Rubber or plastic pipes for the air and hydraulic installations;
- Gaskets, parts in rubber or plastic;
- Flanges of the transmission shafts or power take–offs;
- Radiators;
- Shock absorber and hydraulic or air cylinder rods;
- Drainage and bleeder valves (mechanical components, air tanks, cold starting heater plug pre–heating tanks etc.);
- Fuel sediment filter;
- Nameplates and logos.

With particular regard to the engine and its electric and electronic components, adequate precautions shall be taken to protect:

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

If the wheels are removed, protect the contact surfaces on the hubs, avoid increasing the thickness and especially avoid the build–up of paint on the connecting flanges of the wheel disks and resting points of the fixing nuts. Ensure that the disc brakes are adequately protected. The electronic components and modules must be removed.

When the painting operation is to be completed by oven drying (max. temp. 80ºC), all parts which may be damaged by exposure to heat (e.g. all electronic control units), must be removed.
2.3 Drilling the Chassis

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

**Under no circumstances should the flanges of the supporting member of the vehicle be drilled** unless in compliance with the indications given in point 3.4.

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

**Position and Size**

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

The diameter of the holes must be proportional to the thickness of the steel. Under no circumstances must this exceed 15 mm unless otherwise specified. The distance from the centre of the hole to the edges of the side member must not be below 40 mm. The centres of the holes must never be located at a distance of less than 45 mm from each other or in relation to the existing holes. The holes must be staggered as shown in Figure 2.2. When moving spring or crossbeam supports, always maintain the original boring diagrams.

**Figure 2.2**

![Figure 2.2](image-url)
2.4 Screws and nuts

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

As a general rule, materials of class 8.8 are recommended.

Class 8.8 and 10.9 screws must have been hardened and tempered.

For applications of diameter 6mm, stainless steel parts are recommended.

Approved finishes are Dacromet and zinc coating, as detailed in Table 2.3.

A Dacromet finish is not recommended if the screws are to be subjected to welding.

If space allows, use screws and nuts with flanged heads. Use self-locking nuts. Nuts must be tightened using a torque wrench set to the correct torque setting for the fixing.

Table 2.6 – Classes of resistance for screws

<table>
<thead>
<tr>
<th>Class of resistance</th>
<th>Usage</th>
<th>Tensile strength (N/mm²)</th>
<th>Yield point (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Non-load bearing screws</td>
<td>400</td>
<td>320</td>
</tr>
<tr>
<td>5.8</td>
<td>Low resistance screws</td>
<td>500</td>
<td>400</td>
</tr>
<tr>
<td>8.8</td>
<td>Medium resistance screws</td>
<td>800</td>
<td>640</td>
</tr>
<tr>
<td>10.9</td>
<td>High resistance screws</td>
<td>1000</td>
<td>900</td>
</tr>
</tbody>
</table>

2.5 Characteristics of the material to be used when modifying the chassis

When modifying the chassis of the vehicle, and in applications which reinforce the side members directly, the material used must correspond in quality (Table 2.7) and thickness (Table 2.8) to that of the original chassis.

Should it not be possible to source materials of the thickness indicated, the next superior standard thickness may be used.

Table 2.7 – Material to be used to modify the chassis

<table>
<thead>
<tr>
<th>Steel name</th>
<th>Tensile strength (N/mm²)</th>
<th>Yield point (N/mm²)</th>
<th>A5 elongation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVECO</td>
<td>FeE420</td>
<td>530</td>
<td>420</td>
</tr>
<tr>
<td>Europe</td>
<td>S420MC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>Q50E420TM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>50P45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 2.8 – Chassis section and thickness measurements

<table>
<thead>
<tr>
<th>Model</th>
<th>A x B (mm)</th>
<th>Wheelbase (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2700</td>
</tr>
<tr>
<td>ML60E, ML65E, ML75E, ML80EL</td>
<td>172.5 x 65</td>
<td>4</td>
</tr>
<tr>
<td>ML80E, ML90E, ML100E</td>
<td>195.5 x 65</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>A x B (mm)</th>
<th>Wheelbase (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3105</td>
</tr>
<tr>
<td>ML100EL, ML120EL</td>
<td>195.5 x 65</td>
<td>5</td>
</tr>
<tr>
<td>ML120E, ML130E</td>
<td>240 x 70</td>
<td>5</td>
</tr>
<tr>
<td>ML150E</td>
<td>240 x 70</td>
<td>5</td>
</tr>
<tr>
<td>ML180E</td>
<td>262.5 x 80</td>
<td>—</td>
</tr>
<tr>
<td>ML190E</td>
<td>262.5 x 80</td>
<td>—</td>
</tr>
<tr>
<td>ML260E28K</td>
<td>262.5 x 80</td>
<td>—</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>A x B (mm)</th>
<th>Wheelbase (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3240</td>
</tr>
<tr>
<td>ML100EW</td>
<td>240 x 70</td>
<td>5</td>
</tr>
</tbody>
</table>

1) Thickness can be 6.7 or 7.7 mm depending on date of production. Check the thickness before starting any jobs.
2.6 Stresses on the chassis

Do not exceed the following stress values under static conditions:

<table>
<thead>
<tr>
<th>Range</th>
<th>Permitted static stress on the chassis (N/mm²), σ_{amm}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>on road</td>
</tr>
<tr>
<td></td>
<td>120</td>
</tr>
</tbody>
</table>

When prescribed by national regulations, the bodybuilder must check that the stress limits are not exceeded. Welding activity will cause a deterioration in the characteristics of the material. Therefore, when checking the stresses in thermically-modified zones, consider a reduction of approx. 15% of the resistance characteristics.

2.7 Welding the Chassis

Welding operations must only be carried out by specialist, trained personnel, using suitable equipment and in a perfectly workmanlike manner.

Welding is permitted:
- when joining structural elements to extend or shorten the wheelbase or rear overhang,
- for the application of reinforcing L section flitch on a side member that is to be modified as detailed below (v. Figure 2.5).

If electric welding has to be done on the vehicle, isolate the system, disconnect the control unit connectors, remove the power lead from the battery positive terminal and connect it to the chassis earth.

Do not touch the electronic control unit connector pins.

Should it be necessary to carry out welding operations close to a control unit, disconnect the control unit itself and remove it from its position.

During welding earth the welding machine directly to the piece that is to be welded in order to protect the electrical equipment (alternator, batteries). Ensure that the negative pole of the battery has been disconnected.
Plastic pipes must be protected from heat sources and splashes of material during welding. If necessary these parts should be removed.

The surfaces of the leaf springs and air springs must be protected against weld splashes during welding. Do As part of the procedure it will be necessary to remove the paint and deoxidise the parts of the chassis that are affected by the welding operation as well as those parts which may have to be covered by possible reinforcements. When work has been completed, the modified part must be protected with adequate rustproofing (see point 2.2).

The instructions given below should be followed to ensure that welding is carried out correctly.

a) Cut the side members with a diagonal or vertical cut. We recommend that the diagonal cut be used particularly for the section between the wheelbase. Cuts are not permitted in areas in which the profile of the side member as well as the chassis width change or in those where there is a high concentration of stresses (e.g. spring brackets). The cuts must not be made through the holes present in the side member (v. Figure 2.3).

Figure 2.3

b) on the inner side of the side member give the parts that are to be joined a V-shaped chamfer of 60° along the entire length to be welded (v. Figure 2.4).

c) archweld in stretches using carefully dried basic electrodes.

Diameter of the electrode is 2.5 mm, current intensity approx. 90A (max. 40A for each millimetre of diameter of the electrode).

Using MIG–MAG welding use a welding rod with the same characteristics as the material to be welded (diameter 1–1.2 mm).

Avoid current overloading. Welding must be free from marginal cuts and waste material.

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

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

f) Remove excess material resulting from the welding operations by grinding.
g) On the inner side reinforcing L–section flitches should be applied. These should be made of steel and have the same characteristics as the steel used for the chassis. The minimum dimensions are given in Fig. 2.5. The reinforcements may only be fixed to the vertical web of the side member using welding beads, plug welds, bolts or rivets (Huck rivets may also be used). The cross-section and the length of the weld bead, the number and distribution of the plug welds, bolts or rivets must be adequate to transmit the bending and shearing moment of the section.

Closing of existing holes

If, when making new holes, the existing holes are found to be too close (see Figure 2.2), these may be closed up by welding. To ensure the success of this operation the outer edge of the hole should be chamfered and copper plate used for the inner part.

For holes with a diameter of over 20 mm, chamfered plugs may be used, welded on both sides.
2.8 Modifying the Wheelbase

2.8.1 General Specifications

As a rule, for each vehicle, modification to the wheelbase must be carried out on the standard wheelbase, among the ones envisaged by IVECO, above or closer to the new wheelbase required.

Cutting the chassis must be done by following the instructions given in point 2.7. Whenever permitted by the body size, wheelbases should be made equal to those planned in our production. This enables the original propeller shafts and previously defined cross member positions to be used.

When making the wheelbase longer than the standard IVECO wheelbases, particular care must be taken to comply with the limits set by national regulations particularly with regard to the limits for overall dimensions (where specified).

2.8.2 Approval

The alteration of the wheelbase is permitted without specific approval by IVECO in the following cases:
- if the wheelbase is to be lengthened and the new value is still within the standard range of length with the same side member section and material as the original (see Table 2.8);
- if the wheelbase is to be shortened without falling below the standard minimum values established for each model.

The Workshop carrying out the operations must provide sufficient technological and quality control guarantees (qualified personnel, adequate operating procedures, etc.).

Operations must be carried out in compliance with these directives, using suitable adjustments and adaptations when required, and taking all the necessary precautions (e.g. arrangement of exhaust pipes, respecting the minimum tare weight on the rear axle, etc.), foreseen for the corresponding original wheelbases.
2.8.3 Consequences for steering

Generally, lengthening the wheelbase has a negative effect on the steering. Whenever national regulations require it, the limits on the overall dimensions must be observed as well as the limits concerning the effort applied on the steering wheel and the relevant operation times (e.g., ECE – R 79/01 standard or current EC Directive).

The Table 2.10 gives the wheelbase lengthening limits for the various models, for vehicles with standard steering, the maximum permitted load on the front axle and approved tyres.

<table>
<thead>
<tr>
<th>Model</th>
<th>Maximum wheelbase (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML60, ML65E, ML75E, ML80EL, ML80E, ML90E, ML100E, ML110EL, ML120EL</td>
<td>5670</td>
</tr>
<tr>
<td>ML120E, ML130E, ML150E</td>
<td>6570</td>
</tr>
<tr>
<td>ML180E</td>
<td>6700</td>
</tr>
<tr>
<td>ML260EK</td>
<td>4190/1372</td>
</tr>
<tr>
<td>ML100EW, ML140EW</td>
<td>4500</td>
</tr>
</tbody>
</table>

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

The option of using a supplementary pump must be approved by us and the pump must be applied by a firm specialising in this type of operation.

2.8.4 Effect on braking

Generally, shortening the wheelbase has a negative effect on braking characteristics. Table 2.11 gives the wheelbase alteration limits. Ask an authorised IVECO dealer for the conditions (brake cylinder, minimum tare settings see section, technically permitted masses, tyres, height of centre of gravity) under which these values are permissible.

<table>
<thead>
<tr>
<th>Model</th>
<th>Wheelbase alteration limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML60E, ML65E, ML75E, ML80EL</td>
<td>Minimum (mm)</td>
</tr>
<tr>
<td>ML80E, ML90E, ML100E</td>
<td>2700</td>
</tr>
<tr>
<td>ML110EL, ML120EL</td>
<td>2700</td>
</tr>
<tr>
<td>ML120E, ML130E, ML150E</td>
<td>3105</td>
</tr>
<tr>
<td>ML180E</td>
<td>3105</td>
</tr>
<tr>
<td>ML260EK</td>
<td>3828/1372</td>
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<tr>
<td>ML100EW, ML140EW</td>
<td>3240</td>
</tr>
<tr>
<td>ML140EW</td>
<td>3240</td>
</tr>
</tbody>
</table>

If longer wheelbases are required for certain types of body, specific approval must be requested from IVECO and measures must be taken to improve the braking characteristics, such as the reduction of the maximum load limit on the front axle, changing the brake cylinders or using tyres and wheels with lower loaded radius values.
2.8.5 Recommended Procedure

To ensure the success of the conversion proceed as follows:

- Arrange the vehicle so that the chassis is perfectly level, using the appropriate stands.
- Disconnect the propeller shafts, the braking system pipes, the wiring harness and any equipment that might prevent the work being carried out correctly.
- Identify the reference points on the chassis (e.g. pilot holes, suspension supports).
- Mark the reference points with a light line of punch marks on the top flange on both side members after ensuring that their joining line is perfectly at right-angles to the longitudinal axis of the vehicle.
- When re-positioning the spring hanger brackets, identify the new position using the reference marks made previously.
  
  Check that the new measurements are identical between the left and right sides. Differences no greater than 2 mm should emerge from diagonal checking of the lengths less than 1,500 mm.
  
  Unless another tool is available, make new holes by using the supports and gussets of the cross members as a template.
  
  Fix the supports and cross members with rivets or bolts. If using bolts, fix the supports by reaming the holes and using class 10.9 calibrated bolts with nuts equipped with a device that prevents them from working loose. When space permits it use flanged-head screws and nuts.
  
  If cutting the chassis, make a second line of reference points so that the area affected by the modification is included between these and the previous points (in any event ensure a distance of not less than 1500 mm measured when the work has been completed). Inside these two reference lines make points to mark out the area of the cut then proceed as indicated in point 2.7.
  
  Before welding, ensure that the side members, including any added portion, are perfectly aligned and take measurements on both sides and diagonally to check, as previously described. Fit the reinforcements as instructed at point 2.7.

Further indications

- Protect the surfaces from oxidation as described in point 2.2.
- Restore the electrical and braking systems as described in points 2.19 and 2.21.
- For work on the drive line follow the instructions given in point 2.8.8.
2.8.6 Chassis Stress Level

When lengthening a wheelbase, in addition to local reinforcement on the side member joint, the bodybuilder must provide sufficient reinforcements to achieve the section moduli of the side member section no lower than that designed by IVECO for the same wheelbase or for next size up. Alternatively, when permitted by local regulations, larger subframe sections can be used.

The bodybuilder shall verify that such stress is not greater than the one of the chassis with the original wheelbase, by assuming an evenly distributed load and the chassis being considered as a beam resting on the suspension supports. In any case, more restrictive limits (if any) set by the national standards shall be complied with.

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

2.8.7 Cross Members

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

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

As a general rule the distance between the two cross members must not be greater than 1,000 to 1,200 mm.

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

Figure 2.6
2.8.8 Modifying the Drive Line

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

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

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

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

2.8.8.1 Maximum lengths

The maximum working lengths possible, both for the intermediate sections Lz and the sliding ones LG (see Figure 2.7), can be determined based on the external diameter of the tube already existing on the vehicle and the maximum working revolutions (see formula), and they are indicated in Table 2.13.

For the propeller shaft length specified in Table 2.13, when the tube diameter is not sufficient, a new shaft section with the same characteristics as the existing shafts must be used. As an alternative, in some cases the transmission shaft with a larger diameter tube can be used. The tube diameter required can be determined in compliance with the required length and the maximum rotational speed, directly from Table 2.13.

Figure 2.7

LZ Intermediate sections
LG Sliding sections
As far as sliding shafts are concerned, length LG shall be assessed between the spider centers, with the sliding stub in its intermediate position.

As regards single-stub shafts, check both branches LG and LZ.

The maximum working revs number shall be obtained from the formula below:

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

- \( n_{\text{max}} \) = maximum number of engine revolutions (rpm) for transmission calculation, see Table 2.12
- \( i_G \) = gear ratio in fastest gear, see Table 2.12
- \( i_V \) = torque divider minimum ratio, 0.95 for EuroCargo 4WD and equal to 1 if absent or for shafts upstream of divider

<table>
<thead>
<tr>
<th>Engine</th>
<th>Engine code</th>
<th>( n_{\text{nom}} ) (rpm)</th>
<th>( n_{\text{max}} ) (rpm)</th>
<th>Gear</th>
<th>( i_G )</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>F4AE0481D</td>
<td>2700</td>
<td>3000</td>
<td>285.5</td>
<td>1</td>
</tr>
<tr>
<td>E15</td>
<td>F4AE0481C</td>
<td>2700</td>
<td>3000</td>
<td>285.6</td>
<td>0.78</td>
</tr>
<tr>
<td>E17</td>
<td>F4AE0481A</td>
<td>2700</td>
<td>3000</td>
<td>285.5</td>
<td>0.78</td>
</tr>
<tr>
<td>E18</td>
<td>F4AE0681E</td>
<td>2700</td>
<td>3000</td>
<td>285.5</td>
<td>0.78</td>
</tr>
<tr>
<td>E21</td>
<td>F4AE0681D</td>
<td>2700</td>
<td>3000</td>
<td>287.0</td>
<td>1</td>
</tr>
<tr>
<td>E24</td>
<td>F4AE0681B</td>
<td>2700</td>
<td>3000</td>
<td>287.0</td>
<td>1</td>
</tr>
<tr>
<td>E28</td>
<td>F4AE0681A</td>
<td>2500</td>
<td>3000</td>
<td>289.9</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 2.12 – EuroCargo, maximum no. of engine revolutions**

**Table 2.13**

Obtainable propeller shaft characteristics

<table>
<thead>
<tr>
<th>Outer diameter (mm)</th>
<th>2800</th>
<th>2900</th>
<th>3000</th>
<th>3100</th>
<th>3200</th>
<th>3300</th>
<th>3400</th>
<th>3500</th>
<th>3600</th>
<th>3700</th>
<th>3800</th>
<th>3900</th>
<th>4000</th>
<th>4100</th>
<th>4200</th>
<th>4300</th>
<th>4400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feasible lengths LG or Lz (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Caution]

The maximum possible lengths given above refer to the original shafts; plan for shorter lengths (~10%) for segments obtained for transformation.
The greater thickness of the tube depends on the class, i.e. on the torque that the original shaft has to transmit and on the design of the driveline (torque, ratios of kinematic chain, power axle load).

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

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

The minimum operating length (from flange to flange) must not fall below 800 mm for the sliding sections and 700 mm for the intermediate sections.

### 2.8.8.2 Determining Driveshaft Positions

In the case of drive line which consist of several segments, the individual shafts must all be approximately of the same length. As a general rule, the difference in length between a non sliding and a splined shaft (see Figure 2.8) must not exceed 600 mm. The difference in length between the shafts must not be more than 400 mm. A margin of at least 25 mm must be left so that the sliding joint can travel when the splined shaft is closed. When fully extended the shaft sliding sleeve should cover the splined stub for a length that should be about twice the diameter of the splined stub itself.

When the required length of the drive line exceeds the permissible length, an additional driven shaft must be provided as illustrated in Figure 2.8.

**Figure 2.8**

1 Engine, clutch, gearbox axis
2 Intermediate shaft (non sliding)
3 Intermediate shaft support
4 Propeller shaft with sliding end
5 Inclination of rear axle case (static load)
6 Inclination of rear axle case (max. compression)
7 Inclination of rear axle case (unladen)
8 Intermediate shaft and axle case axis must have the same inclination
The intermediate shaft and the inclination of the rear axle case must be aligned accurately. The difference in their inclination relative to the engine—clutch—gearbox axis must not vary more than 1°. This can be achieved by fitting wedges between the rear axle and the springs, or by adjusting the rear axle reaction bars. The inclination of the rear axle must not exceed 5°30’.

When, with a loaded vehicle, the rear axle flange is at a level which is lower than that of the gearbox flange, care must be taken to ensure that the inclination of the differential housing and of the driven shaft are greater than the inclination of the engine—gearbox axis. On the other hand, if, with a loaded vehicle, the rear axle flange is at a level which is higher than that of the gearbox flange, the inclination of the differential housing and of the driven shaft must be less than the inclination of the engine—gearbox axis.

When the lengthening of the wheelbase is substantial, it may become necessary to employ a supplementary intermediate shaft as shown in Figure 2.9. In this case it is necessary to ensure the same inclination in the engine—gearbox axis, the second intermediate shaft and the axis of the bridge case on static loading of the vehicle.

Figure 2.9

![Diagram of chassis modifications](image)

1 Engine, clutch, gearbox axis
2 1st intermediate shaft
3 Intermediate shaft support
4 2nd intermediate shaft
5 Propeller shaft with splined end
6 Inclination of rear axle case (static load)
7 Inclination of rear axle case (max. compression)
8 Inclination of rear axle case (unladen)
9 Gearbox, 2nd intermediate shaft and rear axle case axis must have same inclination.

Elastic supports shall be applied with the aid of supporting plates, at least 5 mm thick (see, Figure 2.10), connected to cross-members having the same characteristics as those specified by IVECO.

When reducing the wheelbase it is recommended that the intermediate shafts be removed if the length of the splined shaft is less than approximately 800 mm.
If the drive line consists of a single shaft (articulated), the inclination of the axle housing must be the same as the inclination of the engine–gearbox axis.

For these modifications it is recommended to use genuine drive lines made by IVECO or by the Manufacturers who originally equipped the vehicle.

Modifications to the universal joints are not permitted.

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

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

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

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

When re-positioning rear cross members originally fastened by rivets, these can be replaced by flanged nuts and bolts with the same diameter or by class 8.8 hexagonal-headed screws with the next largest diameter. Use self-locking nuts (do not use bolts with a diameter larger than M14).

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

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

2.9.1 Authorisation

The extension of the overhang at the rear of the chassis employing body overhang values up to 60% of the wheelbase and shortening down to the minimum serial value of each model require no specific approval by IVECO on condition that the operations are carried out in compliance with these instructions.

2.9.2 Reducing the Overhang

When reducing the length of the rear overhang of the chassis (e.g. in the case of tippers) the last cross member must be moved forward.

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

2.9.3 Increasing the Overhang

Various methods of increasing the length are given in Figs. 2.11 and 2.12.

The connection of the added section is to be carried out in compliance with the specifications given in point 2.2.4.

The frame may also be cut straight. The minimum dimensions of the reinforcements that are to be applied to the modified section are indicated in Fig. 2.5.

Fig. 2.11 shows a typical method of extension for increases of 300 to 350 mm. In this case the reinforcing L-bars, which also serve to connect the cross member and the chassis frame, must be of the same thickness and width as the original gusset plate. The connection of the cross member and the plates, originally achieved with rivets, may be made with class 8.8 bolts with the next larger diameter.
In those cases where the joint between the cross member and the gusset plate is made by means of a weld, it is permissible to join the gusset plate to the reinforcement by welding (see Figure 2.11). When the increase exceeds 350 mm, Figure 2.12 shows the procedure to be used.

**Figure 2.11**

1. Added portion
2. Reinforcing runner
3. Reinforcing runner (alternative solution)
4. Original rear cross member

**Figure 2.12**

1. Added portion
2. Reinforcing runner
3. Original rear cross member
4. Supplementary cross member (if necessary)

When the extension reaches a certain dimension, it will be necessary to examine on a case by case basis, the feasibility of installing a supplementary cross member to give the frame sufficient torsional rigidity. Adding a supplementary cross member with the same properties as the standard production cross member is necessary whenever the distance between two cross members is greater than 1,200 mm.
2.10 Installing a Towing Device

2.10.1 General Specifications

Without prior authorisation, the installation of a tow–hook is permissible only on those cross members which are intended for that use and on those vehicles which IVECO has intended for towing a trailer.

The subsequent installation of a tow hook in vehicles for which the installation of a tow hook was not originally contemplated, must be authorised by IVECO.

In trailers with one or more axles close together (centre axle trailers), considering the stress resulting in particular from the vertical dynamic load to which the rear cross member is subjected, the instructions given in point 2.10.5 must be taken into account.

The tow hook must be suitable for the permissible load and be of a type approved by National Requirements.

2.10.2 Choosing a Hook

The hook must be chosen based on the following characteristic values:

- for towing gear which is not suitable for transmitting vertical loads, the $D$ value is defined by the following formula:

$$D = g \cdot \frac{T \cdot R}{(T + R)} = (kN)$$

- for towing gear for trailers with a centre axle, the $D_c$, $S$ and $V$ values are defined by the following formula:

$$D_c = g \cdot \frac{(T + S) \cdot C}{(T + S) + C} = (kN)$$

$$V = a \cdot \frac{X^2}{l^2} \cdot C (kN)$$

$D$ = representative value of the class of jaw (kN). This is defined as the technical reference force for the horizontal force between the towing vehicle and the trailer;

$g$ = acceleration due to gravity (m/s$^2$);

$T$ = maximum weight (in tonnes) of the towing vehicle;

$T + S$ = maximum weight (in tonnes) of the towing vehicle + the vertical load of a trailer with a centre axle;

$R$ = maximum weight (in tonnes) of the trailer;

$S$ = value of the static vertical load (in tonnes) which, in static conditions, is transmitted to the point of attachment.

S must be $\leq 0.1 \cdot R \leq 1000$ kg;

$C$ = sum of the maximum axle loads (in tonnes) of the trailer with a centre axle at maximum load. It is equal to the maximum weight of the trailer with a centre axle less the static vertical load ($C = R - S$);

$V$ = value $V$ of the intensity of the theoretical dynamic vertical force;

$a$ = for the equivalent acceleration at the point of attachment, as a function of the rear suspension of the towing unit, use the following values:

$- a = 1.8 \text{ m/s}^2$ for air suspension;

$- a = 2.4 \text{ m/s}^2$ for other suspension types;

$X$ = length of the load surfaces (m);

$l$ = theoretical length of the drawbar (distance between the centre of the drawbar towing eye and the centre line of the trailer axle (m));

$X^2/l^2 \geq 1$ if the result is less than 1, use the value 1.
Example of calculation of class of coupling device for semi–trailers

Consider a new EuroCargo ML120E24R/P vehicle of maximum weight 12t that has to tow a conventional trailer of maximum weight 8000 kg.

From the following data:
1. \( T = 12 \text{ t} \)
2. \( R = 8 \text{ t} \)

we obtain:
\[
D = 9.81 \cdot (12 \cdot 8) / (12 + 8) = 47.0 \text{ kN}
\]

Example of calculation of class of coupling device for central axle trailers

Consider a new EuroCargo ML120E24R/P vehicle of maximum weight 10t that has to tow a central axle trailer weighing 9t with load surface length 8m and theoretical drawbar length 7m.

Thus, from the following data:
1. \( S \) is 0.9 t, i.e. lower than values 0.1 \( \cdot R = 0.9 \text{ t} \) and 1 t
2. \( C = R - S = 9 - 0.9 = 8.1 \text{ t} \)
3. \( (T + S) = 10 + 0.9 = 10.9 \text{ t} \)
4. \( X^2 / l^2 = 64 / 49 = 1.3 \)

we obtain:
\[
D_c = 9.81 \cdot (10.9 \cdot 8.1) / (10.9 + 8.1) = 45.6 \text{ kN}, \quad V = 1.8 \cdot 1.3 \cdot 8.1 = 18.9 \text{ kN}
\]
Since tow hooks are important to vehicle driving safety (in some countries they must be specifically certified) they must not be modified in any way.

When mounting the tow hook to the cross member, the specifications of the hook manufacturer as well as the limitations imposed by current standards — such as minimum space required for the brake and electrical connections the maximum distance between the swivel hook axis and the rear edge of the body — must be respected.

Should the dimensions of the hook coupling flange not match the holes on the rear cross member of the vehicle, in some case drilling may be authorised on the cross member after mounting adequate reinforcements.

2.10.3 Increasing the Towable Mass

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

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

These include possible reinforcements to the standard cross member (see Figure 2.18), the instructions for installing a reinforced cross member when available, and those on the brake system to be made.

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

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

If the type of trailer used requires that the tow hook be positioned lower than originally intended, IVECO may issue authorisation for the original cross member to be lowered or for an additional cross member (of the original type) to be fitted in a lower position. Figure 2.13 and Figure 2.14 give some examples of how this is done.

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

**Figure 2.13**

1 Original rear cross member
2 Gusset
3 Upside–down gusset
4 Connecting angle piece

The thickness of the outer reinforcing angles must not be less than the thickness of the side members of the vehicle. They must cover a length which is at least 2.5 times the height of the side member itself (maximum 600 mm) and be made of material with the properties indicated in point 3.3.1. The angles are to be attached to the web of the side members using all the bolts joining the cross member to the frame, integrating them with the other bolts so that, as a result of their number and location, they will take into account the greater moment transmitted. As a general rule, when the cross member is lowered by an amount equivalent to the height of the side member, the number of bolts is increased by about 40%.

When an additional cross member is installed (see Figure 2.14) a central joining plate with a thickness commensurate with that of the cross members, must be employed.

A device to prevent the bolts from loosening must be adopted for the joints.
Assurance should be given that the movements between the tow bar and vehicle conform to current regulations. As a general rule, the original towable mass can be confirmed by IVECO. In any event the responsibility for the work carried out will rest with the bodybuilder.

The vehicle must be presented for inspection if local government regulations require it.
Figure 2.14 shows an example of a lowered supplementary cross member.

When this solution is applied to short rear overhang vehicles, the external connecting plates must conform to the arrangement described in Figure 2.14. Should the brackets of the underrun bar be modified, following the lowering of the rear cross member, the new version will be equivalent to the original in terms of attachment, strength and stiffness and the positioning of the lights checked for compliance with the standards (local standards where applicable).

2.10.5 Centre Axle Trailers (Rigid Towbar)

The use of trailers with centre axles (rigid tow bar trailers with single or tandem axles), with respect to articulated tow bar trailers, entails an increase in bending stress on the rear chassis overhang as well as an increased torsional stress of the rear towing cross member resulting from the vertical static and dynamic loads which the tow bar exerts on the hook (for example when braking or on bumpy roads).

On those vehicles on which the towing of trailers is permissible within the values established for each model by IVECO, the mass that may be towed with the centre axle trailer and the vertical loads on the cross member may be authorised on the basis of the dimensions of the flange located on the vehicle cross member.

The value of the maximum (static + dynamic) vertical load transmitted by the trailer to the hook can be determined more accurately through the following ISO formula:

\[
F_v = a \cdot \frac{x^2}{l^2} \cdot C \cdot 0.6 + S
\]

\( F_v \) = Max vertical load (static + dynamic) transmitted by the trailer to the tow hook (kN).
\( a \) = Vertical acceleration in the drawbar/towing hook coupling area; depending on the rear suspension of the tractor for semitrailer, use the following values:
- \( a = 1.8 \text{ m/sec}^2 \), for vehicles with pneumatic suspension (or equivalent)
- \( a = 2.4 \text{ m/sec}^2 \), for vehicles with other suspension types
\( x \) = Total length in mms of the loading area of the trailer (m).
\( l \) = Length of the trailer wheelbase (distance between drawbar towing eye centre and axle centre or trailer axle centre line) in m.
\( C \) = Total weight of trailer, \( R \), minus the static load applied \( S \) (all values expressed in tons).
\( S \) = Static support load (kN).
0.6= Deceleration factor.

In addition to this, where the overhang is relatively long, it may be necessary to fit an auxiliary frame with section irons larger than those normally planned (see Table 2.14).

If central axle trailers are to be used, the connection of chassis frame to subframe will be carried out from the rear overhang to the front support on the rear suspension with cleat plates or by strengthening the existing connections with shear–resistant reinforcing (see Figure 2.15).
Use profiles with a higher section modulus, if required by the body structure. On each occasion, check whether it is necessary to fit a towing cross member and tow hook.

