

english version

**Guide for the Fitting
of Bodywork.**
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RENAULT V.I.

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GENERAL RULES FOR CONVERSIONS

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1. GENERAL FEATURES

1.1 Scope of liability

RENAULT V.I. vehicles are merchandized at the end of corroborated technical designwork and endurance testing, taking the various laws, regulations, standards... involved into consideration.

Modifications to a RENAULT vehicle for the fitting of bodywork and equipment should be carried out in accordance with the rules and recommendations set out in this bodywork fitting guide and require an "Agreement in Principle", issued by the Product Applications Department.

Guarantee and responsibility

Any intervening party is responsible for his services in terms of guarantee and responsibility, including any damage caused by his work and/or the equipment installed on-vehicle or the basic product.

In the event of RENAULT V.I. (or its network) being prime contractor for its own equipment (in relation to the end customer), the guarantee is considered as being at least that of the warranty offered by RENAULT V.I. to its customer.

Unless clearly specified otherwise in the order, the equipment warranty shall be negotiated directly between the end customer and the equipment manufacturer.

The meeting of recommendations contained in the present document can in no way be considered as relieving the equipment manufacturer's responsibility, but simply as complying with the basic rules for professional trade practice.

Any breach of these recommendations must be considered as shortcoming in respect of the rules and shall relieve RENAULT V.I. of its liability in the event of damage connected directly or indirectly to such non-compliance.

All the equipment is considered to comply with these recommendations and shall not require any acceptance testing upon delivery to check the conformity.

RENAULT V.I. guarantees non-modified original parts and components.

Interventions, conversions, adaptations of fittings carried out by the intervening party involves his responsibility, even if they are authorized administratively (Conversion appendix II).

Such conversions must not under any circumstance lead to any impairment of the quality or of the primary functions of the component elements of the vehicle (whether these elements are affected directly or not by the intervention).

Any modification, movement of position of constituent vehicle parts or elements must be covered by an "Agreement in Principle", issued by the RENAULT V.I. Product Applications Department.

For further information or assembly agreement, contact:

TO OBTAIN ANY INFORMATION OR APPROVAL OF MOUNTING, PLEASE CONTACT:

For France:
SERVICE TECHNICO-COMMERCIAL
RENAULT V.I.
API. COM 00A 238
69806 ST PRIEST CEDEX
Tel.: 04 72 96 68 14
Telex: 300 265 UDCF +
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Product Applications Department
RENAULT V.I. UNITED KINGDOM LIMITED
Boscombe Road,
Dunstable
Bedfordshire LU5 4LX
Tel. (Switchboard): (+44) (0)1582 471 122
Fax (Marketing): (+44) (0)1582 479 146

1.2 Regulatory domain

The bodybuilder must meet:

- the different European and/or destination country laws, regulations and standards governing driving and vehicle building,
- the stipulations of the highway code and its various amendments and appendices,
- the different laws, regulations and standards governing road traffic in force in the country of destination.

The scope of this compliance must cover:

- Lighting and signalling,
- Weight and dimensions,
- The field of vision and rear view,
- The regulation protection devices (e.g. sideguards, anti-spray, run-under bar),
- The coupling and towing systems, (compliance with standards and regulations),
- Specific clauses concerning the transport of dangerous goods (ADR, COSHH etc.),
- Sunroofs,
- Pollution control standards,
- Electromagnetic compatibility standards for electronic equipment.

1.3 Safety

All components having an influence on:

- The control of the driver of the trajectory and the ability to stop the vehicle and its trailer,
- The load distribution on the front or the rear, the left or the right,
- The risk of fire,
- and any other risk for the vehicle and its surrounding environment.