For towing central axle trailers, especially on vehicles with a long rear overhang, we recommend fitting a suitable towing cross member in a lowered, forward position, next to the rear suspension rear supports.
Table 2.14
New EuroCargo: subframe longitudinal runners for central axle trailers

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<th>Model</th>
<th>Chassis profile AxB (mm)</th>
<th>S (mm)</th>
<th>Wheeled-base (mm)</th>
<th>Rear-overhang (mm)</th>
<th>R = Maximum trailer mass (kg)</th>
<th>S = Static vertical load (kg)</th>
<th>Yield point of material used (N/mm²)</th>
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Chassis modifications 2–35
Table 2.14 (continued)
New EuroCargo: subframe longitudinal runners for central axle trailers

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<th>R = Maximum trailer mass (kg)</th>
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<td>135 46 173 89 245 105</td>
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2-36 Chassis modifications
### Table 2.14 (continued)

**New EuroCargo, subframe longitudinal runners for central axle trailers**

<table>
<thead>
<tr>
<th>Model</th>
<th>Chassis profile AxB (mm)</th>
<th>S (mm)</th>
<th>WHEEL-base (mm)</th>
<th>REAR over-hang (mm)</th>
<th>R = Maximum trailer mass (kg)</th>
<th>S = Static vertical load (kg)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>R6500</td>
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<td>6570</td>
<td>3500</td>
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<td>57</td>
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<td>ML150E/P, ML150E/FP</td>
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<td>2055</td>
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<td>19</td>
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<td>5175</td>
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<td>6570</td>
<td>2775</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

A = the subframe profile specified for the body structure is sufficient;  
(1) = in long cab versions use profiles with \(W \) not less than \(57\) cm³.

Contact IVECO for any configurations not in the table.
Should a reduction in the height of the structural element be required, again using shear–resistant connections, in place of the C element prescribed in Table 2.14 it is possible to use structural elements with combined sections, as indicated in Table 2.15, provided the width of the wing and the thickness are not less than the corresponding values for the structural element prescribed by IVECO. In any case, the minimum values for the section modulus required for the various superstructures (e.g. for normal caissons) must always be respected.

**Table 2.15— Combined section reinforcement runner profiles (see Figure 2.16)**

<table>
<thead>
<tr>
<th>Engine</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{0.2}$ (N/mm²) (1)</td>
<td>320</td>
<td>320</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>Maximum runner profile height reduction (mm)</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>$LV$ (see Figure 2.15)</td>
<td>0.5 Lu</td>
<td>0.5 Lu</td>
<td>0.8 Lu</td>
<td>0.85 Lu</td>
</tr>
<tr>
<td>$Lh$ (see Figure 2.15)</td>
<td>0.6 Lu</td>
<td>0.6 Lu</td>
<td>0.95 Lu</td>
<td>1.0 Lu</td>
</tr>
<tr>
<td>Example of combined section as alternative to 250x80x8 (mm) channel section</td>
<td>210x80x8</td>
<td>190x80x8</td>
<td>150x50x8+ angle section</td>
<td>130x50x8+ angle section</td>
</tr>
<tr>
<td>Actual height reduction (mm)</td>
<td>40</td>
<td>52</td>
<td>92</td>
<td>104</td>
</tr>
</tbody>
</table>

(1) These are instructions of a general nature applying to the materials covered by this manual. Materials with higher mechanical specifications call for the measurement of the overall chassis and subframe bending moment.

**Figure 2.16**

The continuity of combined reinforcement runners can be interrupted only in special cases and is subject to authorisation. Similarly, when it is difficult to apply an external reinforcing L section (items C and D see Figure 2.16)– owing to the presence of suspension mountings or air spring connection brackets – and the recessing to be performed could excessively reduce the section’s resisting capacity, the adopted solution will require special authorisation.
2.10.5.1 Towing cross member in lowered and forward positions (short coupling)

Vehicles designed to tow central axle trailers for which a final cross member located in a lowered or forward position (next to the rear suspension rear mountings or air springs) is envisaged, do not require particular chassis reinforcing devices. For the subframe, the runner profile dimensions indicated for the different types of equipment (e.g., see Tabella 3.6 standard bodies) will be sufficient. The bodybuilder will accurately work out the size and position of the chassis connection structure (see items 2.3 and 2.10.4) and make use of a suitable cross member and an appropriate towing hook.

The tow hook position will be such to permit any movement between tractor and trailer drawbar according to the various conditions of use, to comply with the required safety margins and the standards and legal regulations in force (where applicable). In these cases the standard underrun bar cannot be used, and the bodybuilder will investigate the possible permitted changes from specifications or the specific solutions to adopt (e.g., underrun bar of the tilt type).

2.10.5.2 Reinforcement of Standard Rear Cross Member

When it is necessary to reinforce the standard cross member and when original cross members are not available, the bodybuilder will provide suitable reinforcements for which he shall be responsible. These reinforcements may consist of C-sections mounted on the inside of the cross member. Care must be taken to ensure that the connections between the cross member and the side members are also reinforced following the procedures recommended below, whenever stronger enforcements are required:

1) The mounting of a channel section on the inside of the cross member and joining it to the vertical web of the side member or to the following cross member of the chassis, if it is situated in close proximity, in compliance with the procedures illustrated in Figure 2.17.

Figure 2.17

1 Original cross member
2 Reinforcing rail
3 Connecting angle pieces or plates
2) Mounting a box section of suitable dimensions underneath the cross member, anchored at the extremities to the vertical web of the side members and joined at the centre of the cross member as shown in Figure 2.18.

In vehicles having a short rear overhang and a subframe, the box section can be fitted within the subframe sections, above the cross-member, and connected to it by means of a plate (as shown in Figure 2.14).

Should box-section assembly require modification to underrun bar plates the original requirements for fastening, resistance and stiffness must be met (comply with local government regulations if any).

**Figure 2.18**

1 Original rear cross member
2 Box section
3 Connecting plate
4 Ribbing plate

### 2.10.5.3 Tow hooks for Central Axle Trailers

The use of central axle trailers implies the use of tow hooks suitable for this purpose.

The values of the trailer loads and of the permissible vertical loads are contained in the technical documentation of the manufacturer of the tow hook or on the production data plate.

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

**Remarks about the Payload**

It should be ascertained that the static drawbar load does not cause the allowable load on the rear axle or axles to be exceeded and that the required minimum load acting on the front axle is adhered to (see 3.2.3.
2.11 Installing a Supplementary Axle

2.11.1 General Specifications

On certain models IVECO may authorise, upon request, the installation of a supplementary axle and, consequently, an increase in the total mass of the vehicle.

The modification must respect the mass limitations and the conditions imposed by IVECO as well as all other conditions that may be imposed by national laws and such that are necessary to ensure the safety and proper functioning of the vehicle.

Diagrams of the installation procedure may be submitted for inspection. These proposals must indicate the parts necessary to connect the axle to the chassis as well as the reinforcements to, and modifications of the chassis. It is also necessary to submit diagrams showing the changes made to the systems.

Follow the instructions in the previous paragraphs for alterations to the chassis.

In view of the increased stresses due to the increase in permissible load, and in consideration of the different phases of the dynamic stresses in operation as a result of the different reactions on the chassis when the axle is added, it is necessary to provide appropriate reinforcements to the chassis.

These reinforcements must in all cases satisfy all provisions of local applicable laws. The chassis that has thus been modified must not be subject to flexural stresses greater than those of the original chassis in the corresponding sections.

2.11.2 Chassis Frame Reinforcement

Figure 2.19 illustrates possible ways of modifying the chassis. The reinforcements must be continuous and must span the length of the entire frame of the vehicle up to the driver’s cab. For their attachment to the side member — when using L-bars — class 8.8 reinforcement bolts must be used and their diameter and distribution must be such to enable the section iron to provide the required strength.

Figure 2.19

1 Bracket
2 Plate
3 Screws, rivets or dia. 20 to 30 mm holes to be filled with welding.
Where an auxiliary frame is required as reinforcement, (see section 3.3.2) the body mounting brackets on the chassis (if any) should be used for the attachment. An alternative method of attachment is shown in section 3.4.1 and those that follow it.

We recommend using a shear resistant connection in the area of the rear overhang up to approximately the mid wheelbase (in any case up to no more than 2 m from the front axle) (see Figure 2.20).

The fitting of reinforcing plates directly onto the flanges of the side members, using holes filled with welded material is not permitted. This is to avoid affecting the strength of the original sections caused by poor welding. This procedure is only permitted in special cases with specific IVECO authorization when there are proven difficulties in subsequent body applications.

The reinforcement on the chassis can be omitted provided the following static stress values are not exceeded:

<table>
<thead>
<tr>
<th>Range</th>
<th>Permitted static stress on the chassis (N/mm²), σ_amm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>on road</td>
</tr>
<tr>
<td>EuroCargo</td>
<td>120</td>
</tr>
</tbody>
</table>

Any limitations, imposed by national laws must be complied with.

If the installation is unavoidable, because of the deterioration of the material's properties due to the welding process, in checking the load—effects acting on the various sections, it is advisable to assume a reduction of ca 15% in the strength of the material.

As a general rule the thickness of the reinforcing plate must not exceed that of the flange of the original chassis. The mounting must be carried out by skilled personnel and the bodybuilder will be responsible for any damage to the frame resulting from poor workmanship.

### 2.11.3 Application of a rear or central axle on models ML150 and ML180

The following modifications are obligatory when installing a third rear or central axle on the ML150 and ML180:

- replacement of ABS 3—channel control unit with ABS 4—channel control unit;
- addition of ABS solenoid valve, bringing total number of solenoid valves to 4: two on the front axle and two on the rear axle;
- adoption of suitable brake cylinders on rear axle for parking brake;
- adaptation of braking system.

One of the two rear axle ABS solenoid valves must control the right wheels of the drive and additional axles and the other the left wheels.

ML150E and ML180E models have optional n° 4667, for the installation of a third rear axle. With this option, the three conditions stated above are already complied with. In any event, the third axle must be installed in accordance with the technical standards, available on request from the IVECO agency that approves the installation.

If the additional axle is being installed in a central position, take particular care to ensure that the axle does not interfere with the propeller shaft.

### 2.11.4 Installing a Rear Supplementary Axle

The installation of a rear supplementary axle generally implies that the chassis overhang should be lengthened, the extension must be carried out in compliance with the specifications given in point 2.9. relating to the modifications of the chassis, leaving the reinforcements mentioned above unaffected.

When an additional axle is added to the overhang with a section depth smaller than the depth within the wheelbase area the adjustment of the section to give a higher value could be a solution towards reducing the stress arising from the conversion.
Figure 2.20 shows an example of the installation of a rear axle with an extension of the rear overhang.

**Figure 2.20**

![Diagram of a rear axle installation with annotations]

1. Added supplementary axle
2. Extension to the overhang
3. Reinforcements for the modification of the chassis
4. Connections
5. Reinforcing runner

### 2.11.5 Installing an Intermediate Supplementary Axle

The installation of an additional axle in a forward (intermediate) position relative to the drive axle may require a possible reduction in the rear overhang (see point 2.9) per realizzare un’adeguata ripartizione delle masse (v. Figure 2.21).

**Figure 2.21**

![Diagram of an intermediate supplementary axle installation with annotations]

1. Added supplementary axle
2. Reinforcing runner
3. Connections
4. Reduction in the rear overhang
2.11.6 Steering Axles

Steering axles can be installed both intermediatively and at the rear. They can be of the self-steering or force-steering types and be designed and installed in such a way that the required dependability and road safety are guaranteed. The self-steering axles will be fitted with a device controlled from the driver’s seat which is able to render them rigid when reversing.

The installation of an axle whose force-steering is obtained by means of the original steering system of the vehicle requires specific authorisation from IVECO in relation to the suitability of the original components for the conversion in question. In this case, it will be necessary for diagrams of the supplementary system to be submitted for our inspection.

2.11.7 Components and Suspension

Manufacturing quality of all components used (axle, suspension, braking units, systems etc.) must be ensured in order to guarantee driving safety and good vehicle operation.

Particular care and attention must be paid to the designing and construction of the suspension in consideration of its importance for the proper performance and handling of the vehicle on the road.

The designed suspension may be either of the mechanical leaf-spring type, pneumatic with air actuated springs or of a mixed type. Whatever type is used it must not negatively affect the handling characteristics of the vehicle and its components in terms of driving quality, comfort, road holding, working angle of the transmission and its working space in the case of an intermediate supplementary axle.

Where the additional axle has its own independent suspension, the suspension characteristics must be proportional to those of the original rear suspension in relation to the static loads applied to the two axles.

2.11.8 Stabilisers

When pneumatic suspension is used for the added axle, depending on the solution adopted, it may be further necessary to fit an antiroll bar in particular when a body with a high centre of gravity is used.

Similar measures must be adopted to ensure stability in relation to mixed type suspension on an additional rear axle.
2.11.9 Connection to the Chassis Frame

The connections of the added axle to the chassis must be such as to be able to withstand all longitudinal and transverse stress forces without transmitting them to the drive axle.

At the points in which the forces are introduced (spring supports, air spring brackets etc.), appropriate cross members or suitable frame reinforcements must be provided.

Ensure that the added axle is at right angles and aligned properly in relation to the longitudinal axis of the vehicle and the live axle. Check using the appropriate equipment available in the market.

2.11.10 Braking System

The braking system, considering its importance relative to the active safety of the vehicle, must be extremely well developed and constructed.

Braking units, hoses and joints of the same type as on the original vehicle must be used.

The auxiliary axle must be equipped with the same brake components as those provided for the front axle.

Use flexible pipes to form the connection between the fixed parts (chassis) and moving parts (axles).

The braking torque must be proportional to the static and dynamic loads in order to provide an even distribution of the braking action to all the axles of the vehicle.

The total braking capacity of the modified vehicle must, as a general rule, be proportional to that of the original vehicle, allowing for the different total mass that is now applicable. The performance of the braking system (service, emergency and parking) must in all cases satisfy the current government regulations in terms of deceleration, behaviour when hot, response time, efficiency of engine braking and so forth.

If the Technical Control Authority demands that the technical documentation regarding the braking system be submitted (e.g. adhesion curves, compatibility range diagram) this must be provided by the company in charge of the conversion or the manufacturer of the auxiliary axle.

Upon request, technical documentation with characteristics and attainable performances of the braking system of the original vehicle may be made available.

For the construction of the braking circuit for the additional axle it is advisable to employ equipment and circuits specially provided for each single model by the Manufacturer of the equipment in use on the original vehicles.
Arrangements are permitted whereby the direct connection is achieved between the braking sections of the added axle and that of the live axle. It should be ascertained that the capacity of the air reservoir is adequate to the size of the additional brake cylinders. If necessary an additional air reservoir should be installed.

Current government regulations regarding emergency and parking brakes must be respected. We recommend that the parking brake be constructed to act on the added axle as well.

**Warning**

For indications of a general nature concerning the braking system, see the instructions given at point 2.19.

For the electrical system, comply with the indications provided at point 2.21.

### 2.11.11 Raise Device

The additional axle may be equipped with a raise device and may also be used in specific cases where permitted by government regulations, to increase the adhesion of the drive axle to the ground under certain conditions (starting uphill, slippery or snow/ice covered roads) provided that:

- this modification is made conditional to the issue by IVECO of a permit in which the maximum permitted load on the overloaded axle is specified.
- this modification is made conditional to the issue by IVECO of a permit in which the maximum permitted load on the overloaded axle is specified.

Some national regulations permit the use of the lifting device even during normal vehicle travel, provided that the max. type-approval load specified for the drive axle and admissible speed limits are not exceeded.

In such cases the indications given in point 3.2.2 should be heeded concerning the centre of gravity of the body plus the payload.

**Approval of and Responsibility for the Operations Carried Out**

Following conversion, the vehicle will be submitted to local authority technical control for approval (e.g. single inspection or type approval).

The authorisation given by IVECO to install an auxiliary axle and the passing of the approval inspection do not free the bodybuilder/ converter from responsibility for the conversion in question, or its effect on the vehicle.

For the added assemblies, the required service or maintenance operations with relevant schedule, consistent with the operations and relevant schedule planned for the original vehicle must be defined and entered in the specific documentation.
2.12 Work on the Suspension

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

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

It is not possible to use a parabolic spring on one side of an axle and a semi-elliptic type spring on the other side of the same axle.

2.12.1 Transformation from mechanical to pneumatic suspension

Modifications of this kind are generally authorised for the rear axle only. Modification proposals presented by bodybuilders to the Company may be examined upon submission.

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

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


**2.13 Modification to the Engine Air Intake and Exhaust System**

Modification which would alter the characteristics of the air intake and exhaust systems may not be carried out without prior IVECO authorisation.

Any work done must not alter the existing vacuum values of the intake or the exhaust back pressure shown in the table.

### Table 2.16 – Maximum back-pressure permitted at rated speed and full load

<table>
<thead>
<tr>
<th>Engine</th>
<th>Engine code</th>
<th>Maximum back pressure (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E13</td>
<td>F4AE0481D</td>
<td>10.0</td>
</tr>
<tr>
<td>E15</td>
<td>F4AE0481C</td>
<td>10.0</td>
</tr>
<tr>
<td>E17</td>
<td>F4AE0481A</td>
<td>10.0</td>
</tr>
<tr>
<td>E18</td>
<td>F4AE0681E</td>
<td>10.0</td>
</tr>
<tr>
<td>E21</td>
<td>F4AE0681D</td>
<td>10.0</td>
</tr>
<tr>
<td>E24</td>
<td>F4AE0681B</td>
<td>10.0</td>
</tr>
<tr>
<td>E28</td>
<td>F4AE0681A</td>
<td>10.0</td>
</tr>
</tbody>
</table>

The routing of the tubing must be as even as possible. Bends must not have an angle of over 90° and the radii should not be lower than 2.5 times the external diameter. Avoid kinks and use cross-sections which are no smaller than those corresponding to the original system. Any connections on the intake duct must guarantee resistance of the tube to penetration by water or dust and absence of sharp edges or welding burrs inside the tube.

Sufficient clearance should be maintained (min. 150 mm) between the exhaust pipe and the electrical system, plastic hoses, the spare wheel, the plastic fuel tank (min. 100 mm), etc. Lower values (e.g. 80 mm) may be permitted if suitable sheet metal shielding is used. Further reductions require the use of heat insulation and the substitution of the plastic tubes with steel pipes.

Any work done on the exhaust system of the vehicle requires that the vehicle be homologated again with regard to noise and smoke wherever government regulations require it.

The air intake must be positioned to avoid the intake of hot air from the engine and/or of dusty air or snow and rain. The apertures for the intake of air which may have to be made in the bodies of vans, must have a working surface of not less than twice that of the master hose located upstream of the filter and in any case not less than the original one. These apertures (e.g. openings in the grill) must be of such a dimension that they do not become obstructed.

It is not permissible to modify or substitute the original air filter; the silencer body cannot be altered. Modifications to the equipment (injectors, engine control unit etc.) are not permissible as this may alter the correct functioning of the engine and adversely affect the emissions of gases from the exhaust.

**Vertical Exhaust**

Apart from the general matters discussed in the above point, ensure that:

- The exhaust is far enough away from the inlet area.
- A suitable supporting structure duly braced and fixed to the vehicle chassis, is made for the vertical section of the pipe.
- A section of flexible hose is fitted to free the silencer elastically from the rest of the added pipe.
- Arrangements are made to prevent the direct entry of water into the end part of the pipe.
2.14 Modification of the Engine Cooling System

The proper functioning of the original system, especially in connection with the radiator, the free surface of the radiator and hoses (dimensions and layout) must not be tampered with. In any case, whenever modifications must be made that entail work on the engine cooling system (e.g., modifications to the cab), the following points must be considered:

− The useful area for the passage of air for the cooling of the radiator must not be less than that which is available on vehicles with the standard cab. Maximum venting of air from the engine compartment must be ensured and care must be taken – possibly using shields or baffles – to avoid stagnant air pockets or back flow of air. The performance of the fan must not be altered.

− If it is necessary to re-position the hoses this must be done without affecting the complete filling of the system (which must occur at a continuous flow. without forming blockages at the mouth) or the normal flow of water. The maximum stabilising temperature of the water must not be altered even under the most severe operating conditions.

− Hoses must be located so that air pockets are not formed (i.e. avoiding air traps and providing appropriate bleeding points) that could hinder the circulation of water. So, it is necessary to check that the water pump primes immediately on starting the engine and later operates with the engine idling (accelerate a few times, if necessary) even when the circuit is not pressurized. In addition to this check that the delivery pressure of the water pump, when the engine is running under no load and at maximum RPM, is not lower than 1 bar.

− Always reinstall the radiator anti-clogging protection after making alterations to the engine cooling system.
2.15 Installation of a Supplementary Heating System

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

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

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

Furthermore:
- Ensure correct operation of the vehicle components and equipment (i.e. cooling system).
- Check the electrical system to ensure that the battery capacity and alternator output is sufficient for the higher current requirements (see point 2.21). Provide the new circuitry with a protection fuse.
- Connect the intake of the newly added fuel system to the reservoir connected to the engine fuel return line. Direct feed from the vehicle fuel tank is permitted only if this is independent from the engine fuel system and the new circuit is perfectly leakproof.
- Trace pipe and cable paths, the location of brackets and hoses bearing in mind that the overall dimensions and heat affect the various units on the chassis. Avoid runs and arrangements that could lead to hazards when the vehicle is running. Use shields or armouring if necessary.
- When installing a water heater, original vehicle heating and engine cooling circuits are involved (see point 2.14), it is advisable to follow the instructions listed below to ensure reliability of the heating system and safe operation of the original system:
  - special care must be taken when defining the connections between the supplementary equipment and the main one; refer to IVECO, if necessary.
  - determine a rational arrangement for piping, avoid neckings and siphonings;
  - install proper venting valve (bleeding points) to ensure proper filling of the system;
  - supplementary plugs should be installed to ensure draining of the system, if necessary;
  - proper insulation should be used to prevent heat dissipation.
- When air heaters are used and when the installation is to be made directly in the cab, make sure that the engine exhaust system does not touch the added installation (to prevent combustion gas circulation inside the vehicle) and have the correct warm air distribution by avoiding direct air flows.
- The complete installation should be designed to ensure good accessibility for quick and easy servicing.
2.16 Installation of an Air Conditioning System

When the installation of an air conditioning system is deemed necessary, it is advisable to use the types recommended by IVECO.

If this procedure is not applicable, the installation must be carried out in accordance with the supplier’s instructions and the following points:

- The installation must not interfere with the correct operation of the vehicle components and of equipment which may be connected with the installation.
- Check the electrical system to ensure that the battery capacity and alternator output is sufficient for the higher current requirements (see point 2.21). Provide the new circuitry with a protection fuse.
- With the agreement of IVECO, establish a method for installing the compressor, if fitted on the engine.
- Trace pipe and cable paths, the location of brackets and hoses bearing in mind that the overall dimensions and heat affect the various units on the chassis. Avoid runs and arrangements that could lead to hazards when the vehicle is running. Use shields or armouring if necessary.
- The complete installation should be designed to ensure good accessibility for quick and easy servicing. At vehicle delivery, the bodybuilder will supply all service and maintenance instructions which are deemed necessary.

Furthermore, according to the system operations:

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

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

2.17.1 General Specifications

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

The variations in the weight of the cab as well as its different depth must be considered when positioning the payload, in order to ensure correct distribution of the permitted weights on the axles (see point 3.2).

Nor operations that require the removal of sound deadening panels or internal protective elements (panelling, padding) restrict the removal to the absolute minimum, taking care to restore the protective elements to their original condition, ensuring the previous operating capability.

Controls and equipment (power take–off engagement control, external operating cylinder control etc.) may be fitted in the cab provided that:

– They are positioned rationally, properly and are easily accessible to the driver.
– Safety, control and warning devices are fitted which meet the requirements of use and safety of the vehicle and its equipment as well as the requirements of national legislation.

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

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

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

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

The bodybuilder must check that after modification, the cab satisfies legal requirements regarding both the inside and outside of the vehicle.

2.17.2 Roof Panel Modifications

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

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


2.17.3 Installation of a Spoiler or a Top–sleeper

Upon request, the various versions designed by IVECO can be delivered with relevant instructions for installation. It is recommended that these versions are used as they are specifically checked.

The installation of other versions will be carried out in the same way as prescribed for the original ones by using the anchorage points placed on the roof sides resting on devices of adequate dimensions. Moreover, the instructions of the manufacturers of the add–on assemblies are also to be met.

Their positioning must not impair the correct operation of the engine air intake system.

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

2.17.4 Crew Cabs

When making crew cabs, cabs for special vehicles, for municipal use, fire fighting etc. check whether the cab’s suspension requires uprating due to the increase in weight, also taking into account any extra seating arrangements made. Before work of this type can be started on tilting cabs, IVECO’s approval is required to confirm whether the original suspension, tilting and locking devices are suitable.

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

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

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

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

Whenever the cab has to remain of the tilting type, the following points will be taken into consideration depending on the increase in cab weight:
– Modify the tilting devices.
– Restore the cab locking devices.
– Decrease the tilting angle.
– Adapt the suspension.

For the cab tilting system, a cylinder of greater capacity with relevant resting devices can be installed or a supplementary one fitted taking care to maintain the required clearance from the adjacent components.

The area affected by the thrust of the hydraulic devices must be such to avoid an excessive concentration of stress. For this purpose ensure that:
– The lifting points are positioned as far back as possible.
– There are suitable anchorage points both on the cab floor and vehicle chassis.
If the tilting cab exceeds the upper point of equilibrium, ensure that the added hydraulic device enables the cab to be held in the end-of-travel, if it does not, fit a safety cable.

Adopt the necessary measures to ensure that the cab locks properly on lowering.

The original cab safety lock and warning light arrangement must remain unaltered.

The cab suspension system must be adjusted to suit the added weight and new dimensions. This must be done rationally without affecting the normal movements of the cab.

When working out a suitable cab suspension system, the following points must be observed:

- The cab's attitude, designed for the standard vehicle, must not be altered.
- The added part with its weight must not affect the original portion of the cab with its suspension.
- Ensure normal oscillation of the cab along the vertical, longitudinal and transverse plane.

If the cab has to be converted to a fixed cab, use similar suspension systems as those used on tilting cabs. Take care to provide a removable cowling, hatches and panels to enable inspection and maintenance work on the parts underneath.

To ease workshop operations we recommend that a rear anchorage point be provided for lifting, or that it should be possible to fit a safety bar.

A cab modification may affect components such as the air inlet and filter. Using standard parts fitted to other models such as sleeper cab variants may offer a good solution and enable legal requirements to be met.

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

**The cab suspension system must be adapted according to the mass added and to the new measures. This should be done in a logical way so that the normal movements of the cab are not hindered.**
2.18 Changing the Size of the Tyres

IVECO’s approval must be sought prior to replacing the tyres with others of a different size or load capacity from those which were approved at the time the vehicle was homologated.

Changing the size of the tyres may involve replacing the wheels with others of a correspondingly greater loading capacity. In this case check whether the spare wheel carrier needs to be changed.

Mounting tyres of different sizes or types of construction on the same axle is prohibited.

Changing the size of the tyres may affect the ground clearance of the rear underrun guard, therefore compliance with the national legal requirements must be verified.

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

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

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

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

2.19.1 General Specifications

The braking system with its components represents an element of crucial importance to vehicle safety.

It is prohibited to make changes to units such as the brake force control system, distributor, brake cylinders, valves, etc., which are rated as safety components.

Any modification to the braking system (modification of pipes, fitting additional working cylinders, etc.) must be authorised by IVECO.

For new equipment we recommend the same make as those fitted to the original vehicle.

When required by national regulations, the vehicle must be submitted for testing to the respective authority.

In the event of the regulating valves, air drier etc., being moved, reinstate the same type of installation as originally envisaged, verifying correct operation. In addition, operations carried out on the air drier must not affect cooling of the air supplied by the compressor.

If the drier has to be repositioned, or if the body reduces the drier ventilation or intake lines (i.e. from the compressor), then the drier intake temperature (measured at the section of intake hose next to the drier) must never be more than 65°C in all vehicle use conditions.

If the drier is repositioned, the hoses must not be lengthened with a siphon. The original length of the intake hose is to be considered as minimum.

2.19.2 Brake Pipes

Pipes must never be welded.

When the wheelbase or rear overhang of the chassis are modified, the brake pipes concerned must be replaced by a single length of new pipe. Where this is not possible the connectors used must be of the same type as those used originally on the vehicle. When replacing observe the minimum internal dimensions of the existing pipes.

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

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

Metal Pipes

For the hydraulic system pipes and those between the air compressor and adjustment units, any additions and replacements must be as follows:

- Brake pipes (material, size, connectors) : according to ISO 4038 Standard
- Compressor pipes (material, size, connectors) : according to DIN 3901
- Curvature radii (referred to pipe centreline) : minimum 2 x outer dia.
- Tightening torque
  - brake pipe dia. 6x4 (connectors M12x1) : 20 Nm
  - Compressor pipes dia. 19x15 (connectors M26x1.5) : 90 Nm
Plastic Pipes

When fitting new pipes or replacing others, plastic must not be used for the following:

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

During modification the following must be observed:

- Material and dimensions : Standard DIN 74324 (Iveco Standard 18–0400)
  (max. operating pressure 11 bars)
- Radii of curvature : min. 6 x outer dia.
  (referred to the pipe centreline)

Preparation and installation (Iveco Standard 17–2403)

Cut the pipe at right angles (max. permissible variation 15°) using the correct tools to avoid flaws which could impair tightness.

Mark the portion of the length L (see Figure 2.22) to be inserted in the connector with indelible ink or adhesive tape to ensure tightness. Mark the pipe to avoid confusion while it is being installed for subsequent modifications.

Figure 2.22

<table>
<thead>
<tr>
<th>d (mm)</th>
<th>L (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>19,8</td>
</tr>
<tr>
<td>8</td>
<td>20,5</td>
</tr>
<tr>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>16</td>
<td>27,1</td>
</tr>
</tbody>
</table>
As a rule quick coupling connectors should be used. We recommend that the same makes present on the original vehicle be used. When necessary (e.g. near bends), connectors with metal inserts may be used. Before inserting the pipe into the connector the latter must be screwed into its threaded seat on the component (e.g. pneumatic valve) adopting the tightening torques indicated below:

Table 2.17

<table>
<thead>
<tr>
<th>Thread</th>
<th>Tightening torque (Nm ± 10%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 12 X 1.5 mm</td>
<td>24</td>
</tr>
<tr>
<td>M 14 X 1.5 mm</td>
<td>28</td>
</tr>
<tr>
<td>M 16 X 1.5 mm</td>
<td>35</td>
</tr>
<tr>
<td>M 22 X 1.5 mm</td>
<td>40</td>
</tr>
</tbody>
</table>

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

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

Should piping be replaced, use new connectors. After opening, connectors must not be reused.

Installing pipes on vehicle

New pipes must be thoroughly cleaned inside before use (e.g. by blowing through with compressed air). Pipes must be fixed in their correct position. The fixing clips must go right round the pipe. They may be of plastic, metal or rubber.

Observe adequate distances between the various fixing elements. As a rule a maximum distance of 500 mm for plastic pipes and 600 mm for metal pipes is applicable.

For plastic pipes, in order to prevent distortion and tension on the connectors when fitting them, take the necessary precautions when working out the run and fitting the fixing brackets onto the chassis. Correct fitting of the fixing brackets will ensure that the pipes do not rub against the fixed parts of the chassis.

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

When a pipe has to pass through the chassis frame (side or cross members) appropriate precautions must be taken to avoid damage.
A solution which can be used as a bulkhead connection for a straight or angled run is given in Figure 2.23:

**Figure 2.23**

![Diagram of bulkhead connection](image)

1. Pipe
2. Bulkhead connector
3. Chassis

After completing any work either on the system or the equipment, the braking system must be checked to ensure its efficiency. For air systems, build up the pressure to its maximum value. Check for leaks in the areas affected by the work carried out.

### 2.19.3 Vehicles with ABS

When modifying the wheelbase, the ABS modulators must be kept in their original position with respect to the rear wheel axle. The electrical wires between the sensors on the rear axle and the control unit and between the unit and modulators must be modified accordingly by using new wires or extensions with appropriate connectors should there be insufficient length in the originals. Brake pipes upstream of the modulators must be similarly modified.
Small quantities of air may be removed from the service tank to actuate auxiliary devices (such as a power take-off), provided that a control pressure value of 8.5 bar and limited return, which does not permit the drawing of air below that pressure, is inserted in the new take-off. Take the air directly from the 4-way safety valve on the service line (outlet 24) located by the air reservoirs. A T-connector (e.g. IVECO detail n° 98420917) can be used for this purpose (see Figure 2.24).

**Figure 2.24**

If additional pneumatically powered units are installed, the demand on the compressor must not exceed 50% of its operating time.

If larger quantities of air are required, a supplementary air tank must be fitted. However, in this case it will be necessary to verify that the standard air compressor is capable of filling the brake system tank in the specifically prescribed times.

A compressor of greater capacity may have to be installed if necessary.
2.21 Operations on the electrical system

2.21.1 General Information

The vehicles operate on a 24v electric system for normal requirements and the chassis is an earth return. This acts as a current return wire between relevant components, such as battery and alternator. All component negative terminals are connected through the chassis in the absence of an insulated return wire.

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

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

Note

For more detailed information on the vehicle's electrical system, please refer to the specific Workshop Manuals.

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

Work on the system (e.g. removing wiring harness, making additional circuits, replacing equipment, changing fuses, etc.) that is not done in conformity with IVECO instructions or is carried out by unskilled personnel can severely damage the systems (control units, wiring, sensors, etc.), jeopardizing safety and operation of the vehicle besides causing significant damage (e.g. short-circuiting with the risk of fire and destruction of the vehicle) that is not covered by warranty.

It is absolutely prohibited to make any changes or connections to the line linking the ECU's (CAN line), which cannot be tampered with, under any circumstances. Any fault diagnosis or maintenance work can only be done by authorized personnel with IVECO approved equipment.

Always disconnect the batteries before commencing any work on the electrical system. First disconnect the negative and then the positive power cable.

Use fuses with the required capacity for their specific function. Never use fuses of higher capacity. Change them only after eliminating the problem with keys and ancillaries disconnected.

Restore the original conditions of the wiring (routing, guards, and binding, preventing the cable at all costs from coming into contact with metal surfaces of the structure that may impair its integrity).
2.21.2 Modifying the electrical system

Alternator, electrical/electronic components

In order to protect the vehicle components, take the following precautions at all times.
Never disconnect the batteries from the system or open the main current switch when the engine is running.

Never disconnect the connectors from the control units when the engine is running or when the control units are powered.
Never power components interlocked by electronic modules with the rated voltage of the vehicle through wander cables.
Control units equipped with metal sheathes have to be earthed through a screw or bolt unless otherwise specified.

Do not tow—start the vehicle.
Do not start the engine without connecting the batteries permanently.

Should it be necessary to quick charge the batteries, disconnect them from the vehicle circuit. Starting will have to be carried out only with the external battery trolley, ensuring correct polarity.

Checking the earth connections

As a general rule the original earth connections of the vehicle must not be changed. If it is necessary to move these connections or to implement further earth points use the existing holes on the chassis as far as possible and:
- Remove the paint, either by filing and/or using a suitable chemical product, on both the chassis side and terminal side, ensuring that the anaphoretic paint is completely removed from the chassis and a support surface is created with no indentations or ridges;
- Apply appropriate high conductivity paint between the cable terminal and the metal surface.
- Connect the earth cables within 5 minutes from the application of the paint. Do not use the standardised (engine and chassis earth connection) points for the earth connections for control switches (e.g. sensors or low absorption devices).

Figure 2.25

1 – EARTH CONNECTIONS: A. EFFICIENT EARTH POINT – B. INEFFICIENT EARTH POINT
3 – WIRE CONNECTED TO EARTH
The negative wires connected to the system earth points must be as short as possible and interconnected with a "star" connection.

2.21.3 Additional circuits

These must be separated from the vehicle's main circuit and protected with a fuse. Additional electric wires must be connected to the original electrical system with the same type of sealed connectors as the original ones. They must be protected with sheaths (not PVC) or ducted in corrugated pipes fixed with fasteners, shielded from impact and heat sources.

The wires must be at minimum distances of:

- 150 mm from major heat sources (turbine, engine, exhaust manifold, ...)
- 50 mm from containers of chemical agents (batteries, etc...)
- 20 mm rom moving parts

Take great care to prevent the wires rubbing against other components, especially against sharp edges on the bodywork.

Wherever possible, wire routes must be secured with fasteners and dedicated clips, set close together (about 350 mm apart) to prevent sagging, making it possible (and obligatory) to route them in the same way after repairs/fitting work.

When the wires pass through holes or along the edges of panels, etc. they must be shielded with protective conduits (in addition to the corrugated piping). It is forbidden to drill through the chassis for wire passages.
The corrugated piping must protect the whole wire completely and connected to the rubber grommets on the terminals (with heat-shrink fasteners or tape). The clips on the corrugated pipe (when cut lengthwise) must not deform the pipe and the wires must not stray out of the piping or come into contact with sharp pipe edges. All (+) terminals for wires must be protected with rubber grommets, (hermetically sealed in zones exposed to atmospheric agents or where water collects). The wires must be attached to the terminals (both positive and negative) in such a way as to prevent slackening. Tighten with a torque wrench where possible and using radial crimpers for multiple connections (to be avoided where possible).

Where possible it is recommended that different runs are used between wires (looms) with high intensity absorption signals (e.g. electric motors, solenoid valves) and those with low intensity absorption signals (e.g. sensors) to avoid any interference between them. All should be kept as close as possible to the metal structure of the vehicle.

When making chassis-tiltable cab connections, the position of the wire bundle must be checked with the cab both closed and open, in order to detect and put right any possible obstructions or stretching.

Use fuses and wires of suitable cross-section, depending on current levels, as shown in the table. The fuse must be installed as close as possible to the current drawing point.

<table>
<thead>
<tr>
<th>Max continuous current 1) (A)</th>
<th>Wire cross-section (mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0.5</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>2.5</td>
</tr>
<tr>
<td>25</td>
<td>4</td>
</tr>
<tr>
<td>35</td>
<td>6</td>
</tr>
<tr>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>70</td>
<td>16</td>
</tr>
<tr>
<td>90</td>
<td>25</td>
</tr>
<tr>
<td>120</td>
<td>35</td>
</tr>
<tr>
<td>150</td>
<td>50</td>
</tr>
</tbody>
</table>

1) For use periods longer than 30 seconds.

According to the position as well as the temperature that might be registered inside the storage compartment choose fuses that can be charged up to 70% – 80% of their total maximum capacity.

When grouping several wires together, remember that there will be a reduction in their intensity as compared to the rated value of a single cable due to reduced heat dissipation.

On vehicles where the engine is frequently started up, with power drawn off and limited engine speed (e.g., vehicles with cold storage), periodically charge the battery to keep it effective.

Plug connections and terminals must be shielded and resistant to atmospheric agents, using the same type of components as on the original vehicle.
**Corrugated pipe for coachbuilders**

A specific corrugated pipe (located on the front of the cab on the passenger side) enables the coachbuilder to utilize a handy passage for the electric cables from inside to outside the cab (see Figure 2.27).

The lower end of the pipe is protected by a plug to prevent fumes and dust getting into the cab; seal this end after passing the cables through it.

The arrow in Figure 2.28 indicates the panel behind which there is the other end of the corrugated pipe inside the cab.

---

**Figure 2.27**

![Figure 2.27](image1)

**Figure 2.28**

![Figure 2.28](image2)
2.21.4 Installing additional equipment

When fitting additional equipment, where necessary, diodes must be fitted to provide protection against any induction current peaks.

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

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

Additional equipment should be connected to the system earth with the utmost care (see point 2.21). The relative wiring must not be fitted alongside the existing electronic circuits in order to avoid electromagnetic interference.

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

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

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

- 50V/m immunity for secondary devices, for frequencies ranging from 20 MHz to 1 GHz
- 100V/m immunity for primary devices, for frequencies ranging from 20 MHz to 1 GHz.

The maximum admissible variation in transient voltage for units powered with 24 V is ±80V, as measured at the terminals of the artificial network (L.I.S.N.) during bench tests; otherwise, if the measurements are made on the vehicle, the variation must be determined at the most accessible point in the proximity of the device generating the disturbance.
Maximum radiated and conducted emission levels are:

### Table 2.19

<table>
<thead>
<tr>
<th>Type of disturbance</th>
<th>Type of transducer</th>
<th>Type of band</th>
<th>Type of detector</th>
<th>Acceptable disturbance limits in dBµV (normal unit of measurement at CISPR for measurement of emissions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiated</td>
<td>Aerial at a distance of 1 metre</td>
<td>Broadband</td>
<td>Quasi-peak</td>
<td>150 KHz 300 KHz 2 MHz 5 MHz 6.2 MHz 30 MHz 54 MHz 70–108 MHz, 144–172 MHz 420–512 MHz, 820–960 MHz</td>
</tr>
<tr>
<td>Radiated</td>
<td>Broadband</td>
<td>Peak</td>
<td>63</td>
<td>35</td>
</tr>
<tr>
<td>Radiated</td>
<td>Narrowband</td>
<td>Peak</td>
<td>76</td>
<td>67</td>
</tr>
<tr>
<td>Conducted</td>
<td>LISN d 50 ohm/5 µH/0.1 µF</td>
<td>Broadband</td>
<td>Quasi-peak</td>
<td>80</td>
</tr>
<tr>
<td>Conducted</td>
<td>Broadband</td>
<td>Peak</td>
<td>90</td>
<td>76</td>
</tr>
<tr>
<td>Conducted</td>
<td>Narrowband</td>
<td>Peak</td>
<td>70</td>
<td>50</td>
</tr>
</tbody>
</table>

Use electrical/electronic equipment in compliance with the EC Directives on electromagnetic compatibility, i.e. use suitable components for vehicle applications “e..” marked (the EC marking is not sufficient). If in any doubt, call the IVECO Service Network.

These levels are granted only if the system comes from "IVECO Spare Parts" or it has been certified as per ISO, CISPR, VDE international regulations. In case of systems which use the primary or secondary civil electric network (220V AC) as a supply source, the relevant characteristics have to comply with the IEC regulations.

**Transceiver System (C.B., 2 metres and cellular telephone)**

To fit CB units (27 MHz), 2m amateur units (144 MHz), cellular phones (GSM) and satellite navigators (GPS), use the power supply system already fitted to the vehicle, connect directly to terminal 30 (and terminal 15, if necessary), through an extra fuse.

These units must be type–approved according to the applicable legal requirements and must be of the fixed type (non portable) type.

The use of non type–approved receiver–transmitter units or supplementary amplifiers might affect the correct operation of standard on–board electrical/electronic devices, with adverse effects on vehicle and/or driver safety.

The most frequent applications include:
- amateur receiver–transmitter units for CB and 2M bands.
- receiver–transmitter units for cellular telephones.
- GPS receiver and satellite navigation units.
HAM and 2m radio system installation

HAM (27 MHz) and 2m (144 MHz) radio systems must be installed using the power system provided in the vehicle. Connect to terminal 30 via a supplementary fuse. The systems must be legally type–approved and fixed (not portable). Install the transmitting part in a flat, dry area separate from the electronic components of the vehicle, away from humidity and vibrations.

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

Selecting the right type of antenna and installing it correctly is crucial for ensuring maximum performance of the device. The antenna must be of good quality and it must be installed with care. Installation is very crucial as this determines the performance and, consequently, the range of the radio.

The are two options concerning the type of installation: fixed (i.e. permanent) or on drip moulding (or other type of support). The second option is more practical and avoids the need to drill the vehicle body.

Install at a distance which is no less than 1/2 lambda (wave length) from other antennas. The middle of the roof is the best position because the mass plane is proportional in all directions. With assembly on a side or in any other part of the vehicle, the mass plane will be proportional to the mass itself.

Follow the precautions below when connecting and arranging the wires:

– Use a top–quality, low–loss coaxial antenna cable with the same impedance as the transmitter and the antenna.

– The coaxial cable run must be at a suitable distance (minimum 50 mm) from pre–existing wiring (TV, radio, telephone, amplifiers and other electronic devices) to prevent interference and malfunctioning. Ensure the minimum distance from the metallic structure of the cab. Cable installation on the left or right–hand side is preferable.

– Clean the lower part of the hole made in the body for installing the antenna in fixed position so that the antenna support is perfectly connected to the vehicle earth.

– The coaxial cable connecting the antenna to the radio must be fitted with the utmost care. Avoid curves or bends which can pinch or distort the cable. Avoid tangling. Shorten the wire as much as possible. Remember that any imperfections in the coaxial cable will cause severe interference for the radio transmitter.

– Use existing holes for routing the cable. Take all the necessary precautions for protecting the body if additional hole have to be drilled (use anti–rust paint, sheath, etc.).

– Ensure a good connection with the vehicle earth both at the base of the antenna and at the device fixing to ensure maximum power transfer.

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

If the equipment uses a 12v power supply, a suitable 24–12V DC/DC converter will have to be fitted (if not already provided). The power cables for the converter must be as short as possible with no coils and maintaining the minimum distance from the reference plane.
Notes for drip moulding fitting

No special procedures are required for fitting vehicle antenna supports. Follow the instructions provided with the drip mould support. After assembly make sure there is a good earth connection between the vehicle and the metal support; check with the radio disconnected from the antenna cable. Check also that there is a good connection between the metal support and the body. It is important that the cable is suitably protected from deterioration regarding the drip moulding assembly and if the cable is routed between the door frame and the door. IVECO recommends the fixed antenna installation is used in preference to the drip moulding type.

Cellular telephone system installation

Cellular telephone systems must be installed using the power system provided in the vehicle. Connect to terminal 30 via a supplementary fuse.

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

The antenna must be installed outside the vehicle, possibly on a large metallic base as vertically as possible with the connection cable facing down. Follow the instructions and the manufacturer’s warnings for assembly.

The ideal location of the antenna is on the front of the cab roof at a distance no less than 30 cm from other antennas.

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

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

If the equipment uses a 12v power supply, a suitable 24–12V DC/DC converter will have to be fitted (if not already provided). The power cables for the converter must be as short as possible with no coils and maintaining the minimum distance from the reference plane.
GPS antenna cable and navigation system installation

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

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

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

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

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

The ideal location for the GPS antenna is under the plastic dashboard in the middle and at the base of the vehicle windscreen. Do not install the antenna under any type of metallic structure in the cab.

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

Follow the precautions below when connecting and arranging the wires:

- Use a top quality cable particularly concerning the protective shielding.

- The wire course must be at a suitable distance (minimum 50 mm) from pre-existing wiring. Ensure the minimum distance from the metallic structure of the cab. Avoid excessively pulling or pinching the cable. Installation on the left or right-hand side is preferable.

- Never shorted or extend the coaxial antenna cable.

- Use existing holes for routing the cable. Take all the necessary precautions for protecting the body if additional holes have to be drilled (use anti-rust paint, sheath, etc.).

- Ensure a good connection with the vehicle earth both on the base of the antenna and at the device fixing to ensure maximum power transfer.

Navigation systems must be installed using the power system provided in the vehicle. Connect to terminal 30 via a supplementary fuse.

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

If the equipment uses a 12v power supply, a suitable 24-12V DC/DC converter will have to be fitted (if not already provided). The power cables for the converter must be as short as possible with no coils and maintaining the minimum distance from the reference plane.
Warnings

When fitting devices such as:
- Retarder
- Auxiliary heaters
- Power take–offs
- Air conditioning systems
- Automatic gearboxes
- Fleet management
- Anti theft devices
- Cellular phones etc
- Compressors for refrigerator systems.

which could interact with the other electrical systems already fitted to the vehicle (e.g. ABS, EDC etc.), contact IVECO in order to optimise the installation.

Remarks

For the operations which might cause interference with the basic system, it is necessary to carry out diagnostic checks in order to make sure that the system has been properly fitted.

These checks can be carried out using the self–diagnosis system of the on–board control units (blink–code) or at the IVECO Service Network.

IVECO reserves the right to decline its own warranty cover on the vehicle should any work be carried out which does not comply with the regulations of the Company.

2.21.5 Additional equipment power supply

The vehicles system is designed to provide the necessary power to all the standard equipment. Each piece of equipment has its own specific protection for its own function and the appropriate dimensions of the wires.

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

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

If batteries of a greater capacity are used, due to the demand of the added loads, it is advisable to request optional batteries or alternators with a greater capacity.

In any case we recommend that the increase in the capacity of the batteries should not exceed 20–30% of the maximum values provided as an optional extra by IVECO so as not to damage some components of the system (e.g. Starter motor). If greater capacities are required, use additional batteries making the necessary arrangements for recharging as described below.

2.21.6 Additional Batteries and Alternators

Installing high power–consumption electric equipment (e.g. electric motors used frequently or for a long time without using the vehicle’s engine, as, for example, with the tail lifts in urban applications) or a great deal of additional electrical equipment, may require power which the vehicle’s standard system is unable to deliver. In such cases additional batteries of the appropriate capacity must be used.
Their insertion into the vehicle’s circuits must include a separate recharging system (see Figure 2.29) integrated with that of the vehicle. In this case it is advisable to provide supplementary batteries with the same capacity as the batteries originally installed in order to ensure correct recharging of all batteries.

**Figure 2.29**

Fitting of additional batteries

Installing additional batteries involves checking that the alternator is of a sufficient capacity to recharge. If necessary, an alternator with larger power or an additional one must be used. In this case connect up as shown in Figure 2.30.

When using electric motors which are activated only while the vehicle engine is running, instead of supplementary batteries, it could be sufficient to use a larger power alternator or a supplementary one.

Such alternators have to be equipped with Zener diode rectifiers in order to avoid damaging the electrical/electronic systems already fitted which might arise from accidental disconnection of the batteries. Also, every alternator must have a warning light to signal when the battery is not recharging.


**Figure 2.30**

Installing an additional alternator

---

**Alternators for refrigeration units**

Special care has to be taken when fitting refrigeration units that are driven by a second engine driven alternator.

These generators, according to their RPM, generate a voltage between 270 to 540v in the wires that are routed to the cooling unit on the vehicle.

The danger caused by possible electromagnetic interferences between wires from the above mentioned alternator being to close to those already on the vehicle, can easily occur.

Such cases require highly insulated wires routed separately, yet not close to the standard wires of the vehicle.

The electromagnetic output levels previously mentioned have to be complied with for these units.

An error message will appear on the on–board panel in the event of standard alternator failure (e.g. low voltage, no signal).
2.21.7 Drawing off power

The information about the points from which power draw–off is possible (see Figure 2.31), the available current and the precautions to be observed are as follows:

**Precautions:**

Use appropriate fuses, where necessary, fitting them near the power tap.

Protect the added cables in suitable sheaths, installing them in accordance with the instructions of point 2.21.3.

Current can be drawn from the following points:

a) from the batteries;

b) from the main current switch (manual or contactor);

c) from the 20 pin connector (referred to below as pinout);

d) from the 5 pin connectors on the frame (substituting the previous 4–way connectors) or from the 4 pin connectors, for vehicles with MD3060P gearbox.

e) connectors for side marker lamps

**Figure 2.31**
a) Batteries

The different types of available batteries are given in the table below.

Table 2.20

<table>
<thead>
<tr>
<th>Model</th>
<th>Batteries</th>
<th></th>
<th></th>
<th></th>
<th>Alternator</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>70 Ah</strong></td>
<td><strong>88Ah</strong></td>
<td><strong>110Ah</strong></td>
<td><strong>143Ah</strong></td>
<td><strong>170Ah</strong></td>
<td><strong>70A</strong></td>
<td><strong>90A</strong></td>
</tr>
<tr>
<td>60E, 65E, 75E, 80EL</td>
<td>standard</td>
<td>opt 563 1)</td>
<td>opt 567 2)</td>
<td>opt 568 2)</td>
<td>–</td>
<td>standard</td>
<td>opt 6315</td>
</tr>
<tr>
<td>80E, 90E, 100E</td>
<td>–</td>
<td>standard 3)</td>
<td>standard 4)</td>
<td>opt 568</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>110EL, 120EL</td>
<td>–</td>
<td>–</td>
<td>standard</td>
<td>opt 568</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>120E, 130E, 150E, 180E, 260E</td>
<td>–</td>
<td>–</td>
<td>standard</td>
<td>opt 568</td>
<td>opt 5031</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100EW, 140EW</td>
<td>–</td>
<td>standard</td>
<td>opt 568</td>
<td>opt 5031</td>
<td>–</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) 2700 mm wheelbase only
2) not available for 2700 mm wheelbase
3) for 2700 mm and 3105 mm wheelbases
4) for wheelbases of 3300 mm and over

Figure 2.32

Taking power through the specific terminal 'c' specially provided for bodybuilders.

With engine stopped: Up to 10% of the battery rating.
With engine running: A further 20% of the battery rating can be drawn, according to the alternator power and the engine revs.

When greater power is needed, uprated batteries and alternator should be fitted for frequent use with high loads (E.G. tail lifts) higher capacity batteries (minimum 110A) with an alternator of not less than 90A should be fitted.

Additional circuits should be isolated and protected with suitable fuses, positioned near to the current drawing point, as specified in the Table 2.18. Protect the additional cables by means of special sheaths or corrugated covers, and install them in compliance with the instruction of 2.21.
Maxifuse and Megafuse fuses

A set of five fuse holder kits is available from any IVECO Parts Dept., to protect high power supplies. These fuses should be positioned as close as possible to the supply terminal on the battery according to the space available on the vehicle.

**Figure 2.33**

<table>
<thead>
<tr>
<th>Capacity</th>
<th>IVECO Ref. No.</th>
<th>Cable section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kit 40A</td>
<td>4104 0110 KZ</td>
<td>10mm²</td>
</tr>
<tr>
<td>Kit 60A</td>
<td>4104 0111 KZ</td>
<td>10mm²</td>
</tr>
<tr>
<td>Kit 100A</td>
<td>4104 0112 KZ</td>
<td>25mm²</td>
</tr>
<tr>
<td>Kit 125A</td>
<td>4104 0113 KZ</td>
<td>35mm²</td>
</tr>
<tr>
<td>Kit 150A</td>
<td>4104 0114 KZ</td>
<td>50mm²</td>
</tr>
</tbody>
</table>

**b) Battery cut–out**

If the vehicle has a battery cut–out, current can be drawn from the threaded terminal (positive pole) on the component:

**Figure 2.34**

Isolating cap for cables
The chassis is the return.
The contact surfaces of the connection to the current drawing point should be sufficiently large for quantity of current to be drawn (the maximum drawable current limit is as specified in point a: current draw–off from batteries). For this purpose use nuts and washers to secure the draw–off points to the battery disconnector threaded terminal.
Install a fuse downstream of the disconnector and use wires of suitable cross–section for the current level, as specified in the NO TAG.
The outgoing wires must be routed parallel to the reference surface, i.e. as close as possible to the chassis/body structure. Always shield the wires with corrugated piping and isolate the contact with a wire–isolating cap of the correct size.

Isolate the battery disconnector threaded terminal (positive pole) if no current is being drawn from the battery.

c) 20 pin connector (blue)

From the 20 pin connector, located in the electronic control unit compartment (passenger side), it is possible to take current from pins 3, 5 and 6. To use this connector, you must request spare part kit 2994016, comprising the connectors, cable terminals and protective pads.

### Table 2.21 – New EuroCargo, 20 pin connector pinouts

<table>
<thead>
<tr>
<th>Pin</th>
<th>Wire no.</th>
<th>D (mm²)</th>
<th>Maximum load</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5542</td>
<td>0.5</td>
<td>1 mA</td>
<td>Speed signal B7, from tachograph</td>
</tr>
<tr>
<td>2</td>
<td>7780</td>
<td>0.5</td>
<td>100 mA</td>
<td>Engine state, alternator L 24V with engine running</td>
</tr>
<tr>
<td>3</td>
<td>8000</td>
<td>1</td>
<td>5 A</td>
<td>24V with side lights on</td>
</tr>
<tr>
<td>4</td>
<td>9907</td>
<td>0.5</td>
<td>200 mA</td>
<td>Earth with parking brake engaged</td>
</tr>
<tr>
<td>5</td>
<td>8710</td>
<td>2286</td>
<td>1</td>
<td>5 A</td>
</tr>
<tr>
<td>6</td>
<td>7772</td>
<td>1</td>
<td>10 A</td>
<td>Battery direct (30)</td>
</tr>
<tr>
<td>7</td>
<td>8050</td>
<td>0.5</td>
<td>10 mA</td>
<td>Engine state, to activate pin 15 connector</td>
</tr>
<tr>
<td>8</td>
<td>9906</td>
<td>0.5</td>
<td>10 mA</td>
<td>Engine stop, to activate pin 15 connector</td>
</tr>
<tr>
<td>9</td>
<td>0000</td>
<td>1</td>
<td>10 A</td>
<td>Earth</td>
</tr>
<tr>
<td>10</td>
<td>8154</td>
<td>0.5</td>
<td>~10 mA</td>
<td>CC OFF ¹</td>
</tr>
<tr>
<td>11</td>
<td>8154</td>
<td>0.5</td>
<td>~10 mA</td>
<td>CC OFF ¹</td>
</tr>
<tr>
<td>12</td>
<td>8155</td>
<td>0.5</td>
<td>~10 mA</td>
<td>CC RESUME, to activate pin 9 connector</td>
</tr>
<tr>
<td>13</td>
<td>8156</td>
<td>0.5</td>
<td>~10 mA</td>
<td>CC SET–, to activate pin 9 connector</td>
</tr>
<tr>
<td>14</td>
<td>8157</td>
<td>0.5</td>
<td>~10 mA</td>
<td>CC SET+, to activate pin 9 connector</td>
</tr>
<tr>
<td>15</td>
<td>0150</td>
<td>0.5</td>
<td>~10 mA</td>
<td>Node W2</td>
</tr>
<tr>
<td>16</td>
<td>0169</td>
<td>0.5</td>
<td>~10 mA</td>
<td>PTO earth</td>
</tr>
<tr>
<td>17</td>
<td>0166</td>
<td>0.5</td>
<td>~10 mA</td>
<td>PTO1, to activate pin 16 connector</td>
</tr>
<tr>
<td>18</td>
<td>0167</td>
<td>0.5</td>
<td>~10 mA</td>
<td>PTO2, to activate pin 16 connector</td>
</tr>
<tr>
<td>19</td>
<td>0168</td>
<td>0.5</td>
<td>~10 mA</td>
<td>PTO3, to activate pin 16 connector</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td>–</td>
<td>Not connected</td>
</tr>
</tbody>
</table>

¹) Pins 10 and 11 are connected with a jumper. For vehicles with cruise control, remove the jumper and install a NC switch; the OFF function (to switch off CC and PTO) is obtained by opening the switch. For vehicles without CC, remove the jumper and install a NC switch, then connect pins 10 and 9; the OFF function (to switch off CC and PTO) is obtained by opening the switch.

Current take–off from pins 3, 5 and 6 on the 20 pin connector is protected by three fuses located in the ICU (interconnection control unit), as illustrated in the following table:

<table>
<thead>
<tr>
<th>Position</th>
<th>Maximum load</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>10 mA</td>
<td>Direct battery (24 V)</td>
</tr>
<tr>
<td>9</td>
<td>5 A</td>
<td>Underkey (15)</td>
</tr>
<tr>
<td>17</td>
<td>5 A</td>
<td>After lights switch</td>
</tr>
</tbody>
</table>
d) 5 pin and 4 pin connector for vehicles with MD3060P gearbox

E’ posizionato sul telaio. Per utilizzare questo connettore, deve essere ordinato il kit 2994016, composto dai connettori, capicorda e gommini di protezione.

Positioned on chassis. To use this connector, order kit 504033457, consisting of connectors, cable terminals and rubber grommets.

Table 2.22 – New EuroCargo, 5 pin connector pinouts

<table>
<thead>
<tr>
<th>Pin</th>
<th>Wire no.</th>
<th>D (mm²)</th>
<th>Maximum load</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>71S1</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>Node V2 (24V) ¹)</td>
</tr>
<tr>
<td>2</td>
<td>5502</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>2nd speed limiter, to activate pin 1 connector</td>
</tr>
<tr>
<td>3</td>
<td>2226</td>
<td>0.5</td>
<td>10 mA</td>
<td>Gearbox in reverse, 24V in reverse</td>
</tr>
<tr>
<td>4</td>
<td>5584</td>
<td>0.5</td>
<td>10 mA</td>
<td>Engine revolutions signal</td>
</tr>
<tr>
<td>5</td>
<td>0150</td>
<td>0.5</td>
<td>10 mA</td>
<td>Gearbox in neutral, earth in neutral</td>
</tr>
</tbody>
</table>

¹) Use only for connection to pin 2. Do not use for other applications.

Figure 2.35

For vehicles with the Allison automatic gearbox, current can be taken from the 4 pin connector in the electronic control unit compartment (passenger side). To use this connector, order kit 2994016, consisting of connectors, cable terminals and rubber grommets.

Table 2.23 – New EuroCargo, 4 pin connector pinouts

<table>
<thead>
<tr>
<th>Pin</th>
<th>Wire no.</th>
<th>D (mm²)</th>
<th>Maximum load</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>312 NO</td>
<td>1</td>
<td>10 mA</td>
<td>PTO ON</td>
</tr>
<tr>
<td>2</td>
<td>323 NO</td>
<td>1</td>
<td>10 mA</td>
<td>Gearbox in neutral, 24V in neutral</td>
</tr>
<tr>
<td>3</td>
<td>8353</td>
<td>1</td>
<td>10 mA</td>
<td>External gearbox in neutral</td>
</tr>
<tr>
<td>4</td>
<td>–</td>
<td>–</td>
<td>10 mA</td>
<td>Not connected</td>
</tr>
</tbody>
</table>

e) connector for Side Marker Lamps.

See point 2.21.11.
2.21.8 Harness Modifications due to Changes to Wheelbase or 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 components used such as wires, connectors, terminal blocks, conduits etc. must be of the same type as those used originally and be correctly fitted.

2.21.9 Power Draw-off at a Voltage Different from that of the System

If a 12 V power supply is required from a 24 V system, a suitable voltage adapter must be installed for drawing power from the normal circuit. Power must not be drawn from one battery only due to the detrimental effects this would have on the batteries during recharging.

2.21.10 Battery Main Switch (optional equipment)

This is generally located on the battery box and is manually operated. Single–pole type: when switched, disconnects the battery from the on–board system, leaving the body computer, bunk lights, refrigerator, radio and Webasto timer working, along with the tachograph, as required by the law.

An electric battery disconnector is available on request, fitted in the same position as for the hand–operated disconnector. Switching on can be performed by either operating a key switch, warning light switch, external light switch, auxiliary heater thermostat, air conditioning system.

For special bodies (e.g. for transporting fuel, dangerous goods, etc.), a specific ADR standard switch is required.

2.21.11 Installing Side Marker Lamps

In some countries, regulations (domestic or EC) require the vehicle to be equipped with side marker lamps, depending on its overall length.

EuroCargo Restyling 2004 range vehicles are fitted with a specific female, super–sealed female connector for connecting the sidelights to the power supply.

The connections and the lighting system shall be installed by outhouse fitters on the corresponding supplementary structures (bodies, vans, etc.).

The positions of these terminals are shown below.