Among the components, we would mention, among others:

- The cab tilt mechanism,
- The wheels (tightening of the bolts),
- Seats and seat belts (the anchorage points),
- The attachment of bodywork or equipment to be in conformity with the technical instruction document in force, (i.e. the Guide for the Fitting of Bodywork),
- The coupling and towing systems, (i.e. anchorages),
- Electrical systems (protection of circuitry, the electrical rating, attachment, conformity of the connections with the technical instruction document, (i.e. the Guide for the Fitting of Bodywork),
- Warning systems and driver information systems, (i.e. no interference with the information given by the instrument panel on the dashboard),
- Information for use affixed by the manufacturer to the vehicle (i.e. decals for tilting of the cab, drilling points, welding points, batteries, etc.)
- Extension and reduction of the length of the wheelbase and the rear overhang.
- Relocation or replacement of the crossmembers.
- Circuits for ancillary equipment.

In order to guarantee the safety and the satisfactory operation of the vehicle, modification of the following components is strictly forbidden:

- Brakes: circuits, controls and anchorages,
- Steering: circuits, controls, anchorages and geometry,
- Axle and axle housing assemblies,
- The air-bag system and pretensioning systems on the seat belts,
- The electronics.

1.4 Quality assurance

Our permanent objective is to give satisfaction to our customers and we must achieve this in full on the final product consisting of a chassis, bodywork and/or an item of equipment.

In order to achieve this objective, RENAULT V.I. expects from all those co-operating with it in the field of mounting bodywork and equipment supply to implement a Quality Assurance System.

RENAULT V.I. can demand proof for the execution of all bodywork, the fitting of equipment or modification of a basic truck, in accordance with Standard ISO 9000, of:

- The conformity with all legislation, EC Directives and national regulations,
- The compliance with the manufacturers' directions,
- The control of quality of the execution of the work.

This is done with the knowledge that, on the face of it, the vehicle is considered as complying with the whole of the regulations.

1.5 Documentation

In all cases involving equipment, the installer is obliged to supply a manual covering the use, service, maintenance and safety of his installation.

1.6 General instructions

When building and fitting a body (including such equipment as rear run-under guards), a certain number of requirements and a certain number of vital requirements specific to each type of vehicle must be taken into consideration. These various points relate to maintenance, accessibility and the circulation of fluids.

Examples:

- Ease of access to the various maintenance and lubrication points, to the fuel tank and fuel gauge, to the batteries and the various electrical terminal boxes.
- The ability to easily dismantle the various component parts of the transmission and the suspension.
- Access to the circuits for air-intake, exhaust, and fuel supply.
- Taking into account the wheel movement detailed on the bodywork drawing (i.e. take care to allow for snow chains; extra clearance must be provided).
- Ventilation of the brake drums and discs and the battery compartment.
- The radiator inlet and outlet areas, which must not be modified.
- Complete compliance with the dimensions and weights specified in our technical documents. Under all circumstances, the bodybuilder must ensure free movement and safe operation of all the moving component parts of the chassis (i.e. springs, prop shaft, etc.)
- The addition of a body must not affect the vehicle running and driving safety. Take care to ensure that a balanced distribution of the loads on the right and the left hand sides of the vehicle is obtained.
- For any bodywork installation, a calculation of load distribution must be made for each axle, in order to check that the weight imbalance between the right and the left hand side is below 4%.
- **The flow of the coolant must be maintained at all times. It is, therefore, not allowed to blank off, even partially, the air intakes provided (on the radiator grille or the front end). Orange ADR or similar "Hazardous Substances" plates should be affixed to solid surfaces (i.e. without vent holes).**

On the arrival of a vehicle in your workshop for body fitting, we recommend that you should check one hour after the arrival of the vehicle, the state of charge of the batteries.

Voltage at the battery terminals		Specific gravity of the electrolyte	State of charge
6 Volt battery	12 Volt battery		
6.3 Volts	12.7 Volts	1.27	100 %
6.2 Volts	12.5 Volts	1.24	80 %

During the period for the fitting of the bodywork, you should particularly check that:

- The vehicle is not run without a battery.
- Do not move the vehicle on the starter motor.
- Do not use a booster starter.
- Ensure that the tyre pressure is checked and tyres inflated to the correct value where necessary.
- Protect body components or items of trim against all damage.
- Refit the original batteries, where these have been taken off.