⚠️ Leave the cap supplied by IVECO in place in order to protect the female connector electrical contacts over time.
A power supply (24 V) can be drawn from pin 4 of this connector, controlled by a key switch (+15) for use by bodybuilders. Current input not greater than 5A.
Whenever, in the course of modifying the vehicle, it should become necessary to reposition assemblies such as the fuel tank, batteries or the spare wheel, such relocation is permitted provided that the functioning of these parts is not impaired and provided that the same type of connections as originally in use are re-employed. Their transversal location on the vehicle’s chassis may not, when their weight requires it, be changed radically.

In the case of vehicles not equipped with a spare wheel carrier, and vehicles in which the spare wheel carrier must be relocated, the spare wheel must be secured to a suitable wheel carrier which allows the wheel to be readily removed.

To secure the spare wheel to the side of the vehicle with a support attached to the web of the side member, it is advisable to use a reinforcing plate on the inside or outside of the side member. The size of this plate must take into account both the weight of the wheel and the possible presence of other reinforcements on the side member (see. Figure 2.37).

Figure 2.37

In order to limit the torsional stresses on the vehicle chassis, we recommend that the plate be fitted where there is a cross member, particularly in the case of heavy units.

A similar procedure should be adopted when fitting additional units such as tanks, compressors etc. When positioning them, due consideration must be given to the distribution of the weights (see point 3.2). In any event, an adequate distance of their height from the ground must be ensured with due consideration given to the use of the vehicle.
Any holes that are necessary for the relocation must be made on the web of the side member in accordance with the specifications given in point 2.3. Holes already present must be made use of to the greatest extent possible.

**Fuel tank**

When tank refilling is hindered by the position of the body structure, the tank mounting brackets can be installed one drilling unit lower (45 mm), after checking that the new height complies with the minimum height above ground level.

In the event that the fuel tank capacity is not enough, you may proceed as follows:

a) use an original IVECO tank of greater capacity. The table below illustrates the types of tanks available. Verify that the new tank is compatible with the original vehicle configuration.

### Table 2.24 – Available tanks

<table>
<thead>
<tr>
<th>Model</th>
<th>Engine</th>
<th>85L Plastic</th>
<th>110L Plastic</th>
<th>180L Plastic</th>
<th>200L Steel</th>
<th>280L Aluminium</th>
</tr>
</thead>
<tbody>
<tr>
<td>60E, 65E, 75E, 80EL</td>
<td>E13, E15, E17, E18</td>
<td>standard</td>
<td>opt 2175</td>
<td>opt 5102</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>80E, 90E, 100E</td>
<td>E17, E18, E21</td>
<td>–</td>
<td>standard</td>
<td>opt 5102</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>110EL, 120EL</td>
<td>E17, E21</td>
<td>–</td>
<td>standard</td>
<td>opt 5102</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>120E, 130E, 150E</td>
<td>E17, E21, E24</td>
<td>–</td>
<td>standard</td>
<td>opt 5102</td>
<td>–</td>
<td>opt 5101</td>
</tr>
<tr>
<td>180E, 260E</td>
<td>E21, E24, E28</td>
<td>–</td>
<td>opt 2175</td>
<td>standard</td>
<td>–</td>
<td>opt 5101</td>
</tr>
<tr>
<td>100EHV</td>
<td>E18, E24</td>
<td>–</td>
<td>standard</td>
<td>–</td>
<td>opt 179</td>
<td>–</td>
</tr>
<tr>
<td>140EHV</td>
<td>E18, E24</td>
<td>–</td>
<td>standard</td>
<td>–</td>
<td>opt 179</td>
<td>–</td>
</tr>
</tbody>
</table>

b) addition of a supplementary fuel tank. The most thorough solution is to fit the additional tank using the same system layout as for the original tank, whenever possible using original elements, particularly the fuel level indicator. A switch can be fitted to allow the two tanks to be used alternatively.

**Figure 2.38**

The use of the above system is advisable when the added tank is located on the side opposite the original one. When the tanks are in line on the same side it is possible to maintain fuel feed from the original tank then the added one should be connected directly to the former through hoses. The arrangement must conform to national rules and regulations. The tank–to–tank connecting line must be leakproof and not of a smaller internal dimension, have the same technical characteristics as those envisaged for the original system and be properly secured.
2.23 Transporting Dangerous Cargo

Vehicles used to transport dangerous Goods – for instance inflammable materials or explosives – must be built in compliance with the safety specifications established for this type of transport by national or international regulations.

On the assumption that the Bodybuilder is aware of, and in compliance with, the particular specifications relative to this subject we would like to recall, nonetheless, that all vehicles crossing borders within Europe must be in compliance with the "European Agreement on international transport of dangerous substances on roads" (ADR), now included in the specific EC Directive.

For EuroCargo vehicles, optional n° 2342 is available, (ADR) combined with optional n° 6899 (Daily Tacho 2 Drivers for ADR/SIM).

Optional n° 2342 consists of:
- special electric isolator on chassis
- isolator control switch in cab
- emergency switch
- protected electrical connections
- polyamide wiring harness sheathing
- ADR homologation plate
- Operating instructions

Note: when optional n° 2342 is installed the centralised door locking is not available.

2.24 Retarder insulation

A supplementary slow–down brake (e.g. of a parasite current electrical or hydraulic type) can be fitted on the transmission (separate fitting), but this must be authorised by IVECO.

Installation on some vehicles can be carried out at our plants (as optional extra). Later installation on these vehicles must match the original solution (as for brake manufacturer co–operation).

In the remaining cases, the brake manufacturing firm workshops must carry out the installation in compliance with points 2.3, 2.8.8 e 2.21. of these instructions. The firm authorised to carry out the installation is responsible for correct operation, anchoring part size, good quality of work.

The technical documentation needed for the installation can be requested from IVECO. The information on the electrical system of each model is given in the Workshop Manuals and can be obtained from the IVECO Service Network (see point 2.21). Quando sia necessaria l’applicazione di ripari anticalore, la loro sistemazione dovrà essere curata utilizzando materiali con caratteristiche idonee nel rispetto delle norme vigenti, garantendone l’efficacia.

To cool hydraulic retarders, their connection with the engine cooling system is allowed provided that this does not entail exceeding the maximum temperature allowances for the original system coolant. Otherwise, a separate cooling circuit must be fitted.

If it is necessary to install additional heat exchangers, their dimensions must be defined by the retarder manufacturer. Their positioning must not alter the functioning of the original cooling system of the vehicle.

Contact IVECO to optimise the installation.
The choice of retarder must be made based on the following formula:

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

- \(i_p\) = rear axle ratio
- \(C_f\) = maximum braking torque (Nm)
- \(R'\) = radius of the tyre used when loaded (m)
- \(PTT\) = total ground weight (kg)

**Example of calculation of retarder maximum braking torque on new EuroCargo**

Consider a new EuroCargo EuroCargo ML120E18R/P, with 4.88 rear axle ratio and 265/70R19.5 tyres.

From the following data

1. \(i_p\) = 4.88
2. \(R'\) = 0.401 m
3. \(PTT\) = 12000 kg

We obtain:

\[
C_f = \frac{12000 \cdot 0.401}{4.88} = 986 \text{ Nm}
\]

Thus, a retarder brake of maximum braking torque 1000 Nm can be applied.

**2.25 Alterations to the rear protection bar**

Our vehicles are fitted with a rear protection bar in accordance with EC Directives.

The maximum distance allowed by the device at the extreme rear of the body structure is 400 mm, minus the deformation resulting from the homologation (less than 20 mm).

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

When modifying the vehicles or installing special equipment (e.g. tail lifts) it may be necessary to modify the structure of the underrun bar. Such modifications must not change original resistance and stiffness specifications (comply with local government regulations, if any). The firm carrying out the modification must be prepared to present the relevant documentation on the required specifications upon request.

Whenever different underrun bar must be used, check relevant current regulations. Documentation or quality control certificates must be presented upon request from the competent authority.
2.26 Front protection (FUP)

On vehicles in the New EuroCargo range fitted with this device, the Front Underrun Protection bar (FUP) can be fixed to the frame in various positions. In this way the fitter can adjust the position of the protection, in compliance with directive CE 2000/40, according to the set—up of the fitted vehicle, the loads on the axles and/or the tyres fitted.

Table 2.25

<table>
<thead>
<tr>
<th>Model</th>
<th>Possible FUP bar fixing positions</th>
</tr>
</thead>
<tbody>
<tr>
<td>60E, 65E, 75E, 80E, 90E, 100E, 110EL, 120EL</td>
<td>2</td>
</tr>
<tr>
<td>120E, 130E, 150E</td>
<td>4</td>
</tr>
<tr>
<td>180, 260EK</td>
<td>3</td>
</tr>
</tbody>
</table>

For vehicles 150E, 180E and 260EK the first cab access step is fixed to the FUP. If a fitter intends to modify the position of the FUP he must, in this case, replace the step fixing bracket so as to guarantee that it remains in the same position with respect to the cab itself. The above requirements serve to optimise the front attitude angle of the vehicle should the FUP bar be found to be too low as a result of the fitting operations.

2.27 Rear view mirrors

The dimensions of the approved rear view mirrors are given in the table, according to the width of the vehicle and the driving position.

Table 2.26 – Arms for approved rear view mirrors

<table>
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<tr>
<th>Guide</th>
<th>Vehicle width</th>
<th>Size of arms a x b x c (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Driver’s side</td>
</tr>
<tr>
<td>Left</td>
<td>2300 + 2400</td>
<td>245 x 800 x 220</td>
</tr>
<tr>
<td></td>
<td>2300 + 2450</td>
<td>245 x 800 x 220 or 204 x 800 x 200</td>
</tr>
<tr>
<td></td>
<td>2500 + 2550</td>
<td>355 x 800 x 333</td>
</tr>
<tr>
<td></td>
<td>2500 + 2600</td>
<td>355 x 800 x 333 or 317 x 800 x 308</td>
</tr>
<tr>
<td>Right</td>
<td>2300 + 2350</td>
<td>245 x 800 x 220 or 204 x 800 x 200</td>
</tr>
<tr>
<td></td>
<td>2500</td>
<td>355 x 800 x 333</td>
</tr>
<tr>
<td></td>
<td>2500 + 2550</td>
<td>317 x 800 x 308</td>
</tr>
</tbody>
</table>

Figure 2.39
2.28 Rear mudguards and wheel house

When vehicles are supplied without mudguards, the bodybuilder must fit them using similar installations as used by IVECO on similar vehicles. In making the mudguards, wheel arches, as well as the shape of the body, bear in mind that:

- Ensure the wheels can turn even in the full bump condition with snow chains fitted, in compliance with the limits shown in the documentation supplied by IVECO.
- The maximum width of the vehicle over the tyres must comply with the legal limits.
- The supporting structure should be sufficiently strong enough, avoiding any sudden variation in section.
- The connection can be made to the vertical web of the vehicle’s side members or to the longitudinal sections of the subframe. In the first case, the connection must be made solely with screws, or directly under the superstructure (e.g., body, van, etc.), see Figure 2.40.

If the supports are fixed the body longitudinals they can be welded or bolted.

Figure 2.40

2.29 Mudflaps

If legally required, unless already fitted ex–factory, the bodybuilder must ensure that the complete vehicle is fitted with mudflaps. When mounting them legally required distances must be complied with.
2.30 Side guards

In some countries local or EEC regulations require that the vehicle be fitted with side guards. The Bodybuilder who finishes off the vehicle must ensure compliance with the required characteristics unless it is already equipped with them ex-factory.

On permanently fitted structures such as fixed platform bodies, vans etc, the side guards will be fitted directly to their basic structure (floor ribbings cross members) whereas on mobile structures (such as tippers, interchangeable equipment, removable containers), the side guards will be connected to the auxiliary frame by way of suitable brackets or installed directly on the chassis. In the latter case, we suggest that the Bodybuilder makes use as far as possible, of the holes already existing on the side member vertical web in compliance with point 2.3.

According to the EEC regulation, the external protection element can either consist of a single runner whose surface extends in the vertical direction or of several longitudinal sections with preset sizes and distances between them.

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

Operation of and access to the following parts must be ensured.

- Brake system equipment
- Air inlet system
- Fuel supply
- Batteries
- Suspension
- Spare wheel
- Engine exhaust

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

Particular care must be taken when fitting to ensure the clearance from the ground and the distances to the various components required by the regulations.

Figure 2.41 shows a type of side guard designed in compliance with the relevant EC Directive to be fitted to fixed bodies (available on request). The illustration also shows a specimen of a support designed for the combined fastening on the side guard and the rear wheel mudguard which can be fitted to mobile auxiliary subframes.

The Bodybuilder will take care of the preparation and the arrangement of the side guard depending on the type of auxiliary subframe concerned, as it is not possible to provide instructions of a general character applying to all equipment versions.
(*) Either the bottom part of the auxiliary frame is over 1,300 mm from the ground or the width of the auxiliary subframe is less than the external space occupied by the tyres.

Test load 1 kN
Permitted sag values under test load:
≤ 30 mm on the rear, included in the last 250 mm of the device
≤ 150 mm on the remaining parts of the device

Supporting structure for the combined fastening of the side guard and rear mudguard.

2.31 Chocks

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

3 Fitting superstructures

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</table>
3.1 Basic instructions

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

For example:

- Ready access to all parts requiring inspection or maintenance and periodic servicing must be provided. In the case of closed body types suitable opening doors must be provided.

- For tilting cabs, adequate space permitting tilting must be assured. In the case of structures which involve the space above the driver’s cab, adequate space for the passage of intake air must be guaranteed (see Figure 3.1).

Figure 3.1

1 Retain adequate room for tilting the driver’s cab
2 Retain the free space above the gearbox (for tractors with semitrailers consider the movement between tractor and semitrailer)
3 Cab rotational centre
4 Min. distance to be met

- Service access to chassis/driveline components must be retained. For instance repairing the gearbox or clutch must be possible without necessitating the removal of major components of the added structure.

- The cooling system (radiator cowl, radiator, air passages, cooling circuit, etc.) and the engine air intake must not be altered.

- The fuel supply conditions must not be altered (pump position, filters, pipe diameter, etc.).

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

- Adequate brake ventilation and battery box airing must be ensured.
- When positioning the mud flaps and wheelhouses, sufficient space must be left for free rebound of the rear wheels even when used with chains; sufficient space must also be left for the tyres of any additional liftable axles.
- When vehicle body building has been completed the adjustment of the headlights must be checked for safety and re-adjusted where necessary.
- In the case of parts which are supplied loose (e.g. spare wheel, chocks) it will be the responsibility of the bodybuilder to position and secure them in an accessible and safe manner in compliance with relevant national and international regulations.

3.2 Dimensions and masses

3.2.1 General Specifications

The dimensions and maximum permissible mass on the axles are indicated on drawings, on technical specifications and, in greater details, on the official documentation issued by the Company. The kerb weights refer to vehicles with standard equipment. Special equipment may involve considerable modification to the mass and its distribution on the axles. On our models, positioning of the lights and rear view mirrors is foreseen for widths of up to 2600 mm (see point 2.27).

Weighing the Chassis

Consider that variations of ±3% on the declared weights are possible. It is, therefore, necessary to determine the mass of the vehicle with its cab before fitting the body and equipment and establishing their distribution on the axles.

3.2.2 Determining the Centre of Gravity of the Body and Payload

Centre of Gravity: Positioning on longitudinal plane

To establish the location of the centre of gravity of the body and payload the following examples below may be used as guidelines. The technical documentation specific to each model (chassis cab drawing) give the positions permitted with the vehicle in its standard form.
Figure 3.2 refers to vehicles with 2 axles and vehicles with 3 axles with equal loads on the rear axles (ML260EK).

Figure 3.2  Positioning on longitudinal plane

\[ L_1 = \frac{W_1 \cdot L}{W}, \quad o \quad L_1 = L - \frac{W_2 \cdot L}{W} \]

\( W = \) Fitting + payload (kg)
\( W_1 = \) Additional dimension to \( W \) resting on the front axle (kg)
\( W_2 = \) Additional dimension to \( W \) resting on the rear axle center line or the tandem center line (kg)
\( L_1 = \) Distance of the center of gravity from the rear axle center line or the tandem center line (mm)
\( L = \) Calculating wheelbase (mm)

Example of calculation of the load's center of gravity position

Consider a ML120E18/P vehicle with a wheelbase of 4185mm, with

1. PTT  =  12000kg (permitted maximum: 4400 kg on front and 8480 kg on rear)
2. tara  =  4220kg (2760 kg on front axle and 1460 kg on rear)

The permitted maximum load (fitting + payload) shall be \( W=12000-4220=7780 \) kg. Let us calculate the position of the center of gravity in which the maximum permitted on the front axle is achieved. Let us assume a steady load distribution. In this case, out of 7780 kg, \( W_1=4400-276=1640 \) kg will affect the front axle, while the remaining \( W_2=7780-1640=6140 \) kg will affect the rear axle. Thus:

1. \( W_1 = 1640 \) kg
2. \( L = 4185 \) mm
3. \( W = 7780 \) kg

\( L_1 = W_1 \times L / W = 882 \) mm

The center of gravity of the load (fitting + payload) shall not be more than 882 mm far from the rear axle; otherwise, the front axle will be overloaded.
In order to apportion the payload on the axles, it must be uniformly distributed except when the shape of the loading surface itself entails a different distribution of the load.

As for equipment, the actual location of the centre of gravity is considered.

When building bodies or containers, loading and unloading systems for the transported goods must be devised which preclude excessive variations in the distribution of the load and/or excessive loads on the axles, also giving the relevant instructions to the users.

The bodybuilder will also need to install suitable payload securing systems on the body so that transport can be made with the utmost safety.

**Figure 3.3**

- Uniform distribution of the load
- Non–uniform distribution of the load due to the lack of a rear overhang
- Uniform distribution of the load
- Non–uniform distribution of the load (beware of load on axles and of minimum ratio)
**Centre of Gravity: positioning along the vertical plane**

The height of the centre of gravity of the unladen chassis cab is given in the technical documentation specific to each model (chassis drawing).

For testing the vehicle complete with superstructure, the bodybuilder must check that the height of the centre of gravity of the equipment including the payload, or of the entire vehicle when fully loaded, falls within the maximum permitted values.

These limits are defined in compliance with the national or international regulations (e.g. EC Directive 71/320 regarding braking) or requested by the Manufacturer to ensure good handling of the vehicle (e.g. transverse stability of the moving vehicle).

For the various models, IVECO publishes (on—line and otherwise) the heights of the centre of gravity of the vehicle with cab (see diagram of vehicle with cab in Figura 3.4). Ask IVECO for information regarding the maximum height of the centre of gravity of the complete vehicle when fully laden.

**Figure 3.4**

Verification with full load:

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

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

- \(W_v\) = Chassis cab vehicle tare weight
- \(H_v\) = Height of centre of gravity of chassis cab vehicle (laden condition)
- \(W_s\) = Body and payload
- \(H_s\) = Height of centre of gravity of body and payload in relation to ground
- \(W_t\) = Vehicle mass when fully loaded
- \(H_t\) = Height of centre of gravity of vehicle with full load

To check the vehicle with its body but no payload, use above formula but for \(W_s\) use only the body tare weight (The position for \(H_v\) will depend on the load and deflection of the suspension).
3.2.3 Observing the Permitted Weights

All the limits indicated in IVECO documents must be complied with; the mass on the front axle is particularly important, under all loading conditions, in order to ensure the necessary steering and braking characteristics in all road conditions.

The approved minimum tare values in accordance with EC Directive 98/12 must be adhered to for the complete vehicle and its distribution over the axles.

Particular attention must therefore be paid to vehicles with a weight which is concentrated on the rear overhang (e.g. cranes, tail-lifts, centre axle trailers) and to vehicles with a short wheelbase and a high centre of gravity (e.g. silo vehicles, cement mixers).

When positioning the body and equipment, the loads must be correctly distributed transversally. For each wheel a variation in the rated load (1/2 the load on the axle) of 4% is permitted (e.g. admitted load on axle: 10,000 kg load admitted on each wheel: 4,800 to 5,200 kg) provided that the tyres permit it, without impairing braking or driving stability.

For vehicles with an added rear lift axle it must be remembered that, with the axle in the raised position, the effective wheelbase is reduced, whereas the rear overhang is increased. It is therefore advisable that the centre of gravity of the body and payload is located in front of the centre line of the driving axle. In addition to this it is not advisable to equip a vehicle which has its load concentrated at the rear, with a lifting device.

Apart from different specifications for specific individual vehicles, the following may be taken to be the minimum values for the front axle:

- 25% of the total vehicle mass with uniformly distributed loads.
- 30% of the total vehicle mass for loads that are concentrated on the rear overhang.

The rear overhang of the body must be built in strict observance of the permitted axle loads, the limitations in length, the positioning of the tow hook and of the underride guard stipulated by the relevant laws and regulations.

Variations in the Permissible Mass

Special exceptions to the maximum permissible mass may be granted for particular applications for which, however, precise limitations regarding the use will be imposed in addition to possible vehicle reinforcements. Such exemptions, if they exceed the limits imposed by law, must be authorised by the Administrative Authority.

Reduction of the mass allowed on vehicles (declassing) may mean it is necessary to adjust certain elements.

The request for authorisation must include:

- vehicle type, wheelbase, identification number, designated use;
- tare distribution on the axles (e.g. vehicles equipped with crane and body) including positions of the centre of gravity of the payload;
- proposals concerning the reinforcement of the vehicle components where necessary.
In versions where the payload tends to move on side (e.g. suspended loads, fluid loads etc.) especially when turning, higher dynamic stress is generated which makes the vehicle less stable. This must be taken into consideration when providing vehicle operating instructions or for possible reduction in the height of the centre of gravity.

### 3.2.4 Increasing cross-stability

Supplementary stabilising or anti-roll bars, where available, spring reinforcements or the application of rubber components (in compliance with point 2.12), may increase the height of the centre of gravity of the payload which must be defined as each occasion arises. The modification must be carried out after careful consideration has been given to the specifications of the version, to the wheelbase and to the distribution of the cross-stresses acting on the suspension both at the front and at the rear of the vehicle. It must be borne in mind that it is often advisable to modify the rear axle only since a modified front axle would give the driver a false sense of stability making it more difficult to perceive the safety limits. Modification to the front axle may be made where the load is positioned behind the cab (e.g. crane) or where the superstructures are very rigid (e.g. van conversion).

In the case of special loads with high centre of gravity (e.g. machinery, indivisible loads, etc.), it is technically possible to exceed the limit values of height of centre of gravity, provided that the style of driving of the vehicle is suitably adapted (e.g. reduced speed, gradual steering, etc.).
3.3 Construction of the Subframe

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

The following points are to be borne in mind when constructing a subframe:

3.3.1 Material

Usually, provided the subframe is not to undergo great stress, the material used for its construction may be of a lower grade than that used for the vehicle chassis. It must have good welding characteristics and limits not lower than those of the following material:

Table 3.1 – Material to be used for body manufacturing

<table>
<thead>
<tr>
<th>Steel name</th>
<th>Breaking load (N/mm²)</th>
<th>Yield point (N/mm²)</th>
<th>Elongation A5</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVECO Fe360D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe S235J2G3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany S237-3N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK 40D</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

The specifications of several models whose use we recommend are set out below.

Table 3.2 – Material to be used for body manufacturing

<table>
<thead>
<tr>
<th>Steel name</th>
<th>Breaking load (N/mm²)</th>
<th>Yield point (N/mm²)</th>
<th>Elongation A5</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVECO FeE420</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe S420MC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany QSeE420TM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK 50F45</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3.3 – Material to be used for body manufacturing

<table>
<thead>
<tr>
<th>Steel name</th>
<th>Breaking load (N/mm²)</th>
<th>Yield point (N/mm²)</th>
<th>Elongation A5</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVECO FeS10D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe S355J2G3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany S552-3N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK 50D</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Aluminium Subframe

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

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

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

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

3.3.2 Section bar dimensions

The table below illustrates the values for the bulk modulus \( W_x \) for C—section bars recommended by IVECO. The indicated \( W_x \) value refers to the real section and allows for the section bar coupling radii (it can be calculated with some approximation by multiplying by 0.95 the value obtained by considering the section made up of simple rectangles). Bars of different sections can be used as replacements for the indicated ones, provided that the bulk modulus \( W_x \) and the moment of inertia \( J_x \) of the new C—section do not features smaller values.

<table>
<thead>
<tr>
<th>Strength modulus Wx (cm³)</th>
<th>Recommended C—section profile (mm)</th>
<th>Strength modulus Wx (cm³)</th>
<th>Recommended C—section profile (mm)</th>
<th>Strength modulus Wx (cm³)</th>
<th>Recommended C—section profile (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>80 x 50 x 4</td>
<td>74</td>
<td>140 x 70 x 7</td>
<td>245</td>
<td>250 x 100 x 8</td>
</tr>
<tr>
<td>19</td>
<td>80 x 50 x 5</td>
<td>84</td>
<td>160 x 70 x 7</td>
<td>286</td>
<td>300 x 100 x 8</td>
</tr>
<tr>
<td>21</td>
<td>80 x 60 x 5</td>
<td>105</td>
<td>180 x 70 x 7</td>
<td>317</td>
<td>320 x 100 x 8</td>
</tr>
<tr>
<td>26</td>
<td>100 x 50 x 5</td>
<td>119</td>
<td>200 x 80 x 6</td>
<td>343</td>
<td>340 x 100 x 8</td>
</tr>
<tr>
<td>31</td>
<td>100 x 60 x 5</td>
<td>135</td>
<td>200 x 80 x 7</td>
<td>374</td>
<td>360 x 100 x 8</td>
</tr>
<tr>
<td>36</td>
<td>100 x 60 x 6</td>
<td>150</td>
<td>200 x 80 x 8</td>
<td>406</td>
<td>380 x 100 x 8</td>
</tr>
<tr>
<td>46</td>
<td>120 x 60 x 6</td>
<td>173</td>
<td>220 x 80 x 8</td>
<td>439</td>
<td>380 x 100 x 8</td>
</tr>
<tr>
<td>57</td>
<td>140 x 60 x 6</td>
<td>208</td>
<td>250 x 80 x 8</td>
<td>474</td>
<td>400 x 100 x 8</td>
</tr>
</tbody>
</table>

Table 3.4 – Profiles recommended by IVECO
3.3.3 Elements making up the subframe

Longitudinal Runner Profiles

The side member of the added structure must be continuous, extending as far as possible forward to the front of the vehicle to include, if possible, the area of the rear support of the front spring, and rest on the chassis of the vehicle but not on the brackets.

In order to achieve a gradual reduction in the resistant section, the front ends of the longitudinal runner must be tapered upwards at an angle of no more than 30°, or tapered in some other equivalent way (see Figure 3.5), ensuring that the front end in contact with the chassis is suitably connected, min radius 5 mm.

Figure 3.5

If the cab’s rear suspension components do not allow the entire runner to pass through, the latter may be shaped as shown in Figure 3.6. This could require the assessment of the minimum resisting section if high flexural moment occurs at the front (e.g. with crane mounted behind cab if operating towards the vehicle’s front).

Figure 3.6

The construction of auxiliary frames either wider or narrower than the chassis structure is permitted only in particular cases (e.g. removable containers sliding on rollers operated by mechanical or hydraulic systems). In these cases a necessary precaution will be that of ensuring a correct transmission of the forces between the auxiliary frame and the side member vertical web. This can be obtained by inserting an intermediate runner profile shaped according to the vehicle’s side member or by applying a stiffened connecting L-section.
The shape of the section of the runner is determined with due consideration to the function of the subframe and to the type of structure that is above it. It is advisable to use open U–sections if the subframe is supposed to adapt itself elastically to the chassis of the vehicle, and to use box–type sections when added rigidity is called for.

Proper care must be taken to ensure a gradual passing from the box–type section to the open kind. Some examples on how to achieve this are shown in Figure 3.7.

**Figure 3.7**

There must be continuity between the longitudinal runners of the subframe and the vehicle. Do not insert rubber elements between the chassis and subframe.

The specified dimensions for the side members of the various types of body are recommended minimum values that, as a rule, hold for vehicles with standard wheelbases and rear overhangs. In all cases, it is possible to use similar sections whose moments of inertia and resistance are no lower. Such dimensions can be obtained from the technical literature supplied by the manufacturer of the runner profiles. It should be borne in mind that the moment of inertia, apart from being an important factor for the calculation of the share of bending moment to be applied, also represents the most adequate response to the degree of torsional stress required for the specific type of connecting section in use. Therefore, the moment of resistance is a determining factor as regards the stress exerted on the material.
Cross Members

An adequate number of cross members, which should be positioned if possible adjacent to the fastenings, are required to brace the two runners of the subframe. The cross members may be of the open type (e.g. C-type) or, if greater rigidity is desired, of the closed type. Suitable gusset plates must be employed at the points of the connection to confer sufficient strength to the connection (see Figure 3.8). In those cases, when greater rigidity is required for the connection, the work procedure may be carried out as illustrated in Figure 3.9.

Figure 3.8

Figure 3.9

Stiffening the Subframe

In the case of certain bodies, such as tippers, cement mixers, crane on rear overhang or bodies with a high centre of gravity, the subframe must be additionally stiffened at the rear end. Depending on the degree of torsional stress, this must be done in one of the following manners:
- joining the rear section of the longitudinal member by a box-frame construction;
- box-frame construction, closed-section cross members (see Figure 3.10);
- box-frame construction, crossties (see Figure 3.11);
- by applying in addition to the box-frame construction a longitudinal torsion-resistant bar (see Figure 3.12).

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

Figure 3.10
Self-supporting Bodies as Subframes

A subframe (longitudinal runners and cross members) need not be fitted if self-supporting bodies are to be installed (e.g. rigid box body, tankers), or if the base of the structure to be fitted already serves the purpose of subframe.
### Choosing the Type of Body Mounting

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

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

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

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

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

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

In order to improve the longitudinal or transverse securing of the connection, it is permissible to have holes on the flanges of the side members, but only at the rear end of the members, over a length of not more than 150 mm, provided that the anchorage of any cross members that may be present is not weakened (see Figure 3.16). Alternatively, use the connection of Figure 3.17.

### Body Mounting Characteristics

Flexible joints (see Figure 3.13, Figure 3.14 and Figure 3.15), permit limited movement between the frame and the subframe, and permit the use of two parallel working strong sections. Each bears a part of the bending moment in proportion to its moment of inertia.

For the rigid type of joint (see Figure 3.17) between subframe and chassis, a single strong section is obtained, provided that the number and position of the joints are adequate to support the resulting shearing stresses.
When using sheer resisting plates to secure the subframe to the sidemembers, a single strong section is formed which has a higher strength capacity when compared with the connections made using brackets or clamps. This has the following advantages:

- Lower height of the subframe profile under the same bending moment acting on the section.
- Higher bending moment under the same subframe profile dimensions.
- Further increase in the strength capacity, when the subframe is made up of high mechanical characteristic materials.

**Subframe dimensions**

In case of elastic connection between the chassis and the subframe, the bending moment $M_f$ shall be distributed between the chassis and the subframe in proportion to the moments of inertia of the sections:

$$
M_f = M_t + M_c
$$

$$
M_t = \frac{I_t}{I_t + I_c}
$$

$$
M_c = M_f \times \frac{I_c}{I_t + I_c}
$$

$$
\sigma_c = \frac{M_c}{W_c} \leq \sigma_{amm}
$$

$$
\sigma_t = \frac{M_t}{W_t} \leq \sigma_{amm}
$$

$M_f$ = static bending moment generated by the superstructure (Nmm)

$M_c$ = additional dimension of the static bending moment $M_f$ applied to the subframe (Nmm)

$M_t$ = additional dimension of the static bending moment $M_f$ applied to the chassis (Nmm)

$I_c$ = moment of inertia of the subframe section (mm$^4$)

$I_t$ = moment of inertia of the chassis section (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$^2$)

$W_c$ = bulk modulus of the subframe section (mm$^3$)

$W_t$ = bulk modulus of the chassis section (mm$^3$)

$\sigma_{amm}$ = maximum static stress permitted on the chassis (N/mm$^2$)

---

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

Consider two C-section bars with the following dimensions:

3. chassis: $250 \times 70 \times 5$mm

4. subframe: $140 \times 70 \times 7$mm

and stressed, at a given section, by the maximum bending moment $M_f$ equal to 15000 Nm as applied in a perpendicular direction to the plane containing the side-member rib.

From the calculation, the following values will be obtained:

<table>
<thead>
<tr>
<th>Section</th>
<th>$I_x$ (cm$^4$)</th>
<th>$W_x$ (cm$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. chassis</td>
<td>1545</td>
<td>123</td>
</tr>
<tr>
<td>2. subframe</td>
<td>522</td>
<td>74</td>
</tr>
</tbody>
</table>

By applying the formulas, the following will be obtained:

1. $M_t = M_f \times [I_t / (I_c + I_t)] = 8500 \times [588 / (588 + 183)] = 11200$ Nm

2. $M_c = M_f \times [I_c / (I_c + I_t)] = 8500 \times [183 / (588 + 183)] = 3790$ Nm

Thus

1. $\sigma_t = M_t / W_t = 91$ N/mm$^2$

2. $\sigma_c = M_c / W_c = 51$ N/mm$^2$
In case of rigid connection (cut resistant plates) between the chassis and the subframe, the bending moment \( M_f \) shall be applied to the single chassis–subframe section.

\[
\sigma_c = \frac{M_f}{W_c} \leq \sigma_{amm} \\
\sigma_t = \frac{M_f}{W_t} \leq \sigma_{amm} \\
W_t = \frac{I}{\gamma_{tmax}} \\
W_c = \frac{I}{\gamma_{cmax}}
\]

- \( \sigma_c \) = maximum static stress applied to the subframe (N/mm\(^2\))
- \( \sigma_t \) = maximum static stress applied to the chassis (N/mm\(^2\))
- \( M_f \) = static bending moment generated by the superstructure (Nmm)
- \( I \) = moment of inertia of the single chassis–subframe section (mm\(^4\))
- \( \sigma_{amm} \) = maximum static stress permitted on the chassis (N/mm\(^2\))
- \( \gamma_{tmax} \) = distance from the neutral stressing axle of the chassis outermost fibres (mm)
- \( \gamma_{cmax} \) = distance from the neutral stressing axle of the chassis outermost fibres (mm)

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

Consider two C–section bars with the following dimensions

1. chassis: \( 250 \times 70 \times 5 \text{mm} \)
2. subframe: \( 140 \times 70 \times 7 \text{mm} \)

and stressed, at a given section, by the maximum bending moment \( M_f \) equal to 15000 Nm as applied in a perpendicular direction to the plane containing the side–member rib.

From the calculation, you will obtain that the center of gravity lies approximately 28 mm from the contact segment from the part of the section \( 250 \times 70 \times 5 \text{mm} \) (chassis). Thus:

1. \( \gamma_{tmax} = 250 - 28 = 222 \text{ mm} \)
2. \( \gamma_{cmax} = 140 - (-28) = 168 \text{ mm} \)

Moreover

\[
\begin{array}{c|c|c|c}
I_x (\text{cm}^4) & W_t (\text{cm}^3) & W_c (\text{cm}^3) \\
\hline
\text{chassis+ subframe} & 5643 & 254 & 334 \\
\end{array}
\]

By applying the formulas, you will obtain:

1. \( \sigma_t = \frac{M_f}{W_t} = 59 \text{ N/mm}^2 \)
2. \( \sigma_c = \frac{M_f}{W_c} = 45 \text{ N/mm}^2 \)
When using sheer resisting plates to secure the subframe to the sidemembers, a single strong section is formed which has a higher strength capacity when compared with the connections made using brackets or clamps. This has the following advantages:
- Lower height of the subframe profile under the same bending moment acting on the section.
- Higher bending moment under the same subframe profile dimensions.
- Further increase in the strength capacity, when the subframe is made up of high mechanical characteristic materials.

### 3.4.1 Connection with Brackets

A few examples of this type of connection (flexibility mounting), are shown in Figure 3.13 and Figure 3.14.

**Figure 3.13**

In order to ensure a flexible joint there must be a gap of 1–2 mm between the brackets of the frame and those of the subframe before the securing bolts are tightened. When tightening the securing bolts, brackets shall come in contact. Initial gaps larger than 1–2 mm are to be reduced by using suitable shims. Using bolts of proportional length improves the flexibility of the connection. The brackets should be fitted on the web of the side members of the vehicle with screws or bolts.
In order to guide and better contain the loads transversally, a slight protrusion of the brackets above the chassis is recommended. When the brackets are fitted flush with the upper flange of the side member, the lateral movement of the body structure must be secured by other means (e.g. using guide plates the chassis connected). When the front connection is of the elastic type (ved. Figure 3.14), lengthwise securing must be ensured even in the conditions of maximum twisting of the chassis (e.g. off-road).

Use the stake pockets fitted on the chassis for IVECO bodies to mount the structure. The brackets fitted to the subframe or to the body must have characteristics of strength not lower than those of the original brackets fitted to the vehicle.

**Connection with Greater Elasticity**

When greater flexibility is required of the mounting (as for vehicles with high stiffness bodies to be used on winding or bumpy roads, special use vehicles, off-road vehicles etc.), a type of fastening as illustrated in Figure 3.14 should be used behind the cab.

Especially with bodies generating high bending and twisting moments (e.g. crane behind the cab), the subframe dimensions should be such to adequately sustain them.

Specifications of the flexible member must be adequate to body stiffness, to wheelbase and to the type of vehicle operation (bumpy road conditions).

When using rubber mountings, materials that give the same characteristic to that of the spring type must be used. Relevant instructions for visual checking and torque setting should be provided.

The whole connection capacity can if necessary be re-established using shearing resistant fastenings in the rear suspension area.

In versions including vehicle lifting by means of hydraulic stabilizers (e.g., cranes, lifting platforms), limit flexible movement (30–40 mm) so as to ensure sufficient co-ordinated movement of the subframe and avoid excessive bending movements on the original chassis.

**Figure 3.14**

![Diagram showing connection with greater elasticity](image-url)
3.4.2 Connection with U–bolts (clamps)

The most important mounting of this type is illustrated in Figure 3.15.

In this type of construction the bodybuilder must place a spacing piece, preferably made of metal, between the flanges of the two side members at the point where the U–bolts are located, in order to prevent the bending of the frames when the U–bolts are tightened.

In order to guide and to better contain transversally the structure that is attached to the vehicle’s chassis, this type of joint must be complemented by the addition of plates that are attached to the subframe and chassis as shown in Figure 3.17.

Figure 3.15

1 Frame
2 Subframe
3 U–bolts
4 Locking with lock nut
5 Spacers
6 Cleat plate (where necessary)
Due to the nature of this type of mounting, its all-round use on the vehicle is not advisable. However, it is necessary — in order to keep the added structure from sliding, and to increase the rigidity — to provide positive attachment towards the rear with cleat plates to secure both longitudinally and transversally.

For this purpose it is also possible to use bolt-type connections at the rear end of the chassis as illustrated in Figure 3.16.

**Figure 3.16**

![Figure 3.16](91481)

1 Subframe  
2 Frame  
3 U-bolts  
4 Longitudinal transversal securing anchoring.

### 3.4.3 Connection made with Plates for Longitudinal and Transversal Securing Anchorage

This type of anchorage shown in Figure 3.17 is achieved by means of a plate that is welded to the auxiliary frame and is secured to the chassis by means of bolts or rivets. This ensures regeneration following longitudinal and transverse thrust and provides maximum rigidity to the whole.

**Figure 3.17**

![Figure 3.17](91482)
When this type of joint is used, the following must be observed:

- The plate must only be attached to the vertical web of the main sidemembers.
  Before fixing ensure that the subframe is mounted correctly on the top flange with no gaps between the two mating surfaces.
- Use of cleat plates must be confined to the central and rear sections of the frame.
- The number of plates, thickness and number of securing bolts must be adequate to transmit the section shearing and bending moments.
  These values can be determined accurately by calculating them, when all the necessary elements are available.

We believe them to be useful when the bodies cause high bending and twisting moments on the chassis and its strength has to be increased by means of a shear resistant connection between the chassis frame and subframe, or the subframe height has to be limited as far as possible (e.g., towing central axle trailers, crane on rear overhang, tail lifts, etc.). Observe the instructions given in the following table:

### 3.4.4 Mixed Connection

On the basis of instructions given for the construction of the subframe (point 3.3) and considerations included in the general section of point 3.4, the mounting between the vehicle frame and subframe can be of the mixed type, i.e. it may be obtained through a rational use of flexible connections (brackets, clamps) and rigid connections (plates for longitudinal and transversal anchorage).

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

### 3.5 Volume weights

When designing every single fitting, the volume weight of the material to be transported should be assessed beforehand. This data can be inferred from experience of obtained from specialized manuals. Table 3.5 shows a few volume weight values provided as indications.

<table>
<thead>
<tr>
<th>Material</th>
<th>ρ (kg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>7890</td>
</tr>
<tr>
<td>Aluminium</td>
<td>2700</td>
</tr>
<tr>
<td>Concrete</td>
<td>1900–2300</td>
</tr>
<tr>
<td>Cardboard</td>
<td>350</td>
</tr>
<tr>
<td>Celluloid</td>
<td>1400</td>
</tr>
<tr>
<td>Powder cement</td>
<td>1400</td>
</tr>
<tr>
<td>Granite</td>
<td>2600</td>
</tr>
<tr>
<td>Wood (pine)</td>
<td>640</td>
</tr>
<tr>
<td>Marble</td>
<td>2500–2700</td>
</tr>
<tr>
<td>Excavated material</td>
<td>1600</td>
</tr>
<tr>
<td>Ordinary, dry brick</td>
<td>1800</td>
</tr>
<tr>
<td>Solid, urban wastes</td>
<td>90–120 (1)</td>
</tr>
<tr>
<td>Dry sand</td>
<td>1600</td>
</tr>
<tr>
<td>Sand with 7% humidity</td>
<td>2100</td>
</tr>
<tr>
<td>Glass</td>
<td>2200–2700</td>
</tr>
</tbody>
</table>

(1) To be multiplied by the compacting ratio (approximately 5 for the compactors usually fitted to the EuroCargo range vehicles).

Fitting superstructures 3–25
3.6 Fitting Box–bodies

On standard cab vehicles, intended exclusively for road use, box–bodies are usually fitted on a support structure comprising longitudinal runners and cross members. The minimum dimensions of the longitudinal runners are specified in Table 3.6.

### Table 3.6

<table>
<thead>
<tr>
<th>Model</th>
<th>Wheelbase (mm)</th>
<th>Minimum reinforcing profile</th>
<th>Dimensions (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Strength modulus per profile $W_x$ (cm$^3$)</td>
<td></td>
</tr>
<tr>
<td>60E, 65E, 75E, 80EL</td>
<td>up to 3690</td>
<td>21</td>
<td>80 x 60 x 5</td>
</tr>
<tr>
<td>60E, 65E, 75E, 80EL</td>
<td>over 3690</td>
<td>26</td>
<td>100 x 60 x 5</td>
</tr>
<tr>
<td>80E, 90E, 100E</td>
<td>up to 3690</td>
<td>26</td>
<td>100 x 60 x 5</td>
</tr>
<tr>
<td>80E, 90E, 100E</td>
<td>over 3690</td>
<td>36</td>
<td>100 x 60 x 6</td>
</tr>
<tr>
<td>110EL(1), 120EL(1), 120E, 130E, 150E</td>
<td>fino 3690</td>
<td>31</td>
<td>100 x 60 x 5</td>
</tr>
<tr>
<td>110EL(1), 120EL(1), 120E, 130E, 150E</td>
<td>oltre 3690</td>
<td>36</td>
<td>100 x 60 x 6</td>
</tr>
<tr>
<td>180E</td>
<td>all</td>
<td>46</td>
<td>120 x 60 x 6</td>
</tr>
<tr>
<td>260EK</td>
<td>tutti</td>
<td>46</td>
<td>120 x 60 x 6</td>
</tr>
</tbody>
</table>

(1) = on the version with long cab, use a profile with $W_x$ of not less than 57 cm$^3$.

The attachment is carried out using the brackets arranged on the vertical web of the side members. If such brackets have not been provided by the Manufacturer, they must be installed according to the specifications given in point 3.4. In order to provide an adequate lengthwise securing when the brackets or clamps are used, it is good common practice to arrange a rigid joint (one on each side) on the rear overhang, using plates or bolts on the upper flange of the side member (see Figure 3.16 and Figure 3.17).

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

In those instances in which the box–body uses supports that are raised above the subframe (such as cross members) it will be necessary to stiffen these supports in an appropriate manner in order to contain the lengthwise thrusts, as shown in Figure 3.18.

### Figure 3.18

![Figure 3.18](image)

1. Subframe  
2. Brackets  
3. Securing anchorages
For special builds when a reinforcing runner of limited height is needed, the subframe structure may be integrated with the body anchoring brackets matching the height of the whole longitudinal reinforcement runner (see Figure 3.19). In this case, rear wheel boxes may be fitted at the base of the fixture.

**Figure 3.19**

In the case of self-supporting bodies whose bearing structure operates as a subframe, the above explained installation of the reinforcing runners need not be affected.

The application of platforms and structures with high torsional stiffness in general required the use of elastic connections towards the front of the structure to avoid excessive reduction of main chassis distortion in particularly demanding applications.

The front panel of the bodywork must be strong and sturdy enough to withstand the forces generated by the transported load, when braking sharply.
3.7 Demountable Bodies

The construction of interchangeable equipment that is meant to be lifted off when replacement is necessary (e.g. through lifting devices or the vehicle's air suspension itself) and then to be positioned on four supporting posts, generally requires the adoption of a subframe featuring side runner profile dimensions as specified in Table 3.6 or of adequate structures comprising coupling and hoisting devices.

Adequate reinforcements must be fitted whenever concentrated loads imposed by lifting apparatus determine high stress on vehicle chassis.

To ensure good operation, all vehicle stability conditions must be checked out in accordance with the suspension specifications. Models that are equipped with a pneumatic suspension on the rear axle or full pneumatic suspension are particularly well suited for this type of use.

The lifting devices acting vertically may be fitted not only on the subframe but, in special cases, also be mounted on plates of adequate dimensions connecting the chassis frame to the subframe.

Regarding the connecting of bodies, especially when quick locking systems are used, it is necessary to provide adequate supports to counteract the longitudinal and transversal thrusts under dynamic conditions.

The use of an underframe or special substructure could be avoided, if authorised by IVECO, under the following conditions:
- the interchangeable body must rest along its entire length on the vehicle chassis or at least cover most of the area where suspension attachments are;
- an adequate number of coupling devices must be fitted along the side member vertical web;
- lifting apparatus anchoring must be such that its loads upon the chassis are limited.
3.8 Building Vans

To mount the body onto the vehicle chassis, a structure made up of longitudinal runners and cross members may be built (see Figure 3.19). The dimensions of the longitudinal runners should be of the order of those shown in Table 3.6.

Longitudinal runners may be dispensed with provided the cross members used for the floor structures are placed no more than 700 mm from one another, forming a sufficiently rigid (self-bearing) structure. In order to provide the required stability and to avoid the front end of the chassis being too rigid, the suggestions given in point 3.4 should be followed.

3.9 Tipping Bodies

The use of tipping bodies, whether end or three way, subjects the chassis to notable stress. For this reason it is most important to select the right vehicle from among those intended for this use. Therefore we list here the specifications that must be adhered to for this type of construction subdivided according to light or heavy duty. Table 3.7 and Table 3.8 give the minimum runner dimensions for the subframe with which these vehicles must be equipped.

Furthermore any government regulations concerning these vehicles must also be abided by.

After fitting the body, the bodybuilders must ensure that the vehicle remains stable during tipping.

The following points must be kept in mind:

- The subframe must be (see Figure 3.11 and Figure 3.12) suitable for the vehicle type and for the specific operating conditions. It must have adequately dimensioned side and cross members and be stiffened at the rear by box-type construction and crossbraces. Anchoring the subframe to the chassis, flexible joints brackets or shelves must be placed at the front end, whereas the rear section requires rigid-type joints (plates, see Figure 3.17) to allow the added structure to contribute more to the rigidity of the whole. The "omega" brackets can be adopted on vehicles which are already equipped with them.

- The rear tipping hinge must be mounted on the subframe as near as possible to the rear support of the rear suspension. In order not to impair the stability of the vehicle during tilting operations and not to increase excessively the stress on the chassis, it is recommended that the distances between the tipping hinge and the rear spring support or tandem centreline be observed in Figure 3.20. If for technical reasons this cannot be achieved, small increases may be permitted provided a higher strength subframe is used, in order to increase the rigidity of the rear end. In the case of large volume transports requiring long bodies, it is advisable (in those cases where it is permissible) to lengthen the wheelbase of the vehicle.

- Great care must be given to the positioning of the lifting device both in terms of providing supports of adequate strength and in order to position the mountings precisely and conveniently. It is advisable in any case to place the device to the front of the centre of gravity of the body plus payload so as to reduce the extent of the localised load.
For both under floor and front end tipping gear installations it is recommended that appropriate stabiliser acting as a guide for the stroke of the tipping body, are fitted.

The hinge of the lifting unit must be mounted on the subframe. The useful volume on the body must conform, with the consideration of the maximum permissible mass on the axles, to the density of the material that is to be transported (see point 3.5).

When freight having a low density is transported, the useful volume may be increased within the limits established for the maximum height of the centre of gravity of the payload plus the fixtures.

The bodybuilders must see to it that the functioning and safety of all parts of the vehicle (for instance, the positioning of lights, tow hook etc.) is safeguarded, in full compliance with the current safety regulations.

Figure 3.20

1 Subframe
2 Brackets
3 Plates
4 Butt strap
3.9.1 Heavy-duty Service

In Table 3.7 are listed the vehicles that are suitable for heavy-duty operations along with the minimum dimensions for the main subframe runners.

Particular attention must be paid to the strict adherence to the general specifications given to ensure the vehicles have adequate stability in the rear tipping phases.

When mounting tipping bodies on chassis provided with pedestal brackets or other types suitable for different types of bodies, the latter shall be replaced by shear/thrust resistant plates (cleat plates) from the rear spring/bogie front hanger bracket to the rear chassis or additional plates shall be fitted.

The rear frame overhang may have to be shortened, so that the maximum distance to the position of the tipping hinge comply with Figure 3.20.

For the models with two rear axles, the following will be complied with:
- The box-type construction of the reinforcing longitudinal sectional member (see Figure 3.7) will include the section that is included between the rear edge and 1300 mm in front of the centreline of the two axles.
- The cross-braces will include the area between the centreline of the twin axle and the rear end of the chassis.
- The tipping support may not be positioned more than 1400 mm from the centreline of the twin axle.

<table>
<thead>
<tr>
<th>Model</th>
<th>Wheelbase (mm)</th>
<th>Minimum profile of subframe</th>
<th>Strength modulus $W_x$ (cm$^3$)</th>
<th>Dimensions (mm)</th>
<th>Yield limit of material used (N/mm$^2$)</th>
<th>240</th>
<th>360</th>
<th>240</th>
<th>360</th>
</tr>
</thead>
<tbody>
<tr>
<td>60K, 65K, 75K</td>
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<td>39</td>
<td>120 x 60 x 5</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80K, 90K, 100K</td>
<td>-</td>
<td>46</td>
<td>120 x 60 x 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120K</td>
<td>-</td>
<td>65</td>
<td>26</td>
<td>140 x 70 x 6</td>
<td>100 x 50 x 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>130K</td>
<td>-</td>
<td>74</td>
<td>36</td>
<td>140 x 70 x 7</td>
<td>100 x 60 x 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>150K</td>
<td>-</td>
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<td>140 x 70 x 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>74</td>
<td>140 x 70 x 7</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>180K</td>
<td>4815</td>
<td>89</td>
<td>160 x 70 x 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>260EK</td>
<td>3828/1372</td>
<td>105</td>
<td>120 x 60 x 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>260EK</td>
<td>4190/1372</td>
<td>135</td>
<td>120 x 60 x 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100EW, 140EW</td>
<td>-</td>
<td>46</td>
<td>120 x 60 x 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.9.2 Light-duty Service

For these operations we recommend using vehicles with short wheelbases. In Table 3.8 are listed the longitudinal runners to be used. It is understood that the vehicle must be used for light duty on good roads, to transport freight with a low density and a low coefficient of friction.

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

- carefully check the chassis specifications (suspension, chassis, number of axles) to select a body suitable for the vehicle and its intended operation;
- the rear end of the auxiliary frame must be stiffened using e.g. box-type sections, crossbraces, cleat plates etc;
- the rear tipping hinge must be placed as near as possible to the rear support of the rear suspension;
- in cases of vehicles having wheelbase longer than the standard tipper wheelbase, specially stiffened rear tipping support anchoring should be used so as to contain sag and ensure good stability during operation. The rear tipping angle should not exceed 45° while the user should be informed that the tipping should be done on as flat a surface as possible;
- use the most rigid rear suspensions available. When parabolic rear springs are used, the stiffness should be increased using rubber elements that operate at static load;
- in vehicles with pneumatic rear suspension, discharge of air from the springs must be foreseen during tipping, in order to improve stability in the suspensions while the material is being unloaded.
- on vehicles with standard third axle or added third axle (6x2), an antiroll bar may have to be fitted onto the 3rd axle depending on the type of installed suspension to improve the transverse stability. In addition to the above instructions, hydraulic or mechanical stabilisers may have to be installed for operation depending on the tipping support location in relation to the rear axles, to suspension types and to intended operation. The third axle must never lift when tipping.

<table>
<thead>
<tr>
<th>Model</th>
<th>Minimum profile of subframe</th>
<th>Yield limit of material used (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strength modulus $W_x$ (cm²)</td>
<td>Dimensions (mm)</td>
</tr>
<tr>
<td>240</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60E, 6SE, 75E, 80EL</td>
<td>26</td>
<td>100 x 50 x 5</td>
</tr>
<tr>
<td>80E, 90E, 100E</td>
<td>39</td>
<td>120 x 60 x 5</td>
</tr>
<tr>
<td>110EL, 120EL</td>
<td>57</td>
<td>140 x 60 x 6</td>
</tr>
<tr>
<td>120E</td>
<td>31</td>
<td>100 x 60 x 5</td>
</tr>
<tr>
<td>130E</td>
<td>36</td>
<td>100 x 60 x 6</td>
</tr>
<tr>
<td>150E</td>
<td>57</td>
<td>140 x 60 x 6</td>
</tr>
<tr>
<td>180E</td>
<td>46</td>
<td>120 x 60 x 6</td>
</tr>
<tr>
<td>260EK</td>
<td>89 (1)</td>
<td>160 x 70 x 7</td>
</tr>
</tbody>
</table>

(1) = A box section profile with shear-resistant plates is required as from approximately 1000 mm forward of the centre of the driving axle to the rear end of the chassis.
3.10 Removable Containers

Not all vehicles lend themselves equally well to be used for removable type containers (i.e. the containers which can be shifted to the ground by laying or slipping down). Heavy duty vehicles are certainly better suited to this use but it is best to consult IVECO concerning the suitability of the various models in relation to the use of the vehicle.

This type of outfit is subject to additional stresses compared to those of normal on-road vehicles with fixed platform bodies, in particular as regards loading/unloading operations.

For this reason, the auxiliary frame to be used (see point 3.9.2) should be of the same dimensions as that for light tippers. Where vehicles with long wheelbases or rear overhangs are used, it may be necessary to use runners of larger dimensions for the subframe.

The lifting devices must be anchored to the subframe as indicated in point 3.4.

The stability of the vehicle must always be ensured during loading and unloading operations. We recommend fitting the rear ends with supports (stabilisers) that are to be used during work procedures, particularly when the laying containers are used. These supports are also recommended in the presence of rear axles with pneumatic suspensions. As an alternative, refer to the explanations in point 3.9.2, concerning the air bleed from the suspension during the operation.

It is very important, with this type of vehicle, to adhere to the specifications concerning the height of the centre of gravity (see point 3.2), when the containers for rather high payloads are used.

Figure 3.21

The distance between the last rear axle and the sliding pin must not exceed 900 mm.
3.11 Installation of Concrete Mixers

Concrete mixers may be installed only on vehicles that are suitable for this purpose as indicated in Table 3.9, where also the minimum requirements for the reinforcing sections and the capacity drums are given. It is clear that the maximum permissible mass for the vehicles must be respected.

In addition to observing all the possible government regulations relating to the installation of concrete mixers, the following points must be kept in mind:

− the concrete mixer must be fitted with its own continuous steel subframe in observance of point 3.1, so as to distribute the concentrated weight as much as possible over the chassis. For the runners of the subframe, sections with a moment of resistance (Wx) and a moment of inertia (Jx) not lower that those for the sections may be used, which permit substantial reductions in the height of the added structure’s centre of gravity (i.e. boxed–type structures or sections with the upper flange turned toward the outside see Figure 3.22);
− suitable cross members must be provided to ensure adequate rigidity in the mounting between the cement mixing apparatus and its basic frame, so as to free the vehicle’s chassis from the forces that result from the particular geometry and functional configuration of the concrete mixer.

The subframe must be suitably stiffened towards the rear with appropriate crosspieces or crossbraces;

<table>
<thead>
<tr>
<th>Model</th>
<th>Approximate capacity of drum (m³)</th>
<th>Minimum profile of subframe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Strength modulus Wx (cm³)</td>
</tr>
<tr>
<td>150K</td>
<td>3.3</td>
<td>66</td>
</tr>
<tr>
<td>180K</td>
<td>4.5</td>
<td>81</td>
</tr>
<tr>
<td>260EK</td>
<td>6.7</td>
<td>108</td>
</tr>
</tbody>
</table>

(1) = A profile other than of C–section type is permitted: see Figure 3.22.

Figure 3.22

1 Main frame
2 Regular channel profile
3 Runner with upper flange turned over
4 Position of drum
the mounting (see point 3.4) must affect only the two frames and must be constructed in such a manner as to provide a secure anchorage. For those vehicles which are not yet equipped with them, we recommend the use of cleat plates to avoid slippage in length or to the side, restricting the use of flexible joints to the front end of the subframe (see Figure 3.23);

**Figure 3.23**

1 Subframe  
2 Brackets  
3 Cleat plates

when installing the cement mixer assembly, care must be taken to position the centre of gravity as close to the front axle as possible, obviously with due consideration to the maximum permissible weight on the axle itself. To obtain the necessary stability of the vehicle and its safety while in operation, particularly when cornering or on rough terrain with transverse and/or longitudinal slope, the swing effect of the payload inside the drum must be taken into consideration since it results in a shift of the dynamic centre of gravity of the payload and consequently it adversely affects the vehicle’s behaviour;

specific PTO solutions are available on request that are independent of the clutch and suitable for concrete mixer applications (see point 4.5.2). The auxiliary motor to control the drum must be mounted on an appropriate elastic suspension;

due to rotation of the drum the centre of gravity of the load moves and therefore the differences in the transverse load must be kept within acceptable limits.

### 3.12 Installation of Tanks and Containers for Bulk Materials

As a general rule, the installation of tanks and containers on our vehicles requires the use of an appropriate auxiliary frame.

Table 3.10 contains the guidelines for the dimensions of the longitudinal runners to be used for the auxiliary frame.
Tankers, or more generally, structures which are torsionally very rigid, must be fitted so that the vehicle chassis retains sufficient and gradual torsional flexibility, by avoiding areas of high stress.

When installing a tank we recommend using elastic joints (see Figure 3.24) between the body of the tank and the auxiliary frame in front and rigid supports that are capable of withstanding longitudinal and transverse forces in the rear.

As was mentioned in the case of other applications, the positioning of the mountings through which the forces are discharged is similar here. The rigid mounts go in a position corresponding to the rear suspension supports and the flexible mounts as near as possible to the rear support of the front suspension.

When faced with a different situation, a possible solution could be that of reinforcing the structure by means of longitudinal runner profiles of larger dimensions in comparison with those given in Table 3.10. Other type of body connections can be permitted upon request.

In order to define the elastic connection, the rigidity characteristics of the vehicle chassis as well as the area where the connections are to be installed and the type of use for which it is intended must be taken into account.

Table 3.10

<table>
<thead>
<tr>
<th>Model</th>
<th>Minimum profile of subframe</th>
<th>Strength modulus $W_x$ (cm$^3$)</th>
<th>Dimensions (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60E, 65E, 75E, 80E</td>
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<td>40</td>
<td>100 x 65 x 6</td>
</tr>
<tr>
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<td>57</td>
<td>140 x 60 x 6</td>
</tr>
<tr>
<td>120E, 130E, 150E</td>
<td></td>
<td>70</td>
<td>140 x 70 x 7</td>
</tr>
<tr>
<td>180E</td>
<td></td>
<td>90</td>
<td>160 x 70 x 7</td>
</tr>
<tr>
<td>260EK</td>
<td></td>
<td>120</td>
<td>200 x 80 x 6</td>
</tr>
</tbody>
</table>

Figure 3.24
As a rule, for road use, it can be said that the first front elastic mounting will allow for a gap of approximately 10 mm between the subframe and frame during the chassis torsional stage.

Tanks may be mounted directly onto the vehicle chassis without fitting an auxiliary frame under the following conditions:

- the distance between saddles must be determined depending on the load to be discharged. In any case it must not exceed 1 meter;
- saddles must be fitted so as to allow an even distribution of the loads over a considerably large surface. Suitable brackets must be provided between the saddles to limit the longitudinal and transverse thrusts;
- other anchoring solutions will thus be authorised by IVECO;
- self-bearing tanks may be positioned directly on the chassis by means of suitable mountings located right behind the cab and in the rear axle(s) area. Their amount and distribution depend on the number of axles and the wheelbase; they may vary from min. 2 for each side on 2-axle vehicles with short wheelbases to min. 3 for 3-axle vehicles with short wheelbases (Figure 3.25).

The anchoring devices must be sufficiently long (600 mm approx) and be positioned next to the suspension mountings (max. distance 400 mm).

To permit the necessary torsional movements of the chassis, elastic front anchorings should be employed where possible.

Other solutions are possible depending on the type of construction.

**Figure 3.25**
The installation of two or more separate containers or tanks on the vehicle requires the use of an auxiliary frame that permits good distribution of the load and an adequate torsional rigidity for the chassis/subframe using connections resistant to shearing. A good solution is constituted by using a rigid connection which connects the containers together.

In order to adhere to the maximum admissible load limits on the axles, it is necessary to establish the maximum volume, the degree of filling of the container and the density of the freight. When separate tanks or individual containers with separate compartments are used, care must be taken to ensure that with every degree of filling the maximum permissible load on the axles is respected as well as the minimum ratio between the mass of the front axle and fully loaded vehicle mass (see point 3.2).

In consideration of the nature of this equipment, special attention must be paid to limiting the height of the centre of gravity as much as possible so as to ensure good handling (see point 3.2).

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

Concerning the installation of containers for fuel or flammable liquids, all current government safety regulations must be abided by (see point 2.23).
3.13 Installation of Cranes

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

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

Use stabilisers while the crane is operating. As a general rule, the installation of a crane requires the use of a suitable subframe, whose construction must take into account all general specifications relating to it (point 3.3). Concerning the dimensions of the runners for the subframe, refer to Tables 3.11, 3.12 e 3.13.