IMPORTANT

- **Whatever work you are doing on the vehicle, you must switch off the electrical circuit at the master switch or by disconnecting the batteries in order to avoid any risk of electric shock during work.**
- **When a vehicle is laid up (i.e. at a standstill for longer than 10 days), disconnect the electrical circuit by removing the fuse or by the circuit-breaker so as to avoid discharge of the batteries through the tachograph.**

The information contained in this manual is only applicable to bodywork in steel.
For aluminium bodies, refer to the Product Applications Department of RENAULT V.I.

It is forbidden to weld, grind, cut up, drill or heat the sidemembers or crossmembers unless the contrary is clearly stated. These operations may only be carried out in conformity with the recommendations laid down in the present document.

Any special case, any bodywork fasteners and fittings not described in this manual must be submitted for our approval prior to use.

Before commencing the fitting of any bodywork, you must consult:

- **The Vehicle Technical Data Sheet,**
- **The bodybuilders drawing and the relevant calculation sheets which relate to the body to be fitted,**
- **The vehicle driving and maintenance handbook.**

If you do not have these items available, you should obtain them from RENAULT V.I. Dealers or the Product Applications Department.

In the technical manual and on the bodywork drawing is stated the permitted maximum and minimum length of body ; we would strongly advise you to stay within these limits.

Furthermore, it should be noted that the moving of a component such as the spare wheel, tank, etc., the modification of a chassis without uniform weight distribution or the fitting of an over-cab extension, causes a modification of the load distribution of a fully equipped chassis in every single case.

Modification to load distribution must be compensated for by an alteration in the permitted length for bodywork. It then becomes necessary to calculate the new position of the centre of gravity of the bodywork.

The weights specified in our technical data sheets refer to standard vehicles, ready for the road, without optional extras.

Furthermore, the weight of chassis cab is given with a tolerance of plus or minus 4%.

Optional equipment such as reinforced springs, power take-offs, different tyre fitments, will cause an increase in weight for the basic chassis.

For these reasons, when weighing the chassis cab, bodybuilders should weigh:

- The front axle(s),
- The rear axle(s),
- The complete vehicle,

without driver, without passenger, but with full fuel tanks and with vehicle on-board tool kit.

For the preparation and attachment of the various types of bodywork, it is preferable not to take off the wheels, unless absolutely necessary.

Nevertheless, you must take the precautions set out below:

- It is forbidden to paint the bearing surfaces of the wheel rim hubs and the seating for the wheelnuts.
- During fitting, make certain that the parts are perfectly clean prior to fitting.
- Tighten the wheelnuts to the torque recommended (c.f. the vehicle driving and maintenance handbook)

Installation fitted with keys: the section of such keys must be very different to that used for the vehicle keys. Indeed, these keys should not be able to be put into the vehicle locks by mistake, thus avoiding any risk of damage to the barrels of the locks.

1.7 Safety on tilt cabs

After the conversion of standard cabs by the bodybuilders, (i.e. extension, bunk adaptation, over-cab extension, etc.) because the weight distribution has changed, the tilt system may no longer meet the requirements of the safety standards.

Under these circumstances, and without prior agreement from the manufacturer, the full and entire responsibility rests with the bodybuilder.

1.8 Chassis markings

The identification number of the vehicle is on the sidemember (refer to the vehicle driving and maintenance handbook).

The identity markings of the vehicle must remain visible and accessible without having to remove any part of the body.

1.9 Adjustments to the vehicle settings

Under no circumstance may bodybuilder or converters make any alteration to the original settings of RENAULT V.I. vehicles.

1.10 Cleaning

1.10.1 Bodywork

So as not to cause any damage to the condition of the paintwork and the seals:

- Avoid using a high temperature jet of steam.
- Restrict the use of brushes. They must be in good condition and well maintained.
- We advise against the use of brushes, during the first month of vehicle use.
- If you are using a high pressure jet wash unit, limit the pressure to 80 bars maximum.
- Keep the lance well away from the bodywork; do not spray fluidtight joints.
- Use neutral soap based products.
- In order to remove grease spots, use cleaning fluid (not petrol).
- Parts in aluminium must be cleaned with water to which a non-alkaline washing product has been added, and rinsed with clean water.
- Spread a coat of Vaseline or talcum powder over the seals.