The dimensions of the subframe strength module refer to the total maximum static moment of the crane \(M_G\) which is calculated on the basis of the equation given in Figure 3.26.

In those cases where no specific subframe is called for (value A on the table) it is still necessary to provide a suitable mounting on the chassis for the crane using the standard body subframe (the section members must be in length at least 2.5 times the width of the base structure of the crane) in order to distribute the load and the stress developed during the operation of the crane.

If the vehicle requires the use of its own subframe, it may also be used for the crane provided that its dimensions are adequate.

Particular cases in which the values of the \(M_G\) moment are matched by value E in the table (or for higher \(M_G\) values) shall be checked on a case-to-case basis. Special approval shall be requested from IVECO.

\[
M_G [\text{KNm}] = \max \left[ \frac{g \cdot (W_L \cdot L + W_c \cdot l)}{1000} \right]
\]

\(g\) = acceleration of gravity, equal to \(9.81 \text{ m/s}^2\);
\(W_L\) = weight applied to the crane end (kg);
\(L\) = horizontal distance between the point where load \(W_L\) is applied and the vehicle center line [m];
\(W_c\) = crane’s own weight applied to its center of gravity [kg];
\(l\) = horizontal distance between the center of gravity of the crane and the vehicle center line [m];

The fitter must check the stability of the vehicle each time during the phases of work, according to current regulations, taking all the necessary precautions to ensure proper use. Both the crane manufacturer and the body builder are to define the type and number of the stabilizers and make the subframe depending on the maximum static moment and the crane position.
3.13.1 Crane Behind the Driver's Cab

The mounting of the subframe onto the chassis frame will as a rule, be performed by using the standard brackets (see Figure 3.27) to which are added, if necessary, other flexible anchorages (brackets or clamps) so that the flexibility and torsional characteristics of the chassis frame remain unchanged.

The dimensions and the subframe to be used for this type of installation are specified in Table 3.11.

For on-road vehicles only if the height of the subframe runner profile has to be reduced (e.g. to lower the total height of the vehicle) the mounting of the subframe may be carried out with shear resisting connections (see Figure 3.28). For these applications, the minimum dimensions of the reinforcing runner are specified in Table 3.12.

The use of runners with a constant cross-section is recommended over the entire useful length of the vehicle. Any possible gradual reduction of the cross-section of the runners is permissible in those areas in which the flexional moment induced by the crane assumes values that correspond for those of boxes marked "A" in Table 3.11 and Table 3.12.

The crane counterframe, as indicated in Figure 3.27, can be fixed at the rear to the one foreseen for other superstructures; the length “Lv” must in any case be not less than 35% of the wheelbase; this is in cases where the superstructure profiles have a lower cross-section.

Figure 3.27
When mounting cranes on vehicles with large cabs (double cab or 6+1), should it be impossible to extend the subframe up to the rear support of the front spring, it may be necessary to contain crane rotation according to crane capacity, so as not to exceed bending moment allowance for the chassis.

**Fitting superstructures**

**Table 3.11 – Cranes mounted behind cab (fixed to subframe with bracket or clamp)**

<table>
<thead>
<tr>
<th>Model</th>
<th>A x B x t (mm)</th>
<th>Minimum value of strength modulus of subframe section Wx (cm²)</th>
<th>Total torque M₉ max (kNm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>0/20</td>
</tr>
<tr>
<td>ML6, ML6S, ML75, ML80EL</td>
<td>172.5x65x4</td>
<td>240 A A 31 89 135 173 E</td>
<td>360 A A 31 57 89 105 E</td>
</tr>
<tr>
<td></td>
<td>172.5x65x5</td>
<td>240 A A 19 46 119 150 E</td>
<td>360 A A 19 46 57 89 E</td>
</tr>
<tr>
<td></td>
<td>195.5x65x4</td>
<td>240 A A 19 46 105 150 208 E</td>
<td>360 A A 19 46 89 89 119 E</td>
</tr>
<tr>
<td></td>
<td>195.5x65x5</td>
<td>240 A A A 26 46 135 173 208 E</td>
<td>360 A A A 26 46 89 89 119 E</td>
</tr>
<tr>
<td>ML8, ML90, ML100</td>
<td>195.5x65x6</td>
<td>240 A A A A 21 57 89 119 150 208 E</td>
<td>360 A A A A 19 46 89 89 119 150 E</td>
</tr>
<tr>
<td>ML110EL, ML120EL</td>
<td>240x70x5</td>
<td>240 A A A A A 36 57 89 150 245 E</td>
<td>360 A A A A A 36 57 89 105 150 E</td>
</tr>
<tr>
<td>ML120, ML130, ML150, ML150EV</td>
<td>240x70x6</td>
<td>240 A A A A A A A 31 57 89 245 317 E</td>
<td>360 A A A A A A A 31 57 89 119 173 E</td>
</tr>
<tr>
<td>ML120, ML130, ML150</td>
<td>240x70x6.7</td>
<td>240 A A A A A A A A A 36 57 105 208 268 374 E</td>
<td>360 A A A A A A A A 36 57 105 150 208 E</td>
</tr>
<tr>
<td>ML150</td>
<td>240x70x7.7</td>
<td>240 A A A A A A A A A A 36 105 173 245 317 E</td>
<td>360 A A A A A A A A A A 36 105 150 208 245 E</td>
</tr>
<tr>
<td>ML180</td>
<td>262x5x80x6</td>
<td>240 A A A A A A A A A A 36 89 119 160 208 245 E</td>
<td>360 A A A A A A A A A A 36 89 105 150 208 245 E</td>
</tr>
<tr>
<td>ML180</td>
<td>262x5x80x6.7</td>
<td>240 A A A A A A A A A A A A 57 208 317 406 E</td>
<td>360 A A A A A A A A A A A A 57 105 150 208 245 E</td>
</tr>
<tr>
<td>ML180</td>
<td>262x5x80x7.7</td>
<td>240 A A A A A A A A A A A A A A 89 245 374 474 E</td>
<td>360 A A A A A A A A A A A A A A 89 119 173 208 286 374 E</td>
</tr>
<tr>
<td>ML260KE</td>
<td>262x5x80x6.7</td>
<td>240 A A A A A A A A A A A A A A 57 105 150 208 245 286 374 E</td>
<td>360 A A A A A A A A A A A A A A 57 105 150 208 245 286 374 E</td>
</tr>
</tbody>
</table>

![Figure 3.28](image-url)
Installation of cranes on off-road vehicles may require fitting elastic mountings between the chassis frame and subframe on the front and central areas (see Figure 3.14) so as not to excessively constrain the chassis torsional movement. Since in such cases the crane will be virtually connected to the subframe only, the size of the longitudinal runners must be adequate to resist the crane operation-generated movements.

The functioning of the equipment that is placed behind the cab (e.g. gear levers, air filter, locking device for the tilting cab etc.) must not be impaired. Relocating assemblies such as batteries box or fuel tank is permissible provided that the original type of connections are re-established.

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

Table 3.12 – Cranes mounted behind cab (subframe fixing with shear-resistant plates)

<table>
<thead>
<tr>
<th>Modello</th>
<th>A x B x t (mm)</th>
<th>R_{v,1} (N/mm)</th>
<th>Total torque M_{G} max (kNm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>subframe</td>
<td>0/20</td>
</tr>
<tr>
<td>ML60, ML65, ML75, ML80EL</td>
<td>172.5x65x4</td>
<td>240</td>
<td>A A A 31 46 57 89 105 E</td>
</tr>
<tr>
<td>ML60, ML65, ML75, ML80EL</td>
<td>172.5x65x5</td>
<td>240</td>
<td>A A A 31 46 57 89 105 E</td>
</tr>
<tr>
<td>ML80, ML90, ML100</td>
<td>195.5x65x4</td>
<td>240</td>
<td>A A A 31 46 57 89 105 E</td>
</tr>
<tr>
<td>ML80, ML90, ML100</td>
<td>195.5x65x5</td>
<td>240</td>
<td>A A A 31 46 57 89 105 E</td>
</tr>
<tr>
<td>ML110EL *, ML120EL *)</td>
<td>195.5x65x6</td>
<td>240</td>
<td>A A A 31 46 57 89 105 E</td>
</tr>
<tr>
<td>ML120, ML130, ML150, ML100EW</td>
<td>240x70x5</td>
<td>240</td>
<td>A A A 31 46 57 89 105 E</td>
</tr>
<tr>
<td>ML120, ML130, ML150, ML140EW</td>
<td>240x70x6</td>
<td>240</td>
<td>A A A A A A 31 46 57 89 105 E</td>
</tr>
<tr>
<td>ML120, ML130, ML150</td>
<td>240x70x6.7</td>
<td>240</td>
<td>A A A A A A 31 46 57 89 105 E</td>
</tr>
<tr>
<td>ML150</td>
<td>240x70x7.7</td>
<td>240</td>
<td>A A A A A A 31 46 57 89 105 135 208 E</td>
</tr>
<tr>
<td>ML180</td>
<td>262.5x80x6</td>
<td>240</td>
<td>A A A A A A 31 36 57 89 105 150 208 245 E</td>
</tr>
<tr>
<td>ML180</td>
<td>262.5x80x6.7</td>
<td>240</td>
<td>A A A A A A 31 36 57 89 105 135 173 208 E</td>
</tr>
<tr>
<td>ML180</td>
<td>262.5x80x7.7</td>
<td>240</td>
<td>A A A A A A 31 36 57 89 105 135 173 208 E</td>
</tr>
<tr>
<td>ML260KE</td>
<td>262.5x80x6.7</td>
<td>240</td>
<td>A A A A A A 31 36 57 89 105 135 173 208 E</td>
</tr>
</tbody>
</table>

A = The reinforcing profile prescribed for the respective superstructure is sufficient (e.g. for normal bodies). Close the reinforcing profile in the crane mounting area. In the crane area, reinforcing profiles with thickness of less than 5 mm must be reinforced.

E = To be checked on a case-by-case basis. Send the technical documentation with the checks of stresses and stability to the appropriate IVECO bodies.

*) = On the version with long cab, use a profile with strength modulus Wx of not less than 57 cm³.
If the height of the subframe profile has to be reduced, using shear resistant connections between chassis and subframe, combined section profiles can be used, as shown in Figure 3.29, instead of the C-profile, provided that the flange width and thickness are not less than the corresponding values of the profile recommended by IVECO. The above are general conditions which apply to the materials indicated. To assess whether it is possible to use materials with higher mechanical specifications, it is necessary to check the total resistant moment of the chassis plus subframe. Since reducing the height of the subframe profile also reduces the torsion resistance, for cranes with four stabilisers, the bodybuilder must take special measures to ensure adequate torsional rigidity of the subframe in the crane mounting area. For this reason, it is recommended that you do not use profiles with a height of less than 120 mm. Since the execution of these solutions also limits the torsional capacity of the chassis, they can only be used on vehicles intended exclusively for on-road use.

### Table 3.13 – Crane behind cab, solutions with combined section reinforcing profiles (see Figure 3.29)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{0.2}$ (N/mm²)</td>
<td>320</td>
<td>320</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>Maximum reduction of height of profile (mm)</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>$L_V$ (see Figure 3.27)</td>
<td>0.25 $L_H$ or $L_A$</td>
<td>0.35 $L_H$ or $L_A$</td>
<td>0.55 $L_H$ or $L_A$</td>
<td>0.60 $L_H$ or $L_A$</td>
</tr>
<tr>
<td>Example of combined profiles as alternative to a C-profile 250x80x8 (mm)</td>
<td>210x80x8</td>
<td>190x80x8</td>
<td>150x50x8+ angular element</td>
<td>130x50x8+ angular element</td>
</tr>
<tr>
<td>Effective height reduction (mm)</td>
<td>40</td>
<td>52</td>
<td>92</td>
<td>104</td>
</tr>
</tbody>
</table>

### Figure 3.29

- **Version “A”**
- **Normal box section profiles**
- **Gradual change from box section to open section**
- **Version “B”**
- **Special combined section profiles**
- **Version “C”**
- **Chassis/subframe connecting angle plates of same thickness as subframe profile**
- **Version “D”**

**Esempio di profilati combinati in alternativa ad un profilato a C 250x80x8 (mm)**

**Version “D”**
3.13.2 Crane on Rear Overhang

It is advisable for this type of application, to extend the subframe over the entire length of the vehicle that is available for the body up to the rear support of the front spring. The dimensions of the runners to be used are given in Table 3.14.

In consideration of the particular distribution of the mass on the vehicle, wherein the load is concentrated on the rear overhang, and in order to ensure the rigidity that is necessary for good performance on the road and when the crane is in operation, the subframe must be strengthened and stiffened in relation to the capacity of the crane. Box–type construction sections (see point 3.3) and brackets are to be employed in the area corresponding to the rear suspension and the rear overhang (Length Lu) – see Figure 3.30. Care must also be taken to ensure that the transition from box–type to open section be well blended as illustrated in Figure 3.7.

In the area that is affected by the box–type section, the frame must be secured to the chassis of the vehicle by means of shear–resistant joints (i.e. an adequate number of plates spaced at most 700 mm from each other), whereas elastic anchorages are to be used in the front part. Due care must be taken to ensure that under any load conditions, the ratio of the mass on the front axle to the rear axle or axles, respects the limits set for the vehicle (see point 3.2).

As the required stiffness of the subframe depends on various factors (i.e. crane capacity, size of its supporting base, vehicle tare, chassis overhang) we cannot give information valid for all possible different conditions. For this reason the bodybuilder will have to assess the vehicle stability also by means of practical behavioural tests. If, as a consequence of such tests, the subframe stiffness proves insufficient, the bodybuilder will have to achieve this objective by means of alternative methods.

The rear overhang of the crane (length Lu, see Figure 3.30), must be limited as much as possible in order to preserve the good driving characteristics of the vehicle and acceptable stress conditions. This value must not exceed 50% of the wheelbase.

In the case of vehicles with an added lifting rear axle, the verification of the minimum load on the front axle must be done with the rear axle in the raised position in those countries which permit driving under those conditions (see point 3.7). If the minimum prescribed value is not reached, the vehicle must be allowed to drive only with the axle in the lowered position.

Table 3.14 – Cranes mounted on rear overhang (subframe mounting with shear resistant plates)

<table>
<thead>
<tr>
<th>Model</th>
<th>A x B x t (mm)</th>
<th>Wx (cm³)</th>
<th>Subframe</th>
<th>Total torque Mₘₕ max (kNm)</th>
<th>Minimum value of strength modulus of subframe section Wx (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML60, ML65, ML75, ML80</td>
<td>172.5x6x5x4</td>
<td>240</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>ML60, ML65, ML75, ML80</td>
<td>172.5x6x5x5</td>
<td>240</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>ML80, ML90, ML100</td>
<td>195.5x6x5x4</td>
<td>240</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>ML80, ML90, ML100</td>
<td>195.5x6x5x5</td>
<td>240</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>ML100, ML100, ML100, ML100</td>
<td>195.5x6x5x5</td>
<td>240</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>ML110EL 1), ML120EL 1)</td>
<td>195.5x6x5x6</td>
<td>240</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>ML120, ML120, ML120, ML120</td>
<td>240x70x5x6</td>
<td>240</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>ML120, ML120, ML120, ML120</td>
<td>240x70x6x6</td>
<td>240</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>ML120, ML130, ML150</td>
<td>240x70x6x7</td>
<td>240</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>ML150</td>
<td>240x70x7x7</td>
<td>240</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>ML180</td>
<td>262.5x8x6x6</td>
<td>240</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>ML180</td>
<td>262.5x8x6x7</td>
<td>240</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>ML260KE</td>
<td>262.5x8x6x6</td>
<td>240</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

A = The reinforcing profile prescribed for the respective superstructure is sufficient (e.g. table 3.1 for normal bodies). Close the reinforcing profile in the crane mounting area. In the crane area, the reinforcing profiles with thickness of less than 5 mm must be reinforced.

E = To be checked on a case–by–case basis. Send the technical documentation with the checks of stresses and stability to the appropriate IVECO bodies.

*) = On the MLL version, use a profile with strength modulus Wx of not less than 57 cm³.
If the height of the subframe profile has to be reduced, using shear resistant connections between chassis and subframe, combined section profiles can be used as shown in (see Table 3.15), instead of the C-profile, provided that the flange width and thickness are not less than the corresponding values of the profile indicated in Table 3.14. The above are general conditions which apply to the materials indicated. To assess whether it is possible to use materials with higher mechanical specifications, it is necessary to check the total resistant moment of the chassis plus subframe. Since reducing the height of the subframe profile also reduces the torsion resistance, for cranes with four stabilisers, the bodybuilder must take special measures to ensure adequate torsional rigidity of the subframe in the crane mounting area. For this reason, it is recommended that you do not use profiles with a height of less than 120 mm.

**Figure 3.30**

1 Subframe  
2 Plates  
3 Brackets  
4 Crane connections  
5 Stabilisers  
6 Angular connection elements

**Table 3.15 – Crane on rear overhang, solutions with combined section reinforcing profiles (see Figure 3.29)**

<table>
<thead>
<tr>
<th></th>
<th>B (N/mm²)</th>
<th>C (N/mm²)</th>
<th>D (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_{0.2} )</td>
<td>320</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>Maximum reduction of height of profile (mm)</td>
<td>20</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>( L_V ) (see Figure 3.30)</td>
<td>-</td>
<td>0.60 ( L_G )</td>
<td>0.65 ( L_G )</td>
</tr>
</tbody>
</table>

Esempio di profilati combinati in alternativa ad un profilato a C 250x80x8 (mm)

<table>
<thead>
<tr>
<th>Example of combined profiles as alternative to a 250x80x8 (mm) C-profile</th>
<th>200x80x8</th>
<th>160x80x8+ angular element</th>
<th>140x80x8+ angular element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective height reduction (mm)</td>
<td>12</td>
<td>52</td>
<td>64</td>
</tr>
</tbody>
</table>
3.13.3 Removable Cranes

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

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

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

The dimensions of the reinforcing runners to be used when installing tail lifts can be assessed as follows:

- By means of Table 3.16, with the standard rear overhangs and mean bending moments induced by tail lifts; as a function of their capacity. In the table, the minimum capacity values are specified above which suitable stabilisers must be used.

- When cantilever tail lifts or with different lengths of the rear overhang and with special tail lifts (e.g. of aluminium), the flexural moments induced on the chassis frame can be assessed by means of Figure 3.31, whereas the characteristics of the reinforcing runners can be defined with the relevant Table 3.17.

The bodybuilder or the Manufacturer of the tail lift will take care to ascertain safety and operational stability, in particular when applying Table 3.17.

In any event, particularly in those specific uses where there is not suitable auxiliary frame (as in the case with bodies for vans or box-type bodies built by means of cross members), the anchoring for the loading platform must be provided by a structure that enables the stress to be distributed over the chassis of the vehicle.

To provide the necessary strength and rigidity, the connection between the chassis and the auxiliary frame must involve (especially in overhangs of over 1500 mm) the use of shear resisting plates positioned in the area of the overhang and of the rear suspension and spaced not more than 700 mm from one another as shown in Figure 3.31).

**Figure 3.31**

![Diagram showing the calculation of bending moments](image)

**Equations**

\[
W_{TL} = \text{Side board typical weight}
\]

\[
W_L = \text{Side board capacity}
\]

The bending moment on the chassis can be obtained from the relation below:

\[
M [Nm] = W_L \times A + W_{TL} \times B \quad \text{for gates without stabilizers}
\]

\[
M [Nm] = W_L \times C + W_{TL} \times D \quad \text{for gates with stabilizers}
\]
The bodybuilder must consider each time the necessity of using stabilisers even in those cases where merely in terms of stress of the chassis their use may not appear to be necessary. When evaluating the need for stabilisers in relation to the capacity of the platform, the stability and attitude of the vehicle resulting from the deflection of the suspension during loading operations must also be considered.

The stabilisers that must be attached to the platform’s supporting structure should preferably be hydraulically operated and must be employed during all loading procedures with the platform.

The stability of the vehicle must be verified in observance of government regulations in all operating phases of the platform.

To compensate for the elastic give of the chassis, which is inevitable when the tail lift is in operation, the bodybuilder may make use of reinforcement runner profiles of larger size in comparison to the one indicated in Table 3.16.

The runner profile dimensions given in Table 3.16, apply to the rear overhangs shown. Should the latter be of larger size, it may be necessary to consider the possibility of either installing stabilisers or larger runner profiles (see Table 3.17).

The installation of tail lifts must be carried out with due regard for the maximum permissible weights on the rear axle or axles and of the minimum load established for the front axle (see point 3.2); if this should not be the case, the rear overhang will have to be reduced.

When electro–hydraulic tail lifts are installed, it is necessary to check that the capacity of the batteries and of the alternator is adequate (see point 2.21.6).

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

The bodybuilder will be responsible for any modification to the rear underrun guard or for installing a different type (see point 2.25), for preserving the visibility of the rear lights, for the overhang angles, and for the positioning of the tow hook as provided by the respective national ordinances.
If a higher strength modulus is required for the superstructure (e.g. application of bodies) use the latter for the loading gate too.

Table 3.16 – Installation of loading gates

<table>
<thead>
<tr>
<th>Model (1)</th>
<th>Minimum strength modulus of subframe section Wx (cm³) to be adopted according to yield limit of the material (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gate capacity (kg)</td>
</tr>
<tr>
<td></td>
<td>750</td>
</tr>
<tr>
<td></td>
<td>240</td>
</tr>
<tr>
<td>Wire-box (mm)</td>
<td>2145</td>
</tr>
<tr>
<td>Overhang (mm)</td>
<td>2145</td>
</tr>
</tbody>
</table>

| 60E       | 1290 | A    | A    | A    | A    | A    | A+S  | E    |
| 65E       | 1313 | A    | A    | A    | A    | A    | A+S  | E    |
| 75E       | 1313 | A    | A    | A    | A    | A    | A+S  | E    |
| 75/E/P    | 1313 | A    | A    | A    | A    | A    | A+S  | E    |
| 80E       | 1313 | A    | A    | A    | A    | A    | A+S  | E    |
| 80/E/P /F | 1313 | A    | A    | A    | A    | A    | A+S  | E    |
| 90E       | 1313 | A    | A    | A    | A    | A    | A+S  | E    |
| 90/E/P /F | 1313 | A    | A    | A    | A    | A    | A+S  | E    |
| 110EL /120EL | 1313 | A    | A    | A    | A    | A    | A+S  | E    |
| 110EL/P /120EL/P | 1313 | A    | A    | A    | A    | A    | A+S  | E    |
| 120E      | 1313 | A    | A    | A    | A    | A    | A+S  | E    |

Fitting superstructures
Table 3.16 – Installation of loading gates (continued)

<table>
<thead>
<tr>
<th>Model (1)</th>
<th>Wheelbase (mm)</th>
<th>Overhang (mm)</th>
<th>Gate capacity (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>750</td>
</tr>
<tr>
<td>120E/P</td>
<td>4185 2055</td>
<td>A A A A A A A A A A A 21 16 31 16 E</td>
<td></td>
</tr>
<tr>
<td>130E</td>
<td>4185 2055</td>
<td>A A A A A A A A A A A 21 16 31 16 E</td>
<td></td>
</tr>
<tr>
<td>130E/P</td>
<td>4185 2055</td>
<td>A A A A A A A A A A A 21 16 31 16 E</td>
<td></td>
</tr>
<tr>
<td>150E</td>
<td>3105 1313</td>
<td>A A A A A A A A A A A 21 16 31 16 E</td>
<td></td>
</tr>
<tr>
<td>150E/P</td>
<td>4185 2055</td>
<td>A A A A A A A A A A A 21 16 31 16 E</td>
<td></td>
</tr>
<tr>
<td>180E</td>
<td>5670 3000</td>
<td>A A A A A A A A A A A 36 21 36 21 57 31 E</td>
<td></td>
</tr>
<tr>
<td>180E/P</td>
<td>5175 2685</td>
<td>A A A A A A A A A A A 21 16 31 16 E</td>
<td></td>
</tr>
</tbody>
</table>

Minimum strength modulus of subframe section Wx (cm³) to be adopted according to yield limit of the material (N/mm²)

A = The reinforcing profile prescribed for the respective superstructure is sufficient (e.g. Table 3.6 for normal bodies).
(1) For models or wheelbases not included in the table, request assistance from the competent IVECO bodies.
S = Stabilisers must be fitted.
E = To be checked on a case–by–case basis. Send the technical documentation with the checks of stresses and stability to the appropriate IVECO bodies.
<table>
<thead>
<tr>
<th>Model</th>
<th>A x B x t (mm)</th>
<th>$R_{0,2}$ (Nm/mm²)</th>
<th>16</th>
<th>19</th>
<th>21</th>
<th>26</th>
<th>31</th>
<th>36</th>
<th>46</th>
<th>57</th>
<th>89</th>
<th>105</th>
<th>119</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML60, ML65, ML75, ML80, ML85, ML90, ML100, ML100EL</td>
<td>172.5x65x6</td>
<td>240</td>
<td>35.7</td>
<td>39.4</td>
<td>44.2</td>
<td>43.5</td>
<td>46.8</td>
<td>52.6</td>
<td>56.4</td>
<td>(60.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>360</td>
<td>44.7</td>
<td>50.5</td>
<td>52.5</td>
<td>54.4</td>
<td>(58.3)</td>
<td>(60.1)</td>
<td>(67.1)</td>
<td>(74.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ML100EL, ML100</td>
<td>195.5x65x5</td>
<td>240</td>
<td>39.8</td>
<td>42.9</td>
<td>47.9</td>
<td>46.9</td>
<td>50.4</td>
<td>56.7</td>
<td>(60.5)</td>
<td>(65.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>360</td>
<td>48.7</td>
<td>56.3</td>
<td>(59.8)</td>
<td>(58.7)</td>
<td>(63.0)</td>
<td>(70.8)</td>
<td>(75.7)</td>
<td>(81.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ML100, ML100</td>
<td>195.5x65x5</td>
<td>240</td>
<td>41.3</td>
<td>46.5</td>
<td>50.9</td>
<td>49.9</td>
<td>53.5</td>
<td>60.2</td>
<td>64.0</td>
<td>(68.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>360</td>
<td>51.7</td>
<td>57.6</td>
<td>59.6</td>
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<td>(65.6)</td>
<td>(67.6)</td>
<td>(74.6)</td>
<td>(82.4)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>ML100, ML100, ML100, ML100EL, ML120EL</td>
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<td>240</td>
<td>45.2</td>
<td>49.6</td>
<td>55.2</td>
<td>53.9</td>
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<td>(68.7)</td>
<td>(73.2)</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>360</td>
<td>56.5</td>
<td>65.1</td>
<td>(69.1)</td>
<td>(67.4)</td>
<td>(72.2)</td>
<td>(81.0)</td>
<td>(85.9)</td>
<td>(91.5)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>ML120, ML130, ML150</td>
<td>240x70x5</td>
<td>240</td>
<td>60.1</td>
<td>65.4</td>
<td>72.6</td>
<td>70.3</td>
<td>75</td>
<td>83.9</td>
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<td></td>
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<td>75.1</td>
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<td>93.8</td>
<td>(104)</td>
<td>(109.7)</td>
<td>(113.4)</td>
<td></td>
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<tr>
<td>ML120, ML130, ML150</td>
<td>240x70x6</td>
<td>240</td>
<td>65.3</td>
<td>70.9</td>
<td>78.2</td>
<td>75.5</td>
<td>80.4</td>
<td>89.6</td>
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<td></td>
<td></td>
<td>360</td>
<td>81.7</td>
<td>93.0</td>
<td>97.7</td>
<td>94.4</td>
<td>(100.5)</td>
<td>(112)</td>
<td>(116.8)</td>
<td>(122.3)</td>
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<td></td>
</tr>
<tr>
<td>ML120, ML130, ML150</td>
<td>240x70x6.7</td>
<td>240</td>
<td>68.9</td>
<td>74.6</td>
<td>81.9</td>
<td>79.0</td>
<td>84.0</td>
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<td>(101.7)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>360</td>
<td>86.1</td>
<td>98.0</td>
<td>(102.4)</td>
<td>(98.9)</td>
<td>(105)</td>
<td>(116.7)</td>
<td>(121.4)</td>
<td>(127.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ML150</td>
<td>240x70x7.7</td>
<td>240</td>
<td>74.2</td>
<td>82.4</td>
<td>86.1</td>
<td>84.0</td>
<td>88.6</td>
<td>94.8</td>
<td>101.7</td>
<td>117.5</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>360</td>
<td>102.8</td>
<td>114.0</td>
<td>119.2</td>
<td>116.2</td>
<td>120.0</td>
<td>131.3</td>
<td>140.8</td>
<td>162.8</td>
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<td></td>
</tr>
<tr>
<td>ML180</td>
<td>262.5x80x6</td>
<td>240</td>
<td>59.1</td>
<td>64.4</td>
<td>70.4</td>
<td>68.0</td>
<td>72.5</td>
<td>80.4</td>
<td>84.0</td>
<td>88.4</td>
<td>109.3</td>
<td>115.9</td>
<td>116.8</td>
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<tr>
<td></td>
<td></td>
<td>360</td>
<td>77.6</td>
<td>85.8</td>
<td>92.4</td>
<td>89.2</td>
<td>95.2</td>
<td>105.5</td>
<td>110.3</td>
<td>116.1</td>
<td>(143.3)</td>
<td>(152.1)</td>
<td>(153.3)</td>
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<td>(157.4)</td>
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<td>67.4</td>
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<td>79.1</td>
<td>76.0</td>
<td>80.8</td>
<td>89.0</td>
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<td>(125.2)</td>
<td>125.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>360</td>
<td>88.4</td>
<td>97.0</td>
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<td>99.8</td>
<td>106.0</td>
<td>116.8</td>
<td>121.3</td>
<td>(126.9)</td>
<td>(155.5)</td>
<td>(164.3)</td>
<td>(165.0)</td>
</tr>
</tbody>
</table>

If the height of the subframe profile has to be reduced, using shear resistant connections between chassis and subframe, combined section profiles can be used, as shown in Table 3.18, instead of the C-profile, provided that the flange width and thickness are not less than the corresponding values of the profile indicated in the table. The above are general conditions which apply to the materials indicated in Table 3.16. To assess whether it is possible to use materials with higher mechanical specifications, it is necessary to check the total resistant moment of the chassis plus subframe.

**Table 3.17 – Installation of loading gates, maximum permitted bending moment (subframe fixing with shear–resistant plates)**

**Table 3.18 – Solutions with combined section reinforcing profiles (see Figure 3.29)**

<table>
<thead>
<tr>
<th>$R_{0.2}$ (Nm/mm²)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum reduction of height of profile (mm)</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>$L_{W}$ (see Figure 3.31)</td>
<td>0.50$L_{W}$</td>
<td>0.60$L_{W}$</td>
<td>0.80$L_{W}$</td>
<td>0.85$L_{W}$</td>
</tr>
<tr>
<td>$L_{H}$ (see Figure 3.31)</td>
<td>0.60$L_{H}$</td>
<td>0.65$L_{H}$</td>
<td>0.95$L_{H}$</td>
<td>1.00$L_{H}$</td>
</tr>
<tr>
<td>Example of combined profiles as alternative to a 250x80x8 (mm) C-profile</td>
<td>210x80x8</td>
<td>190x80x8</td>
<td>150x50x8+ angular element</td>
<td>130x50x8+ angular element</td>
</tr>
<tr>
<td>Effective height reduction (mm)</td>
<td>40</td>
<td>52</td>
<td>92</td>
<td>104</td>
</tr>
</tbody>
</table>

Fitting superstructures 3–51
3.15 Vehicles for Municipal, Fire-fighting and Special Services

The range of vehicles produced by IVECO includes special versions with characteristics that make them suitable for mounting specific bodies. If these vehicles are used for any purpose other than the intended use, IVECO shall confirm the different tolerances and characteristics (mass, performance).