1.10.2 Chassis/Underbodies

Use a high pressure unit. Limit the pressure of the jet to 80 bars maximum and the time of use to the strict minimum necessary.

In order to prevent any risk of a problem, do not spray:

- Electronic or electrical boxes,
- The seals of link rods,
- Hinge pins,
- Air inlets for the heater, the engine air intake and air filter,
- Pneumatic and electrical apparatus,
- Absorbent materials and soundproofing screens,
- The fuel gauge.

1.10.3 Cleaning of the cab

Spray lightly or use a cloth dipped in a cleaning agent (i.e. soapy water, methylated spirits, etc.). Products with a petroleum and trichlorethylene base are not to be used.

Spread talcum powder lightly onto the door seals and the windows, as well as any link rods.

1.10.4 Cleaning of the instrument panel

Only use soapy water. Any other product is not allowed.

1.11 Safety and protection of components

Before any operation of grinding, drilling, or welding, ensure that the following are effectively protected or taken off:

- Plastic pipework and tubes,
- Electrical wiring harnesses,
- Suspension springs (particularly for the protection against corrosion),
- The bags for the air suspension,
- The soundproofing screens,
- Any other component sensitive to heat, to the discharge of incandescent matter, to ultraviolet rays (i.e. electronic control units, electronic components, items in plastic material, flexible anti-vibration mountings, painted items, etc.)
- For welding work, comply with the other recommendations described in the chapter entitled "Protection of electrical and mechanical components".

1.12 Summary of definitions

Maximum body length (Dimension W on technical data sheets and bodywork drawings).

This is the bracket of lengths for bodies (not including fittings and accessories) worked out in relation to the extreme positions of a given centre of gravity for a load which is taken to be evenly distributed and taking into account the space which must be left to the aft of the cab, laid down by the manufacturer, and the maximum permitted loads per axle on a chassis cab without options.

Body entrance (Dimension B on technical data sheets)

Minimum distance between the front axle centre-line and the front end plane of the body.

Load distribution calculations

Comply with the regulatory constraints for each country and the load limits given per axle for each model by **RENAULT V.I.**

We remind you that these values are given for uniformly distributed loads.

The lateral imbalance of the loads should not exceed a maximum of 4% between the LH and RH roadwheel of each axle.

Chassis rear overhang (Dimension N on technical data sheets)

Horizontal distance between the centre-line of the rear roadwheels and the rear extremity of the body (excluding fittings and accessories).

In the case of vehicles with 3 or 4 axles: distance between the centre-line of the rearmost axle and the extremity of the chassis.

Body rear overhang (Dimension X on technical data sheets)

Horizontal distance between the centre-line of the rear roadwheels and the rear extremity of the body (excluding fittings and accessories).

In the case of vehicles with 3 or 4 axles: distance between the technical centre-line of the tandem and the rear extremity of the body.

Wheelbase (Dimension F or F' on technical data sheets).

Distance between the centre-lines of the front and rear roadwheels (vehicle laden).

In the case of vehicles with 3 or 4 axles: distance between the centre-line of the front roadwheels and the centre-line of the foremost rear axle - for calculations take dimension F' (technical wheelbase).

Tandem

Solely in the case of vehicles with 3 or 4 axles: the 2 rear axles taken together, regardless of whether they are driving axles or trailing axles.

Maximum axle weight

Carrying weights are stipulated on each axle for each type of vehicle. These values are indicated on the technical data sheets and on the VIN plate and must be complied with on all vehicles fitted with bodies when laden and when empty.

Driver and cab passengers weight

The weight of the driver and passenger (passengers) in the cab is applied to the front axle in the case of a forward control cab.

For cabs of the semi-forward control type, 2/3 of the weight should be applied to the front axle and 1/3 to the rear axle.

Weight of driver or each passenger: 75 kg (calculated on the basis of the cab seating capacity), unless stipulated otherwise: i.e. Export, Army, Fire Brigade, etc.

For cabs with a seating capacity of more than 3 persons, calculate the weight distribution of the persons on the basis of the seats layout.

For equipment intended for the Army or for Civil Administrations, take the specific specifications into account.

1.13 Certificate of approval of the conversion of a vehicle

1.13.1 Application for approval

1. If the body or the equipment fitted do not modify the weight and dimensional characteristics of the chassis entered in the descriptive sheet, the vehicle can be submitted to the Type Approval Department without any action by **RENAULT V.I.** being necessary (within the permitted limits in force).
2. The maximum rear overhang is equal to 60% of the wheelbase. However, for special cases, we can grant higher percentages - for this, consult us.
3. If the layout requires modification to the wheelbase, it is essential to consult the Product Applications Department. Each case has to be covered by a specific design.
5. For more accuracy in your calculations, we recommend you to introduce into the data the weighed weight of the chassis cab to be equipped (capable of varying according to manufacturing tolerances and the various options available). The same applies to equipment for which the manufacturers can accurately define the weight and the position of the centre of gravity.

1.13.2 The body fitting certificate

This defines the installation of the equipment on the chassis cab and the unladen weight imposed on the axles and then the weight when fully laden.

It must be attached to all applications relating to the equipment which do not comply with any of the dimensions set out in the descriptive sheet.

1.13.3 Responsibility for installation

The building and fitting of a body on a vehicle is the sole responsibility of the bodybuilder, who must comply with the recommendations in the present document.

He must ensure that the installation of the body does not affect the functions or the reliability of the components or the road behaviour of the vehicle.

1.14 Painting

1.14.1 Precautions

- Protect the **RENAULT V.I.** equipment (i.e. by using screens, self-adhesive tape, cab cover etc.)
- Never put vehicles into drying ovens at a temperature of **more than 80° C.**
- **The chassis of the vehicle must be electrically earthed to allow static electricity to run away to earth (protection of electronic boxes).**
- The vehicle must be protected against corrosion by paints compatible with those used by our Company and conforming to **RENAULT V.I.** Specification N° 4702 441 (protection of bodywork and equipment adapted to **RENAULT V.I.** vehicles) available from the Product Applications Department.
- Thinner solvents must never be used on cables and electrical sheaths.
- Protect the identification marking of electrical wires and compressed air pipes.

Never paint bearing surfaces of brake drums and disc wheels, or with twin tyre fitment, the assembly surfaces between the disc wheels. As a general rule, do not repaint the support surfaces of original fitment nut and bolt hardware and comply with the specification.

NOTE

Our Product Applications Department holds the reference numbers for paint colour shades for chassis and cabs at your disposal. These paint colours can be procured as "spare parts" and can be ordered from our dealers.

The cab colour shade is indicated on the front end of the cab.

Since 1994, chassis and accessories are no longer sprayed with the customer's shade of paint at the time of original fitment.

To preserve the aspect and original quality, it is essential to observe the following methods after fitting equipment, body, sub-frames and various adaptations to major units or chassis frame:

1.14.2 Major units (gearboxes, drive axles, engines, axles, etc.)

Works paint: GLYCEROLPHTHALIC

Retouch (after fitting PTO, charge indicator, etc.)

Retouch method

- Clean with a universal cleaner or using a high-pressure cleaner.
- Wipe down, then apply a primer.
- Let the product cure until mat (about 15 minutes at 20° C), then apply the corresponding polyurethane lacquer.

1.14.3 Chassis frame and accessories (sidemembers, crossmembers, fittings, lockers, etc.)

Works paint: POLYURETHANE or POLYESTER powder.

Retouch method:

Superficial scratches (the metal is not affected).

- Clean with a universal cleaning product.
- Wipe down, then apply the corresponding undiluted but catalyzed polyurethane lacquer, using a small brush.

Deep and fine scratches (down to the bare metal).

- Clean with a universal cleaning product.
- Wipe down, then apply the primer, using a small brush.
- Let the product cure (about 15 minutes at 20° C), then apply the corresponding undiluted but catalyzed polyurethane lacquer.