Preparing municipal vehicles such as compactors, compressors or road sprinklers in many cases requires:

- Building a subframe which is particularly strong at the rear or elastic mountings at the front of the vehicle.
- Shortening the rear overhang of the chassis. When very short overhangs are required, the chassis may be shortened immediately behind the rear spring support (or after the anti-roll bar connection in the case of pneumatic suspension), keeping the cross member connection to the chassis intact.
- Placing the engine exhaust in a vertical position, behind the cab. In such cases adopt solutions similar to those adopted by IVECO (see Point 2.13).
- Rearranging the rear lights.

Do not use the reverse light switch fitted on IVECO gearboxes for functions requiring a high degree of reliability and safety (e.g. stopping engine when reversing, on vehicles fitted for household waste collection, with personnel standing on the rear boards).

3.16 Installation of Snow-removal Equipment on Front of Vehicle

The installation of snow removal equipment on the front of the vehicle, such as blades or plows, requires the use of suitable supporting structures and entails observance of the specifications contained in point 2.3 concerning the connection to the chassis.

Furthermore, all government requirements and regulations governing the application of this type of equipment must be observed.

Operation and possibility to use the original components located at vehicle front (e.g. towing hook, footboard to clean windscreen) must be safeguarded. Otherwise the company carrying out the modification must fit equivalent systems in compliance with the safety regulations and norms.

For most of our vehicles – if used for snow removal purposes at maximum speeds of 62 kph – an increase of the maximum permissible weight of the axle may be granted upon request.

The Manufacturer that carries out the installation must document and guarantee the observance of the requested new weight limit.
3.17 Winch Installation

The winch installation on the vehicle should be positioned on one of the following points:

- On frame front end (front installation)
- On vehicle frame, behind the cab
- Between vehicle frame side member, centred or displaced on one side.
- Sulla parte posteriore del telaio.

The installation should be performed so as not to interfere with operation of units and components of the vehicle, with respect to max. load limits allowed on axles and following the company directions.

Fixing of the winch unit and the relevant drive components should conform to directions reported at point 2.3, ensuring that the reinforced areas are not locally limited to the mounting area (see point 2.22) taking into consideration also the rope operations and in particular, its transverse component when the pulling action is running obliquely.

For the installation of the winch behind the cab a proper subframe will be designed to have dimensions and structure (stiffening cross member and braces) conforming to winch capacity.

We suggest choosing those equipped with hydraulic systems that can be operated through the hydraulic pumps already used for equipment previously installed on the vehicle (tiltable cargo body, crane etc.).

Should mechanical winches be mounted, the drive transmission will conform to the indications given at point 4.

For worm screw type winches, the power take-off system arrangement should take into account the low performance of such a drive system.

Electrical winches should be used for low power requirements and for short periods of use because of the limited capacities of battery and alternator. Follow strictly the safety rules, if any.
4 POWER TAKE-OFFS
<table>
<thead>
<tr>
<th>4</th>
<th>Power take-offs</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>General Specifications 4–5</td>
</tr>
<tr>
<td>4.2</td>
<td>Power Take–off from Gearbox 4–7</td>
</tr>
<tr>
<td>4.3</td>
<td>Power take–off from torque distributor 4–10</td>
</tr>
<tr>
<td>4.4</td>
<td>Power take–off from transmission 4–10</td>
</tr>
<tr>
<td>4.5</td>
<td>Power take off from engine 4–11</td>
</tr>
<tr>
<td>4.5.1</td>
<td>Take–off from the front part of the engine 4–11</td>
</tr>
<tr>
<td>4.5.2</td>
<td>Take–off from the rear part of the engine 4–13</td>
</tr>
<tr>
<td>4.6</td>
<td>Isochronous control of engine rate 4–14</td>
</tr>
</tbody>
</table>
Various types of power take-offs can be fitted to provide drive to command auxiliary units such as tippers, cranes, compressors, municipal vehicles, etc. Depending on the type of use and the performance level required, the application may be applied to:
- the gearbox (or torque distributor)
- transmission
- the front of the engine
- the rear of the engine (only for ML260E28K).

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 r.p.m. (below 1,000 r.p.m.) must be avoided to prevent irregular running.

The amount of power drawn off can be obtained using the following ratio:

\[
P(CV) = \frac{M \cdot n \cdot i}{7023} \quad \text{P(kW) = } \frac{M \cdot n \cdot i}{9550}
\]

- \( P \) = power drawn off
- \( n \) = engine rotation speed (r.p.m.)
- \( M_{\text{max}} \) = Maximum torque that can be drawn (Nm)
- \( i \) = gear ratio = PTO outlet revs / engine revs

**Type of utilization**

The values of the maximum torque that can be drawn \( M_{\text{max}} \) refer to continuous utilization (up to 60'). Any higher value for occasional utilization (less than 30') shall be agreed upon each time depending on the type of utilization.

In case of utilization of more than 60', you shall consider to reduce, if necessary, the values established depending on the conditions of use (engine cooling, gearbox, etc.).

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

To avoid overloading it may be necessary, in certain cases (e.g.: hydraulic pumps, compressors) to fit devices such as clutches or safety valves.
The kinematic forces of the transmission from the power take-off to the relevant apparatus should be carefully considered (angles, r.p.m., moment) during the design phase and the dynamic behaviour during operation in compliance with the transmission Manufacturer’s instructions should be respected. The dimensions should take into consideration the forces which might occur under maximum power and torque conditions.

To obtain a uniformity of kinetic forces angles of equal value, maximum of 7°, should be obtained at the extremities (see Figure 4.1). 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 different spatial inclinations ($\phi$), the variations in r.p.m. should be compensated for with the arrangement of the forks shown in Figure 4.2.

For transmissions employing multiple sections, the instructions given at point 2.8.8 should be followed.

**Figure 4.1**

![Solution Z](image1)

![Solution W](image2)

**Figure 4.2**

![Diagram](image3)
4.2 Power Take-off from Gearbox

According to the type of gearbox it is possible to draw power from the secondary shaft through flanges or keying devices located in the rear or side part of the gearbox.

The technical characteristics necessary are given in the documentation supplied upon request for the various gearboxes.

The types of power take-off and the torque values obtained with the ratio between the number of output revolutions and engine r.p.m. are shown in Table 4.1.

The values refer to the conditions indicated in the table.

Higher values for occasional use must be agreed upon as each occasion arises depending on the type of use.

Check the vehicle to ascertain whether it is possible to fit a power take-off suitable to its size.

The power take-off applied to the gearbox must only be used when the vehicle is stationary and must be engaged and disengaged when the clutch is disengaged to avoid excessive stress on the synchronisers during gear change. For special situations when the power take-off is used and the vehicle is moving the gear must not be changed.

For gearboxes equipped with a torque converter, the same power take-offs used for normal gearboxes are, as a rule, used. It should be carefully noted that, when the engine r.p.m. is below 60% of the max. value the converter will be in the phase of hydraulic r.p.m.; in this phase, depending on the absorbed power, the r.p.m. of the power take-off is subject to oscillation despite the fact that the engine r.p.m. is constant.

Direct Application of Pumps

When the application of pumps of other equipment is carried out directly from the power take-off, without the use of intermediate shafts and after checking that the size of the pump permits margins of safety with chassis and engine unit (cross member, transmission shaft etc.), the static and dynamic torques exerted by the mass of the pump and by the power take-off should be checked for compatibility with the resistance of the walls of the gearbox.

By way of an example, the moment due to the additional masses must not adopt values of over 3% approx. of the maximum engine torque.

Also, the value of added masses must be checked for the effects of inertia so as to avoid inducing resonance in the propulsion unit within the normal operating range of the engine.

Warning

- When employing power take-offs the torque values established in Table 4.1 should be respected.
- Transmission oil temperature must not exceed 120°C during prolonged use. Coolant temperature must not exceed 100°C.
- Not all types of power take-off available on the market are suitable for continuous use. When in use the specifications (working periods, pauses etc.) specific to the power take-off in question should be respected.
Table 4.1 – PTO on gearbox

<table>
<thead>
<tr>
<th>Gearbox</th>
<th>PTO opt</th>
<th>PTO</th>
<th>Mounting</th>
<th>Output</th>
<th>Direction of rotation (1)</th>
<th>ISO flange</th>
<th>Maximum torque Cmax (Nm)</th>
<th>i</th>
<th>Weight (kg)</th>
<th>Part number (KZ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2855.5</td>
<td>06384</td>
<td>1802</td>
<td>Rear</td>
<td>Rear</td>
<td>Anticlockwise</td>
<td>Pompa</td>
<td>295</td>
<td>0.73</td>
<td>8</td>
<td>8870618</td>
</tr>
<tr>
<td></td>
<td>06392</td>
<td>1602</td>
<td>Side</td>
<td>Rear</td>
<td>Clockwise</td>
<td>Pompa</td>
<td>295</td>
<td>1.03</td>
<td>13</td>
<td>8870969</td>
</tr>
<tr>
<td>2855.6</td>
<td>06393</td>
<td>1702</td>
<td>Rear</td>
<td>Rear</td>
<td>Anticlockwise</td>
<td>Pompa</td>
<td>215</td>
<td>1.41</td>
<td>17</td>
<td>8870981</td>
</tr>
<tr>
<td>2865.6</td>
<td>06384</td>
<td>1802</td>
<td>Rear</td>
<td>Rear</td>
<td>Anticlockwise</td>
<td>Pompa</td>
<td>295</td>
<td>0.56</td>
<td>8</td>
<td>8870615</td>
</tr>
<tr>
<td></td>
<td>06392</td>
<td>1603</td>
<td>Side</td>
<td>Rear</td>
<td>Clockwise</td>
<td>Pompa</td>
<td>265</td>
<td>1.05</td>
<td>13</td>
<td>8870972</td>
</tr>
<tr>
<td>FS05206B</td>
<td>06384</td>
<td>2266</td>
<td>Rear</td>
<td>Rear</td>
<td>Anticlockwise</td>
<td>Pompa</td>
<td>195</td>
<td>1.44</td>
<td>17</td>
<td>8870984</td>
</tr>
<tr>
<td>2870.9</td>
<td>06384</td>
<td>1802</td>
<td>Rear</td>
<td>Rear</td>
<td>Anticlockwise</td>
<td>Pompa</td>
<td>295</td>
<td>0.92</td>
<td>8</td>
<td>8870615</td>
</tr>
<tr>
<td></td>
<td>06392</td>
<td>1604</td>
<td>Side</td>
<td>Rear</td>
<td>Clockwise</td>
<td>Pompa</td>
<td>295</td>
<td>0.96</td>
<td>8</td>
<td>8870975</td>
</tr>
<tr>
<td>2895.9</td>
<td>06384</td>
<td>1802.4</td>
<td>Rear</td>
<td>Rear</td>
<td>Anticlockwise</td>
<td>Pompa</td>
<td>295</td>
<td>1.00</td>
<td>8</td>
<td>8870621</td>
</tr>
<tr>
<td></td>
<td>06392</td>
<td>1705</td>
<td>Side</td>
<td>Rear</td>
<td>Clockwise</td>
<td>Pompa</td>
<td>295</td>
<td>1.03</td>
<td>17</td>
<td>8870978</td>
</tr>
<tr>
<td></td>
<td>06393</td>
<td>1706</td>
<td>Side</td>
<td>Rear</td>
<td>Anticlockwise</td>
<td>Pompa</td>
<td>215</td>
<td>1.42</td>
<td>17</td>
<td>8870990</td>
</tr>
<tr>
<td>MD3060P</td>
<td>06392</td>
<td>17A1</td>
<td>Side</td>
<td>Rear</td>
<td>Anticlockwise</td>
<td>Pompa</td>
<td>600</td>
<td>0.93</td>
<td>20</td>
<td>504035601</td>
</tr>
</tbody>
</table>

(1) Looking at the PTO output from the front

Figure 4.3 – Position and output of PTO
**Transmission PTO data**

The following table shows the PTO types provided by ZF and Hydrocar.

Application of a PTO after production of the vehicle will mean that it is necessary to reprogram the BC (Body Controller), as well as requiring various modifications to the electrical and pneumatic systems. For this reason, before applying a PTO you should make sure you read the paragraph carefully.

This operation must be carried out following the instructions given in the IVECO manuals. MODUS stations only must be used (available at IVECO dealers and authorised IVECO workshops) providing data on the PTO used.

**Electrical system**

The vehicle’s system allows safe and reliable management of the power take–offs by connection of the PTO command switch to the 20 pin connector.

This connection is already present when the customer requests the optional PTO or optional 01483, set–up for fitter power take–offs. Should the PTO be installed after purchase, ask IVECO for assistance.

**Pneumatic system**

Take air from the auxilliers circuit to power the solenoid valve.
4.3 Power take-off from torque distributor

In vehicles with integral traction (4x4) the application power take-offs on the torque distributor is possible. The r.p.m. for this use may be chosen on the basis of the most suitable gear. Use is permitted only when the vehicle is stationary (distributor in neutral). The specification regarding the correct use are given in the Owner’s Manual supplied with the vehicle.

The available take-off values are given below:

Table 4.2

<table>
<thead>
<tr>
<th>Transfer box type</th>
<th>Optional PTO</th>
<th>Power take-off</th>
<th>Max. capacity (Nm)</th>
<th>Output type</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC 700</td>
<td>05291</td>
<td>500</td>
<td>flange ext. ∅ 90 mm</td>
<td>4 holes ∅ 8.1 mm</td>
</tr>
</tbody>
</table>

4.4 Power take-off from transmission

Authorisation to fit a power take-off on the transmission downstream of the gearbox will be issued after examination of the full documentation, which must be presented to IVECO.

The various 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 drive take-off may be operated only when the vehicle is stationary.
- The power take-off r.p.m. is tied to the gear selected. — The power take-off must be located immediately downstream of the gearbox. For vehicles with the transmission in two or more sections, the power take-off may also be applied at the site of the flexible support included between the first and second sections (respect the indications given in point 2.8.8).
- The angles of the transmission on the horizontal plane and vertical plane must be kept as close as possible to the original values.
- Masses and rigidity added to the transmission must not provoke a loss of balance or abnormal vibrations or damage to the organs of the drive transmission (from engine to axle) either during vehicle movement or during operation with the motor running.
- The power take-off must be anchored to the chassis with its own suspension.

As the transmission is is an important organ for the safety of the vehicle, modification to it must only be carried out by specialist companies approved by the supplier of the transmission.
4.5 Power take off from engine

In general the use of these power take-offs is planned for apparatus requiring a continuous power supply.

4.5.1 Take-off from the front part of the engine

The drive take-off from the front part of the crankshaft is obtained, for limited power values to be drawn off (e.g. conditioning group commands) by the drive belt transmission, the use of cardan shafts is normally reserved for take-offs of a greater magnitude (e.g. municipal use).

These uses, when not specifically planned, require complicated interventions to the front part of the vehicle, e.g. modifications to the radiator, cab, bumpers etc. Particular attention must therefore be paid:

− to the system composed of additional masses and relative rigidity which must be flexibly disengaged from the crankshaft with regard to the torsional and flexional effects;
− to the additional mass values and relative moments of inertia and to the distance from the centre of gravity of the masses from the centreline of the first main bearing which must be contained as much as possible;
− 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.

Table 4.3 shows the values to be referred to for the take-off.

In the front part of the engine there is a pulley with a 2-groove wheel that supplies force. The position and the size of the pulley are indicated in the following picture.

Figure 4.4

Pulley to obtain mechanical force.
Table 4.3 – PTO at front of engine

<table>
<thead>
<tr>
<th>Engine</th>
<th>Engine code</th>
<th>$n_{\text{max}}$</th>
<th>Maximum take-off power (Nm)</th>
<th>Maximum inertia moment (kgm²) (1)</th>
<th>Maximum bending moment (Nm) (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tector</td>
<td>E13, E15, E17</td>
<td>F4AE0481</td>
<td>2700</td>
<td>400</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>E18, E121, E24, E28</td>
<td>F4AE0681</td>
<td>2700</td>
<td>400</td>
<td>0.015</td>
</tr>
</tbody>
</table>

(1) Maximum inertia moment of rigidly added masses

(2) Maximum bending moment due to radial forces with respect to the axis of the first main bearing. Depending on the angular position which the resulting added radial forces form with the axis of the cylinders (zero is at top dead centre and clockwise rotation), the maximum bending moment can be multiplied by the factor shown in the table.

<table>
<thead>
<tr>
<th>Multiplication factor</th>
<th>Angular position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>225-15</td>
</tr>
<tr>
<td>2</td>
<td>15-60</td>
</tr>
<tr>
<td>3</td>
<td>60-105</td>
</tr>
<tr>
<td>4</td>
<td>105-145</td>
</tr>
<tr>
<td>3</td>
<td>165-210</td>
</tr>
<tr>
<td>2</td>
<td>210-225</td>
</tr>
</tbody>
</table>
4.5.2 Take–off from the rear part of the engine

On model ML260E28KE the IVECO Multipower power take–off is foreseen as an optional, fitted on the rear part of the engine and suitable to absorb power with the vehicle running and stopped (e.g. municipal vehicles, cement mixers, etc.).

The power take–off occurs through the engine flywheel and is separate from the clutch control. The main dimensional characteristics are given in Figure 4.6 while the technical characteristics are shown in Table 4.4.

Currently available is an option for a mechanical control with flanged output via coupling shaft. The engagement and disengagement must be carried out when the engine is stationary. A safety device prevents its use when the engine is running.

<table>
<thead>
<tr>
<th>Table 4.4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output rpm/engine rpm ratio</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>Weight</strong></td>
</tr>
<tr>
<td><strong>Optional PTO</strong></td>
</tr>
</tbody>
</table>
4.6 Isochronous control of engine rate

For power take-off applications, it is possible to adjust the engine r.p.m. during the power take-off phase. This occurs without a reduction in the engine r.p.m. during the take-off phase (isochronal regulation of the r.p.m.). The regulation is carried out via the "Cruise Control" switches as follows:

- On pressing the Resume button with the vehicle stopped, the engine rate automatically reverts to a pre-stored number of revs Nres.
- Through the commands "SET+ and SET−" it is possible to set the number of revolutions required.

Activating the "OFF" button or pressing the brake pedal, clutch pedal or engine brake, the control function of the engine is disengaged.

Figure 4.7

![Diagram showing isochronous control of engine rate with power and torque curves against RPM.](image-url)
For vehicles without Cruise Control, remove the jumper connecting pins 10 and 11 of the 20-pin connector (see chapter 5), fit an NC switch and then connect pins 10 and 9; the OFF function (for switching off Cruise Control and PTO) is obtained by opening the switch. To produce the SET+ and SET– functions, see chapter 5.

For power take-offs where it is necessary to set the values for \( N_{\text{res}} \) and \( N_{\text{SET,max}} \) and \( N_{\text{SET,min}} \) which are different from those already established (e.g. to avoid overrunning of the pump) the system permits the resetting of the control unit for the new values required.

The operation can be carried out by sending the control unit to the IVECO Service Network equipped with MODUS and supplying the following information:

- Type of vehicle; chassis N°
- Type of engine; Serial N°
- \( N_{\text{res}} \) (rpm) required
- \( N_{\text{SET,max}} \) (rpm) required
- \( N_{\text{SET,min}} \) (rpm) required

The system allows adjustment of \( N_{\text{res}} \) up to \( N_{\text{SET,max}} - 50 \) (rpm).

For further information, please see chapter 5.
5 SPECIFIC INFORMATION AND INSTRUCTIONS
Indicazioni e prescrizioni specifiche
### Specific information and instructions

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<td>5-27</td>
</tr>
</tbody>
</table>
Indicazioni e prescrizioni specifiche
5.1 Electronic system

The following shows the location of the electronic control units and connectors that can be installed on the vehicle.

Warning:
Devices or electrical circuits must not be connected directly to the control units described below. It is only possible to use the connectors listed in the following paragraphs

Figure 5.1

1. Connector for Side Marker Lamps
2. Control unit compartment (Body Controller, ABS, ECAS, Electric mirror ECU, DMI, 20 pin and 4 pin connector for MD3060P gearbox)
3. ICU (Interconnection control unit)
4. 5 pin connector
5. ISO couplings for trailer
5.2 Bodybuilder connectors

The various connectors that can be used by the fitter are described in detail in the following paragraphs. To use the fitter connectors, you must request spare part kit 2992273 comprising the female connectors, cable terminals and protective pads.

5.2.1 Behind the cab

20 pin connector

The main connector to be used by the fitter is a blue 20 pin connector.

It is located inside the cab, on the passenger side, in the electronic control unit compartment. The function of the terminals is described in Table 5.1.

Table 5.1 – Pinout of 20–way connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Cable No</th>
<th>D (mm²)</th>
<th>Maximum load</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5542</td>
<td>0.5</td>
<td>1 mA</td>
<td>Speed signal B7, from tachograph</td>
</tr>
<tr>
<td>2</td>
<td>7780</td>
<td>0.5</td>
<td>100 mA</td>
<td>Engine state, alternator L 24V with engine running</td>
</tr>
<tr>
<td>3</td>
<td>8000</td>
<td>1</td>
<td>5 A</td>
<td>24V with parking light ON</td>
</tr>
<tr>
<td>4</td>
<td>9907</td>
<td>0.5</td>
<td>200 mA</td>
<td>Ground with parking brake ON</td>
</tr>
<tr>
<td>5</td>
<td>8710</td>
<td></td>
<td>5 A</td>
<td>Ignition (15)</td>
</tr>
<tr>
<td></td>
<td>2286</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>7772</td>
<td>1</td>
<td>10 A</td>
<td>Direct battery (30)</td>
</tr>
<tr>
<td>7</td>
<td>8050</td>
<td>0.5</td>
<td>10 mA</td>
<td>Start engine; to activate, connect to pin 15</td>
</tr>
<tr>
<td>8</td>
<td>9906</td>
<td>0.5</td>
<td>10 mA</td>
<td>Stop engine; to activate, connect to pin 15</td>
</tr>
<tr>
<td>9</td>
<td>0000</td>
<td>1</td>
<td>10 A</td>
<td>Ground</td>
</tr>
<tr>
<td>10</td>
<td>8154</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>CC OFF ¹¹</td>
</tr>
<tr>
<td>11</td>
<td>8154</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>CC OFF ¹¹</td>
</tr>
<tr>
<td>12</td>
<td>8155</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>CC RESUME; to activate, connect to pin 9</td>
</tr>
<tr>
<td>13</td>
<td>8156</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>CCC SET−; to activate, connect to pin 9</td>
</tr>
<tr>
<td>14</td>
<td>8157</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>CC SET+; to activate, connect to pin 9</td>
</tr>
<tr>
<td>15</td>
<td>0150</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>Node W2</td>
</tr>
<tr>
<td>16</td>
<td>0169</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>PTO ground</td>
</tr>
<tr>
<td>17</td>
<td>0166</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>PTO1; to activate, connect to pin 16</td>
</tr>
<tr>
<td>18</td>
<td>0167</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>PTO2; to activate, connect to pin 16</td>
</tr>
<tr>
<td>19</td>
<td>0168</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>PTO3; to activate, connect to pin 16</td>
</tr>
<tr>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Not connected</td>
</tr>
</tbody>
</table>

¹¹ Pins 10 and 11 are joined by a jumper. For vehicles with Cruise Control, remove the jumper and fit an NC switch; the OFF function (for switching off CC and PTO) is obtained by opening the switch. For vehicles without CC, remove the jumper, fit an NC switch and then connect pins 10 and 9; the OFF function (for switching off CC and PTO) is obtained by opening the switch.
**Warning:**
The signal for starting / stopping the engine requires safety devices to be fitted so that these operations may be performed safely, both for the operator and for the people or property nearby.

Such devices must satisfy current legal requirements. It is the bodybuilder’s responsibility to identify and install the relevant safety devices (for example, parking brake on, gearbox in neutral etc), using solutions that guarantee that the function works correctly, and using components that are certified as reliable.

---

**4-pin connector for vehicles with MD3060P gearbox**

For vehicles fitted with an Allison automatic gearbox, a 4-pin connector is available, located in the electronic control unit compartment (passenger side).

---

**Table 5.2 – Pinout of 4-way connector**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Cable No.</th>
<th>D (mm²)</th>
<th>Maximum load</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>312 NO</td>
<td>1</td>
<td>10 mA</td>
<td>PTO ON</td>
</tr>
<tr>
<td>2</td>
<td>323 NO</td>
<td>1</td>
<td>10 mA</td>
<td>Gearbox in neutral, 24V in neutral</td>
</tr>
<tr>
<td>3</td>
<td>8353</td>
<td>1</td>
<td>10 mA</td>
<td>External gearbox in neutral</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Not connected</td>
</tr>
</tbody>
</table>
5.2.2 On chassis

5-pin connector

Table 5.3 – Pinout of 5-way connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Cable No.</th>
<th>D (mm²)</th>
<th>Maximum load</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7151</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>Node V2 (24V) 1)</td>
</tr>
<tr>
<td>2</td>
<td>5502</td>
<td>0.5</td>
<td>~ 10 mA</td>
<td>2nd speed limiter; to activate, connect to pin 1</td>
</tr>
<tr>
<td>3</td>
<td>2226</td>
<td>0.5</td>
<td>10 mA</td>
<td>Gearbox in reverse, 24V in reverse</td>
</tr>
<tr>
<td>4</td>
<td>5584</td>
<td>0.5</td>
<td>10 mA</td>
<td>Engine rpm signal</td>
</tr>
<tr>
<td>5</td>
<td>0150</td>
<td>0.5</td>
<td>10 mA</td>
<td>Gearbox in neutral, ground in neutral</td>
</tr>
</tbody>
</table>

1) use for connection to pin 2 only. Do not use for other applications

Figure 5.3

ISO coupling connectors for trailer, two 7 pole (optional 01473) or one 15 pole (optional 02085)

Figure 5.4
### Table 5.4 — Pinout of connector 72001

<table>
<thead>
<tr>
<th>Pin</th>
<th>Cable No</th>
<th>Maximum load</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0000</td>
<td></td>
<td>Earth</td>
</tr>
<tr>
<td>2</td>
<td>3331</td>
<td></td>
<td>Sidelights and outline marker lights – rear RHS</td>
</tr>
<tr>
<td>3</td>
<td>1180</td>
<td>—</td>
<td>Indicator lights – rear LHS for trailer</td>
</tr>
<tr>
<td>4</td>
<td>1117</td>
<td></td>
<td>Central control unit connection in cab</td>
</tr>
<tr>
<td>5</td>
<td>1185</td>
<td></td>
<td>Indicator lights – rear RHS for trailer</td>
</tr>
<tr>
<td>6</td>
<td>3332</td>
<td>Max 10A</td>
<td>Sidelights and outline marker lights – rear LHS</td>
</tr>
<tr>
<td>7</td>
<td>8890</td>
<td>—</td>
<td>Power supply for solenoid valve – trailer brakes</td>
</tr>
</tbody>
</table>

### Table 5.5 — Pinout connector 72001

<table>
<thead>
<tr>
<th>Pin</th>
<th>Cable No</th>
<th>Maximum load</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td></td>
<td>Ground</td>
</tr>
<tr>
<td>2</td>
<td>Free</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>2226</td>
<td>—</td>
<td>Reversing lights</td>
</tr>
<tr>
<td>4</td>
<td>8890</td>
<td>5 A</td>
<td>Ignition (15), connected directly with fuse No. 6 of the interconnection control unit</td>
</tr>
<tr>
<td>5</td>
<td>Free</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>6</td>
<td>Free</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>7</td>
<td>2283</td>
<td>—</td>
<td>Rear fog lights</td>
</tr>
</tbody>
</table>

or

### Table 5.6 — Pinout 72010 (15 pin)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Cable No</th>
<th>Maximum load</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1180</td>
<td></td>
<td>Indicator lights – rear LHS for trailer</td>
</tr>
<tr>
<td>2</td>
<td>1185</td>
<td></td>
<td>Indicator lights – rear RHS for trailer</td>
</tr>
<tr>
<td>3</td>
<td>2286</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>4</td>
<td>0000</td>
<td></td>
<td>Earth</td>
</tr>
<tr>
<td>5</td>
<td>3332</td>
<td></td>
<td>Sidelights and outline marker lights – rear LHS</td>
</tr>
<tr>
<td>6</td>
<td>3331</td>
<td></td>
<td>Sidelights and outline marker lights – rear RHS</td>
</tr>
<tr>
<td>7</td>
<td>1179</td>
<td></td>
<td>Trailer stop lights</td>
</tr>
<tr>
<td>8</td>
<td>2226</td>
<td></td>
<td>Reversing lights</td>
</tr>
<tr>
<td>9</td>
<td>free</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>10</td>
<td>free</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>11</td>
<td>free</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>12</td>
<td>free</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>13</td>
<td>free</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>14</td>
<td>free</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>15</td>
<td>free</td>
<td></td>
<td>—</td>
</tr>
</tbody>
</table>
Warning:
Operations which do not comply with the instructions specified by IVECO or made by non qualified personnel can cause severe damage to on-board systems, effect driving safety and good operation of the vehicle and cause considerable damage which is not covered by warranty.

5.3.1 Introduction

Two operations are required to operate a PTO:
1. Mechanical PTO engagement;
2. EDC mode to be associated to the PTO. See below for EDC mode definitions.

The expression "PTO active" indicates that the PTO is engaged and that one of the EDC modes is active.

Otherwise, it is said that the PTO is engaged only. Actions 1) and 2) can be carried out separately, in the sequence 1) – 2), or by means of a single control using the PTO switches on the central console in the cab (as explained below).

In general, the PTO can be engaged by an electrical control (operated by a solenoid valve).

Warning:
It is important to use the signals available on the bodybuilders connectors (e.g. parking brake applied, stationary vehicle signal, reverse gear not engaged) to ensure correct PTO management and avoid possible damage to the vehicle's mechanisms. These signals must exclusively be taken from the bodybuilders connections.
5.3.2 EDC 0 mode (run mode)

In normal operation, an intermediate rpm ratio can be activated to a speed of 20 km/h (important note: the speed regulator will trip at speeds exceeding 20 km/h). Press Resume on the steering wheel stalk unit to activate. A new intermediate rpm ratio can be stored by the driver by holding the Resume button pressed for longer (>5s). Consequently, no programming by IVECO Service is required.

The maximum number of revs that can be reached with SET+ is identical for all modes (EDC mode 0 and EDC modes 1, 2 and 3). The idle speed rate setting range is identical for all modes.

The settings indicated in the table below must not be modified for EDC mode 0 (run mode).

### Table 5.7

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resume/OFF</td>
<td>To switch the intermediate rpm ratio on/off. The intermediate rpm ratio is programmed by default at 900 rpm and can be changed by the driver.</td>
</tr>
<tr>
<td>SET+/SET−</td>
<td>To increase/decrease the intermediate rpm ratio.</td>
</tr>
<tr>
<td>Accelerator pedal</td>
<td>Active</td>
</tr>
<tr>
<td>Maximum rpm which can be reached with SET+ button or accelerator pedal</td>
<td>$N_{LL}^{(1)} + 2700$ rpm (2500 rpm for engines E28)</td>
</tr>
<tr>
<td>Output torque</td>
<td>Maximum specific vehicle torque</td>
</tr>
</tbody>
</table>
| Conditions for deactivating intermediate rpm ratio | – Operate brake or clutch pedal  
                              – Activate CC OFF  
                              – Operate engine brake  
                              – Operate retarder |

$^{(1)} N_{LL}$ N° revs when idling.