Deep and wide scratches (down to the bare metal, drilling of sidemembers for attaching tail lifts and accessories) due to drilling.

- Rub down.
- Clean with a universal cleaning product.
- Let the product cure until mat (about 15 minutes at 20° C), then apply the corresponding polyurethane lacquer.

Making good after conversion (after converting wheelbase and overhang).

- Grind, rub down; prepare the area in question (burnt paint, welding scale, etc.).
- Clean with a universal cleaning product or using a high-pressure cleaner.
- Mask with tape (electrical wiring harnesses, air and fuel pipes, labels, etc.)
- Wipe down, then apply the primer.
- Let the product cure until mat (about 15 minutes at 20° C), then apply the corresponding polyurethane lacquer.
- After drying, put back the electrical wiring harnesses, air and fuel pipes and accessories.

Spraying chassis and accessories (with customers colour shade).

- The bodybuilder undertakes to preserve the aspect and quality of the original fitment vehicle (except for nut and bolt hardware).
- Clean with a universal cleaning product or using a high-pressure cleaner.
- Mask with tape (electrical wiring harnesses, air and fuel pipes, labels, etc.)
- Wipe down, then apply the primer.
- Let the product cure until mat (about 15 minutes at 20° C), then apply the corresponding polyurethane lacquer.
- After drying, put back the electrical wiring harnesses, air and fuel pipes and accessories.

NOTE

All spray gun operations are to be carried out in a painting booth.

Since August 1999, the chassis are painted grey as replacement for Enduro red. For paint retouches on grey chassis, use a grey paint aerosol ref. N° 50 01 848 147.

1.14.4 Recommended products

Manual cleaning

Universal cleaning product or equivalent solvent

Products approved by RENAULT V.I.

Supplier	Commercial name	RENAULT V.I. Ref.	Supplier Ref.
BASF/STANDOX	PK 900	50 01 259 985	FA 9312002
ICI AUTOCOLOR	Slow Spirit Wipe	56 89 330 553	P850-1402

High-pressure cleaning

Degreaser, Degreaser Phosphater

Preparation

Products approved by RENAULT V.I.

Supplier	Commercial name	RENAULT V.I. Ref.	Supplier Ref.
BASF/STANDOX	"EPOXY" resin	50 01 826 019	FA 931 5203
	"EPOXY" hardener	50 01 825 990	FA 931 5204
	"EPOXY" solvent	50 01 826 005	FA 931 5205
	"EPOXY" slow speed solvent	50 01 829 256	FA 931 5213
	"EPOXY" solvent	50 01 825 992	FA 020 7810
ICI AUTOCOLOR	"EPOXY" resin	50 01 829 477	P580-2100
	"EPOXY" hardener	50 01 829 480	P210-833
	"EPOXY" solvent	50 01 829 481	P850-3091

NOTE

It is absolutely forbidden to use methyl ethyl ketone "MEK".

Since EPOXY resins have a strong tendency to flouriness, it is essential to use them only as primer and apply a finishing coat with a thickness at least equal to the covering capacity of the lacquer used.

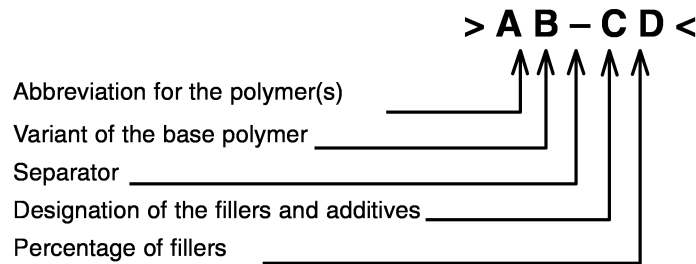
Finish paint

Two-component polyurethane paint and corresponding thinner.

1.14.5 Marking of polymer components (recycling of plastics)

Plastic parts are marked so as to simplify their sorting during recycling at the time when the vehicle is scrapped at the end of its life.

Marking of the plastic parts is done by placing abbreviated terms for the polymer components between the symbols ">" and "<". The parts are marked on a face which the customers cannot see and when it is possible the marking is indelible. Marking is done in the following manner:



Marking of single component products

The abbreviated term for the material is enclosed in symbols ">" and "<".