5.3.3 Configurable EDC 1, 2, 3 modes

IVECO Service can program three different, independent EDC mappings (engine operation settings) in the engine ECU (EDC). Obviously, the engine can only run according to one EDC mode at a time. The following priority order is used to solve this problem:

- EDC mode 3: high priority
- EDC mode 2: medium priority
- EDC mode 1: low priority
- EDC mode 0: driving mode

**Important:**
These priorities must be taken into account during reprogramming. Problems may arise if the sequence is not respected and the PTO wiring may need to be modified. Alternatively, the engine EDC ECU may need to be reconfigured, etc.
The parameters can only be programmed using a MODUS diagnosis station, available at IVECO Service stations.

### Table 5.8

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Possible values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max No. of revs Nmax (with engine not subjected to load)</td>
<td>NLL ÷ 2700 rpm min⁻¹ ² ³ (2500 rpm for E28 motors)</td>
</tr>
<tr>
<td>Maximum N° of revs that can be reached with SET+, NSET_max</td>
<td>NLL ÷ 2700 rpm min⁻¹ ² ³ (2500 rpm for E28 motors)</td>
</tr>
<tr>
<td>Engine revs increase per second with SET+</td>
<td>125 / 250 / 500 / 1000 U/s</td>
</tr>
<tr>
<td>Engine revs decrease per second with SET−</td>
<td>As above</td>
</tr>
<tr>
<td>Torque limitation ³</td>
<td>See Table</td>
</tr>
<tr>
<td>Runaway speed regulator gradient</td>
<td>~2 / ~1 / ~0.65 CV / rpm ³</td>
</tr>
<tr>
<td>Use of the CC buttons (Resume/OFF/SET+/SET−)</td>
<td>Enabled / disabled</td>
</tr>
<tr>
<td>Storing of intermediate speed rate</td>
<td>Fixed programming (MODUS)/free programming (driver)</td>
</tr>
<tr>
<td>TIP function, for SET+/SET− ⁴</td>
<td>Enabled / disabled</td>
</tr>
<tr>
<td>Exclusion of EDC mode using brake or clutch ⁵</td>
<td>Enabled / disabled</td>
</tr>
<tr>
<td>Accelerator pedal</td>
<td>Enabled / disabled</td>
</tr>
<tr>
<td>Call-up intermediate speed rate stored with Resume on enabling EDC ⁷</td>
<td>Enabled / disabled</td>
</tr>
<tr>
<td>Minimum N° of revs that can be reached with SET−, NSET_min</td>
<td>&gt; 500 rpm</td>
</tr>
<tr>
<td>Exclusion of EDC mode using parking brake ⁶</td>
<td>Enabled / disabled</td>
</tr>
<tr>
<td>Maximum speed of the vehicle, above which EDC mode is enabled (intermediate speed rate VZDR_max)</td>
<td>between 2 km/h and 95 km/h</td>
</tr>
<tr>
<td>Possible power take-off rate range ¹</td>
<td>NLL ÷ 2700 rpm min⁻¹ ²</td>
</tr>
</tbody>
</table>

1) The reference speed is that of the crankshaft, not the PTO. The corresponding PTO rpm must be calculated by means of the PTO reduction ratio.

2) The following rules refer to intermediate rpm ratio adjustment:
   - Never drop under the NLL value.
   - Never exceed the Nmax value.
   - In general NLL = NSET_min = N res and N res = NSET_max = Nmax. If the latter is not true, the engine rpm is limited to Nmax.

3) See para. 5.3.3.1.

4) The TIP function (i.e. brief pressure on SET+/SET− toggle button for <0.5 s) is used to gradually vary the intermediate rpm regulator and the speed regulator. The intermediate rpm regulator will be activated at speed <25 km/h; the speed regulator will be activated at speed > 20 km/h. The speed variation of the intermediate rpm regulator steps are equal to 25 rpm for tip, which corresponds to 1 km/h for the speed regulator.

5) Active: the power take off mode is disengaged when the service brake or the clutch pedals are pressed. In PTO mode 0, the power take off mode is disengaged when the service brake or the clutch pedals are pressed.

6) Active: the power take off mode is disengaged when the parking brake or the clutch pedals are pressed. In PTO mode 0, the power take off mode is not disengaged when the parking brake is engaged.

7) Active: the engine remains at the previous rate, to reach the value Nres it is necessary to press the Resume button (pin 9 and 12 on the 20 pin connector).
5.3.3.1 Changing the torque curve, maximum rpm and the overrun regulator curve gradient

The following can be limited to mechanically protect the PTO:

- Maximum engine torque to protect against overloading (horizontal section of the curve in Figure 5.5), as shown in Table 5.9.

### Table 5.9 – Torque limitation for PTO 1, 2, 3 for Modus

<table>
<thead>
<tr>
<th>POWER</th>
<th>POWER</th>
<th>POWER</th>
<th>POWER</th>
<th>POWER</th>
<th>POWER</th>
<th>POWER</th>
<th>POWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>95 kW</td>
<td>110 kW</td>
<td>125 kW</td>
<td>134 kW</td>
<td>154 kW</td>
<td>176 kW</td>
<td>202 kW</td>
<td></td>
</tr>
<tr>
<td>(129 HP)</td>
<td>(150 HP)</td>
<td>(170 HP)</td>
<td>(182 HP)</td>
<td>(210 HP)</td>
<td>(240 HP)</td>
<td>(275 HP)</td>
<td></td>
</tr>
<tr>
<td>rpm</td>
<td>rpm</td>
<td>rpm</td>
<td>rpm</td>
<td>rpm</td>
<td>rpm</td>
<td>rpm</td>
<td>rpm</td>
</tr>
<tr>
<td>2700</td>
<td>2700</td>
<td>2700</td>
<td>2700</td>
<td>2700</td>
<td>2700</td>
<td>2500</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TORQUE rpm</th>
<th>430 Nm (44kgm)</th>
<th>490 Nm (50kgm)</th>
<th>560 Nm (57kgm)</th>
<th>570 Nm (58kgm)</th>
<th>680 Nm (69kgm)</th>
<th>810 Nm (82kgm)</th>
<th>930 Nm (94kgm)</th>
</tr>
</thead>
</table>

### Values that can be set with MODUS

- **1 level**
  - 200 Nm
  - 200 Nm
  - 200 Nm
  - 200 Nm
  - 250 Nm
  - 250 Nm
  - 250 Nm

- **2 level**
  - 250 Nm
  - 250 Nm
  - 300 Nm
  - 300 Nm
  - 400 Nm
  - 400 Nm
  - 450 Nm

- **3 level**
  - 300 Nm
  - 300 Nm
  - 400 Nm
  - 400 Nm
  - 500 Nm
  - 600 Nm
  - 600 Nm

- **4 level**
  - 350 Nm
  - 400 Nm
  - 500 Nm
  - 500 Nm
  - 600 Nm
  - 750 Nm
  - 800 Nm

- Maximum engine rpm to protect against overrun (slanted section of curve in Figure 5.5). This limitation is called "runaway regulator".

These limitations (maximum torque, intersection point, curve gradient) can be selected independently of each other. The combination of limitations is recommended. In this case, according to the envisaged PTO use, bodybuilders shall select the engine ratio limit (intersection point X) which must be made available to the selected torque.

The overrun regulator trips when the engine ratio exceeds the intersection point X. Note that the reference speed is that of the crankshaft, not the PTO. The corresponding PTO rpm must be calculated by means of the PTO reduction ratio.

### Figure 5.5

[Diagram showing the torque curves, maximum torque, rpm, and overrun regulator curve gradient.]
Look at the example in Figure 5.5:
- Maximum engine torque 600 Nm.
- The standard operation of the PTO is 900 rpm.
- The engine rpm must not exceed 1100 rpm.
- The rpm must be determined for all of the overrun regulator slope.

The slope of the curve for the overrun regulator depends on the particular use of the vehicle. For this reason, when stationary, it is generally sufficient for the overrun regulator to have a steep curve, whereas for the “driving” mode, this might give rise to rapid changes in load, which may cause problems.

Power is 1100 rpm and torque is equal to 600 Nm i.e.:

\[
P = \frac{(600 \text{Nm} \times 1100 \text{rpm})}{9550} = 69\text{KW} = 94\text{CV}
\]

- The available rpm at 600 Nm can be calculated using a steeper overrun regulator (curve C; gradient 2CV/rpm):
  \[
  1100 \text{ rpm} - \left(\frac{94\text{CV}}{2\text{CV/rpm}}\right) = 1100 \text{ rpm} - 47 \text{ rpm} = 1053 \text{ rpm}
  \]
- The available rpm at 600 Nm can be calculated by using an intermediate overrun regulator (curve B; gradient 1CV/rpm):
  \[
  1100 \text{ rpm} - \left(\frac{94\text{CV}}{1\text{CV/rpm}}\right) = 1100 \text{ rpm} - 94 \text{ rpm} = 1006 \text{ rpm}
  \]
- The available rpm at 600 Nm can be calculated by using a flat overrun regulator (curve A; gradient 0.65CV/rpm):
  \[
  1100 \text{ rpm} - \left(\frac{94\text{CV}}{0.65\text{CV/rpm}}\right) = 1100 \text{ rpm} - 145 \text{ rpm} = 955 \text{ rpm}
  \]

So, based on the example above, the number of intermediate revs, Nres, should be set to 900 rpm. This will then be activated automatically when the power take off mode is selected. From the example, we see the influence of the overrun regulator. Depending on the usage, the chosen torque of 600 Nm is available up to 1055 rpm, 1005 rpm or 955 rpm.

The same is true in reverse. When the engine torque, the intersection point X and the steepness of the overrun regulator are predetermined, it is possible to calculate the number of revs of the end speed.

**Application warning:**
The maximum rpm \(N_{\text{max}}\) is a theoretical value. This is the rpm at which the ECU reduces the injected amount of fuel at 0 mg/stroke. Considering that all engines, according to the rpm (engine hot and no load) need 20–30 mg/stroke of fuel to maintain the rpm, this theoretical value \(N_{\text{max}}\) is never reached. According to the slope of the overrun regulator, the rpm actually reached is 10–40 rpm lower. You are advised to define overrun ratio by means of practical tests if this is likely to effect the application.

### 5.3.4 Intermediate rpm regulator

**Maximum intermediate rpm regulator setting that can be achieved with SET+, \(N_{\text{SET,max}}\)**

The maximum intermediate rpm regulator (CC) setting that can be achieved with SET+ (CC) can be configured. This limit is identical for all EDC modes (driving mode 0, PTO modes 1, 2 and 3).
Intermediate rpm regulator priority

The maximum rpm \( N_{\text{max}} \) (driving mode 0, EDC modes 1, 2 and 3) has a higher priority than the maximum rpm \( N_{\text{SET, max}} \) which can be achieved with SET+ as well as the stored rpm \( N_{\text{res}} \).

\( N_{\text{max}} \) can be programmed according to the bodybuilders requirements under EDC modes 1, 2 and 3. The intermediate rpm \( N_{\text{res}} \) stored under the respective modes must be either lower than or equal to the maximum rpm \( N_{\text{SET, max}} \) which can be achieved with the SET+ button.

TIP function

The TIP function, i.e. brief pressure (<0.5s) of the SET+/SET− buttons, is used to gradually change the intermediate rpm and speed regulator. The intermediate rpm regulator will be activated at speed <25 km/h; the speed regulator will be activated at speed > 25 km/h. The speed variation of the intermediate rpm regulator steps are equal to 20 rpm for tip, which corresponds to 1 km/h for the speed regulator.

The intermediate rpm or speed value is modified continuously by pressing the SET+ and SET− buttons for more than 0.5s. The effective rpm and effective speed when the SET+ and SET− buttons are released and stored as the new value.

The TIP with buttons SET+ and SET− can be deactivated. This configuration is valid for all EDC modes at the same time (driving mode 0, EDC modes 1, 2 and 3). TIP function deactivation functionally limits the speed regulator. Consequently, this change should be carefully evaluated before being implemented.

Note: this function is provided for the regulation of hydraulic units.

Increasing/decreasing rpm with SET+/SET−

The intermediate rpm regulator value can be changed by pressing the SET+/SET− buttons for more than 0.5s or when the TIP function is deactivated by a certain speed (engine rpm increase/decrease per second). The time interval for this change can be calculated using the following formula:

\[
\text{Time required [s]} = \frac{\text{Rpm difference [rpm/s]}}{\text{rpm increase per second [rpm/s/s]}}
\]

Example: take the intermediate rpm from 800 rpm to 1800 rpm using the SET+ button.

The difference in rpm is equal to 1000 rpm, consequently:

- At a speed of 125 rpm/s, the time interval is 1000/125 = 8s
- At a speed of 250 rpm/s, the time interval is 1000/250 = 4s
- At a speed of 500 rpm/s, the time interval is 1000/500 = 2s
- At a speed of 1000 rpm/s, the time interval is 1000/1000 = 1s

Activating/deactivating the accelerator pedal

The accelerator pedal is always active in normal driving mode (EDC mode 0). The accelerator pedal can be deactivated in EDC modes 1, 2 or 3. In this case, EDC engine regulation will ignore the accelerator pedal. If the accelerator pedal is active, the engine rpm can be increased by means of the pedal to the maximum rpm \( N_{\text{max}} \) valid at the time.
### 5.3.5 Standard configurations

The default settings are shown in the table.

**Table 5.10**

<table>
<thead>
<tr>
<th>EDC mode</th>
<th>Mode 0</th>
<th>Mode 1</th>
<th>Mode 2</th>
<th>Mode 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enabled using 20 pin connector</td>
<td>No enabling is required</td>
<td>Pin 17 and 16 connected</td>
<td>Pin 18 and 16 connected</td>
<td>Pin 19 and 16 connected</td>
</tr>
<tr>
<td>Max torque</td>
<td>Maximum engine torque</td>
<td>Maximum engine torque</td>
<td>Maximum engine torque</td>
<td>Maximum engine torque</td>
</tr>
<tr>
<td>Maximum N° of revs that can be reached with SET+, NSET_max</td>
<td>2700 rpm (2500 rpm per motori E28)</td>
<td>1800rpm</td>
<td>1700rpm</td>
<td>1900rpm</td>
</tr>
<tr>
<td>Minimum N° of revs that can be reached with SET−, NSET_min</td>
<td>700 rpm</td>
<td>800rpm</td>
<td>1050rpm</td>
<td>700rpm</td>
</tr>
<tr>
<td>Minimum N° of revs that can be reached with SET−, NSET_min</td>
<td>2700 rpm (2500 rpm for E28 engines)</td>
<td>1800rpm</td>
<td>2700 rpm (2500 EDC mode)</td>
<td>–</td>
</tr>
<tr>
<td>Runaway speed regulator gradient</td>
<td>Dependent on nominal curve</td>
<td>~1CV/rpm</td>
<td>~1CV/rpm</td>
<td>~1CV/rpm</td>
</tr>
<tr>
<td>Increase/decrease in engine revs per second with SET+/SET−</td>
<td>250rpm/s</td>
<td>250rpm/s</td>
<td>250rpm/s</td>
<td>250rpm/s</td>
</tr>
<tr>
<td>N° revs stored, Nres</td>
<td>Active</td>
<td>Active</td>
<td>Active</td>
<td>Disabled</td>
</tr>
<tr>
<td>&quot;TIP&quot; function for SET+/SET−</td>
<td>Active</td>
<td>Active</td>
<td>Active</td>
<td>Active</td>
</tr>
<tr>
<td>Maximum speed of the vehicle, above which EDC mode is disabled, VZDR_max</td>
<td>900 rpm</td>
<td>1100 rpm</td>
<td>1300 rpm</td>
<td>1450 rpm</td>
</tr>
<tr>
<td>&quot;TIP&quot; function for SET+/SET−</td>
<td>Active</td>
<td>Active</td>
<td>Active</td>
<td>Active</td>
</tr>
<tr>
<td>Maximum speed of the vehicle, above which EDC mode is disabled, VZDR_max</td>
<td>25km/h</td>
<td>30km/h</td>
<td>30km/h</td>
<td>0km/h</td>
</tr>
<tr>
<td>Exclusion of EDC mode using brake or clutch</td>
<td>Active</td>
<td>Disabled</td>
<td>Disabled</td>
<td>Active</td>
</tr>
<tr>
<td>Call-up intermediate speed regime stored on enabling EDC mode</td>
<td>Active</td>
<td>Disabled</td>
<td>Disabled</td>
<td>Disabled</td>
</tr>
<tr>
<td>Exclusion of EDC mode (using parking brake)</td>
<td>Disabled</td>
<td>Disabled</td>
<td>Disabled</td>
<td>Active</td>
</tr>
</tbody>
</table>
5.3.6 **Indicazioni specifiche**: correlation between the EDC configuration and the installed power take offs

There is no direct connection between the EDC power take off mode (which can be activated using the 20-pin connector) and the power take offs physically fitted to the vehicle. Therefore, the bodybuilder can define the necessary connections as suits him.

This setup therefore makes it possible to use the power take off(s) with the various EDC configurations (for example, for particular work cycles). Should a work cycle be established, for example, in which the fitted power take off is made to operate in different conditions, then up to a maximum of 3 modes for the EDC power take off can be used. The corresponding EDC power take off modes must be activated from the body/ancillary at the relevant times.

In a similar way, it is possible to correlate an EDC power take off mode even without there being a power take off physically fitted to the vehicle, or conversely when there is more than one fitted.

5.3.7 **Engaging the power take off**

The power take-offs fitted on the gearbox can only be engaged with the clutch fully pressed. The EDC mode power take-offs, on the other hand, can be enabled independent of the above.

**With Allison Gearbox**

When the vehicle has an Allison gearbox, the selection of the power take off is co-ordinated by the gearbox central control unit. The operation uses the following procedure:

- request to engage the power take off (the gearbox central control unit checks the internal conditions so that the operation can be effected safely: engine speed less than 900 rpm and output speed from the gearbox less than 250 rpm);
- the solenoid valve used to engage the power take off is activated by the central control unit;
- if the power take off and handbrake are engaged at the same time, the gearbox is automatically put into neutral, and EDC power take off mode 2 is activated;
  (a relay is supplied with power, located at: the relay plate on the gearbox central control unit, found on the rear wall of the cab);
- a check is made that the power take off is functioning safely (output speed from the gearbox less than 300 rpm).

The button for engaging the power take off is located in the central section of the dashboard.

**Before engaging the power take off, the gearbox central control unit checks a number of parameters (engine speed is less than 900 rpm and output speed from the gearbox is less than 250 rpm). If all the necessary conditions inside the gearbox are satisfied, the Allison gearbox central control unit automatically engages the power take off. The restrictions (end speed, maximum torque etc) for the EDC power take off mode selected therefore remain valid even while the engagement takes place. Certain values may be modified by Allison Customer Assistance, as required by the bodybuilder.**
Use of the power take-off with vehicle in motion

If restrictions are not required (e.g., restrictions on torque, reduced maximum number of engine revs, etc) when the power take-off is engaged, it is not necessary to use any EDC power take-off mode. In this case, however, the engine power available for running the vehicle is reduced (given that power is being taken simultaneously by the ancillary). This could lead to acceleration problems. In typical usages (e.g., cement mixers, refuse collection vehicles, etc) this problem can be minimised by increasing the idling speed. This increased number of revs would, however, also then be present even when the power take-off was disengaged. In general, a reduction in the maximum torque in this field of operation would not be considered sensible.

If, however, restrictions are required (e.g., restrictions on torque, reduced maximum number of engine revs, etc) then an EDC power take-off mode should be used.

**Warning:** Particularly when the vehicle is operational, care must be taken to ensure that if an EDC power take-off mode is activated, then the stored intermediate number of revs must also be activated at the same time. This could, however, result in an unexpected increase in vehicle speed. It is the bodybuilder's responsibility to ensure that the chosen solution is safe.

The engagement or disengagement of the power take-off depends both on the power take-off chosen and the requirements of the bodybuilder.

Regarding vehicle operation (up to a maximum speed of 25 km/h) with an increased number of revs when the power take-off is engaged. For a range of applications, (e.g., use of a tipping body, cement mixer, refuse collection etc) higher revs are also required during operation. This can be achieved using the following set up:

- Stored intermediate number of revs Nres: fixed programming
- Intermediate number of revs (Nres): as defined by the bodybuilder
- Disengagement of the intermediate number of revs: deactivated via the clutch or brake pedals
- Accelerator pedal: activated
- CC Buttons: deactivated

In this way, the engine can only operate again when the accelerator pedal is regulated between the stored intermediate number of revs, Nres, and the maximum number of revs, Nmax. If VZDR–aus is ever reached, the intermediate number of revs and therefore also the increase in revs is deactivated.

**Changing the stored intermediate number of revs Nres**

The intermediate number of revs can be modified separately for each EDC power take-off mode.

It is necessary to distinguish between two possibilities:

1. Fixed programming (MODUS)
   For power take-off mode 0 (driving mode), this option is not available. Modification is only possible if IVECO Service re-programmes the device using MODUS.

2. Free programming (by the driver)
   To modify the intermediate number of revs, the following procedure is used:
   a) select the particular EDC power take-off mode whose intermediate number of revs are to be
   b) set the desired intermediate number of revs using the SET+/SET− button;
   c) press CC Resume for more than 5 seconds.
Adjustment of the minimum number of revs that can be reached with SET–, NSET_min

The idling speed must only be set when the engine is warm. There are three stages in the process:

1) **Idle running actuation**

The engine must operate at idling speed.
- Actuate the service brake (until the end of adjustment)
- Press the Resume button for more than 3 seconds (and then release)
  Immediately afterwards, the idling speed reduces automatically to the minimum value.

2) **Modifying the minimum idling speed**

It is possible to regulate the idling speed by intervals of 20 min\(^{-1}\) using the SET+ or SET– buttons.

3) **Recording the minimum idling speed (in revs)**

The speed is stored by pressing the CC Resume button again (for more than 3 seconds).

![Warning: The idling speed can only be adjusted in the various EDC power take off modes which are used to activate the CC buttons, otherwise the regulation of the number of intermediate revs is disengaged using the brake or clutch.]

The adjusted interval for the idling speed, set at the factory, is 100 rpm. IVECO Service can increase this interval to 200 rpm. The adjusted interval for the idling speed is identical for all power take off modes (drive mode 0 or power take off modes 1, 2 and 3).

**Influence of the retarder on the intermediate number of revs**

The engagement of the retarder causes the intermediate number of revs regulator to be deactivated (this has the identical effect as pressing the CC Off button). All the CC buttons (CC Resume / SET+ / SET–) are ignored when the retarder is engaged.

![Warning: The regulator for the intermediate number of revs will not be deactivated if the retarder is engaged when the following combination occurs: “intermediate number of revs deactivated through either the brake or clutch = deactivated” and the “intermediate number of revs is lower than 900 rpm”. When the retarder is activated, the engine speed is instead lowered to the idling speed and all the CC buttons (CC Resume / SET+ / SET–) are ignored. Once the retarder has then been disengaged, the original number of revs will be restored.]


**Influence of the exhaust brake on the intermediate number of revs**

The engine brake can be activated by:
1. Pressing the engine brake pedal (on the cab’s floor).
2. Pressing the brake pedal (when the brake is pressed the engine brake is automatically activated).
3. Pressing the accelerator pedal (at idling speed the engine brake is automatically activated).

Selections can be made by means of a switch placed on the dashboard. If the engine brake is activated in any manner as described above (2 or 3) the governor deactivates automatically. When the engine brake pedal is pressed, the CC push button functions (CC OFF/Resume/SET+/SET−) are disabled.

**Simultaneous operation of SET+ and SET−**

These functions are mutually exclusive. Should both be activated simultaneously, then for safety reasons the CC Off button is activated immediately or after 500 ms. If, however, the buttons were pressed simultaneously, the engine’s EDC central control unit recognises an error after 500 ms (EDC error 1.3, control device).

**Second speed limiter**

This function can be activated independently of the various EDC power take off modes (driving mode 0, power take off modes 1, 2 and 3). IVECO Service can set the value using a MODUS station. The second speed limiter is activated using a closed contact between pins 1 and 2 of the 5-pin connector.
When installing anti-theft devices you must observe the following precautions and instructions.

**Type of anti-theft device:**

IVECO recommends you use products that comply with the requirements requested and approved by recognized bodies such as ANIA, TÜV, UTAC, MIRRC (Thatcham), etc. Likewise, follow the instructions given in the Specifications issued by specialized Quality Institutions (e.g. IMQ) at the request of Insurance Companies. They provide information, requirements, performance of components and systems, as well as conformity criteria.

**Installation**

The control devices must be positioned so they will not accidentally trigger while the vehicle is travelling so as to avoid the hazard of it suddenly stopping. If additional circuit breakers are installed to stop the vehicle from starting, in order to prevent them accidentally triggering while the vehicle is travelling (with the above-mentioned consequences), it is recommended to:

- Use suitable components to withstand vibration, changes in temperature, etc.
- Make the installation in areas protected against accidental bumps caused by persons and/or property.

Installation must be made in compliance with IVECO instructions as regards the system (see point 2.15) and the place of use (e.g. max temperatures).

Fitting anti-theft systems must not alter the functioning of systems and components such as ABS, Tachograph, etc.

The anti-theft system must not be connected to or interface with the EDC system other than as instructed by IVECO.

Electrical connections either before or after the EDC control unit is strictly prohibited.
5.5 Predisposition for loading gate – opt 4113

Vehicles with optional 4113 are equipped with specific wiring between the dashboard and the receptacle and a switch on the instrument panel. When the switch is operated, the electric circuit connected to the loading gate is closed. At the same time, a warning light illuminates on the dashboard and the engine cannot be started until the switch is operated again. To complete the electric wiring to the loading gate, refer to the diagram below.

It is recommended that the above be used in conjunction with optional 6229, kit for loading gate fixing.

Figure 5.6 – Basic wiring diagram for vehicles with loading gate
5.6 Predisposition for loading gate + 2nd ECAS remote control – opt 4115

For vehicles with pneumatic suspension (/P and /FP), it is possible to order optional 4115, 2nd ECAS remote control (in addition to the standard remote control). The optional consists of specific wiring and of the 2nd remote control, which can be connected near the loading gate.
Optional 4115 is available exclusively in conjunction with optional 4113 (predisposition for loading gate, see previous paragraph).
When you operate the switch for activating the loading gate, the standard ECAS remote control is disabled and the second remote control is enabled. Operating the switch again restores the original state.

Figure 5.7 – Basic wiring diagram for vehicles with opt 4115

5.7 Switch for reverse gear engaged indicator

Do not use the switch fitted on IVECO gearboxes for the reverse gear engaged indicator, for functions for which a high level of reliability and safety is required (e.g. engine stop during reversing, on vehicles fitted out for refuse collection, with personnel on the footboard).
Optional 5626, DMI (Data Management Interface) is available on all new EuroCargo models. The DMI is an electronic control unit located in the control unit compartment in the cab (passenger side), under the fuse box and is connected to a further three control units by a CAN line (according to SAE 1939/11 Physical Layer 250 kb/s). The output signals can be acquired by means of the 20-pin I/O connector. The availability of information depends on the configuration of the vehicle, i.e. on the ECUs and options present. It is also possible to connect the DMI to an on-board computer to acquire and process data in real time directly via a CAN line, according to the FMS Standard.

The DMI can be used by:

1) Bodybuilders.

The black 20-pin I/O connector is located in the control unit compartment. To pick up the signals, use the female connector already fitted and the following terminals:

<table>
<thead>
<tr>
<th>Part number</th>
<th>Wire cross section area (mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500314820EZ</td>
<td>0.3-0.5</td>
</tr>
<tr>
<td>500314821EZ</td>
<td>1-1.5</td>
</tr>
</tbody>
</table>

By means of the I/O connector it is possible to have 4 grounds on pins 10, 17, 19 and 20, when the conditions set out in the table are met (the figure refers to the rear face of the connector):

<table>
<thead>
<tr>
<th>Pin</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CAN_H</td>
</tr>
<tr>
<td>2</td>
<td>CAN_L</td>
</tr>
<tr>
<td>10</td>
<td>Gearbox in neutral and parking brake ON</td>
</tr>
<tr>
<td>17</td>
<td>Engine running</td>
</tr>
<tr>
<td>19</td>
<td>Brake pedal pressed</td>
</tr>
<tr>
<td>20</td>
<td>Clutch pedal pressed</td>
</tr>
</tbody>
</table>

2) Fleet management system.

The data, transmitted according to the FMS standard (visit www.fms-standards.com), can be acquired in real time by an on-board computer.

As a result of processing the data, it is possible:

- to obtain information about the operating conditions of the vehicle (times, distances, fuel consumption, etc.);
- analyse the operating conditions of the engine and the use of the braking system;
- analyse the distribution of the distances travelled, speed, frequency of stops and starts.

The installation of the on-board computer, hardware and software for data processing and management is the task of the ICT installer.
**After-market fitting**

For after-market fitting of the DMI, order the following components:

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>504091965KB</td>
<td>Cable in cab</td>
</tr>
<tr>
<td>504085516EB</td>
<td>DMI ECU</td>
</tr>
</tbody>
</table>

On left-hand drive vehicles, the DMI must be installed in the control unit compartment according to the following diagram:

**Figure 5.8**

![Diagram of left-hand drive vehicle](image)

On right-hand drive vehicles, the DMI must be installed in the control unit compartment according to the following diagram:

**Figure 5.9**

![Diagram of right-hand drive vehicle](image)

A ABS  
B DMI  
C ECAS  
D Electric mirror ECU
Connect the cable 504091965KB according to the following basic diagram:

---

**Figure 5.10**

---

### 5.9 Operating the hazard lights from outside the cab

Two possible equivalent solutions are shown below: the first refers to working upstream and the second to working downstream of the IBC.

**Solution 1:** simulate the closure of the hazard lights key (unstable) as follows: press once to activate the flashing sequence, press again to deactivate it. Duration of pressing 50 – 100 ms.

**Figure 5.11**

---

**Solution 2:** act directly on the bulbs, by disconnecting (with the diodes) the body from the additional circuit.

**Figure 5.12**

---
In order to change the wheelbase or chassis frame overhang, the following sections are available from IVECO Spare Parts:

Table 5.12

<table>
<thead>
<tr>
<th>Models</th>
<th>Dimensions (mm)</th>
<th>Length (mm)</th>
<th>Part Nr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EuroCargo</td>
<td>180,5x65x4</td>
<td>1500</td>
<td>1908966</td>
</tr>
<tr>
<td>EuroCargo</td>
<td>182,5x65x5</td>
<td>1500</td>
<td>1908967</td>
</tr>
<tr>
<td>EuroCargo</td>
<td>203x65x4</td>
<td>1500</td>
<td>1908964</td>
</tr>
<tr>
<td>EuroCargo</td>
<td>205x65x5</td>
<td>1500</td>
<td>1908965</td>
</tr>
<tr>
<td>EuroCargo</td>
<td>250x70x5</td>
<td>1500</td>
<td>1908962</td>
</tr>
<tr>
<td>EuroCargo</td>
<td>252x70x6</td>
<td>1500</td>
<td>1908963</td>
</tr>
<tr>
<td>EuroCargo</td>
<td>275,9x80x6,7</td>
<td>2000</td>
<td>1908958</td>
</tr>
<tr>
<td>EuroCargo</td>
<td>230,9x80x6,7</td>
<td>2000</td>
<td>1908959</td>
</tr>
<tr>
<td>EuroCargo</td>
<td>277,9x80x7,7</td>
<td>2000</td>
<td>1908960</td>
</tr>
<tr>
<td>EuroCargo</td>
<td>232,9x80x7,7</td>
<td>2000</td>
<td>1908961</td>
</tr>
</tbody>
</table>