For example: ">PP<" or "PP" indicates polypropylene.

Marking of copolymers

The abbreviated terms for the polymers are separated by a "/".

For example: ">P/E<" indicates the copolymer propylene ethylene.

Marking of mixtures or blends of polymers

The abbreviated terms are separated by a "+" (heterogeneous structure).

For example: ">PP + EPDM<" stands for a blend of polypropylene and EPDM.

Marking of polymers with fillers (additives)

The abbreviated term for the polymer is separated from that for the filler by a dash "-".

The number following the abbreviated term for the filler relates to its percentage in the mixture.

For example: ">PA66 - (GF25 + MD15)<" indicates polyamide 66 with 25% filler and 15% reinforcement with mineral fillers (in decreasing order of percentage).

Marking of multicomponent products

The abbreviated terms for the components are separated by commas, in order of appearance (firstly the surface material).

For example: ">PVC, PUR, ABS<" indicates skin surface PVC on PUR foam with an ABS insert.

Marking of special features

Abbreviated terms for the polymers can be added up to 4 symbols, in order to indicate a modification.

The symbols are put in after the abbreviated terms.

For example: ">PE - C<" indicates chlorinated polyethylene, ">PE - LLD" stands for linear low density polyethylene.

- For the fitting of all bodywork, a calculation of the weight distribution has to be made so as to check that the lateral imbalance of the loads should not exceed a maximum of 4% between the LH and RH road-wheel of each axle.

Table of the principal polymers

Abbreviated term	Variant	Materials
A.B.S		Acrylonitrile/butadiene/styrene
A.S.A		Acrylonitrile/styrene/acrylate
E/P		Ethylene/propylene
E.P.D.M		Copolymer ethylene/propylene/diene
P.A		Polyamide
P.A	6	Polyamide 6
P.A	66	Polyamide 66
P.C		Polycarbonate
P/E		Propylene/ethylene
P.E		Polyethylene
P.E	- HD	High density polyethylene
P.E	- LD	Low density polyethylene
P.E	- LLD	Linear low density polyethylene
P.E	- X	Cross-linked polyethylene
P.M.M.A		Poly(methacrylate of methyl)
P.O.M		Polyoxomethylene
P.P		Polypropylene
P.P.E		Poly(phenylene ether)
P.P.O.X		Poly(oxide of propylene)
P.S		Polystyrene
P.S	- HI	Impact polystyrene
P.T.F.E		Poly(tetrafluoroethylene)
P.U.R		Polyurethane
P.V.C		Polyvinyl chloride
P.V.C	- C	Polyvinyl chloride
P.V.C	- P	Polyvinyl chloride

1.15 Electrical equipment

1.15.1 General

- Any mounting of a specific item of equipment on a commercial vehicle must be in conformity with the recommendations of RENAULT V.I. and the legislation in force. Its execution remains the entire responsibility of the bodybuilder, both with regard to the suitability for the vehicle being equipped and any possible electromagnetic interference.
- For reference to wiring diagrams, consult the electrical equipment workshop manual for the vehicle (available from the Spare Parts Department of RENAULT V.I.).
- Check that the electrical consumption of this equipment is appropriate for the capacity of the batteries and also the charging current rate of the alternator (if not, refer to the recommendations of the manufacturer CIC 1081). For the fitting of any particular equipment, consult the Product Applications Department of RENAULT V.I.
- A schematic diagram should be submitted for the approval of RENAULT V.I., when raising any specific question.
- A wiring diagram for the bodybuilder's or equipment manufacturer's installation must be incorporated into the vehicle driving and maintenance handbook of the vehicle. The electrical connection points for the equipment being supplied should be clearly and precisely indicated on this wiring diagram (even after the agreement of RENAULT V.I. has been obtained).
- Follow the electrical protection recommendations of RENAULT V.I.; it is forbidden to change the rating of fuses.
- In order to harmonize vehicle equipment, you should use in preference such items as are identical to those fitted in the basic vehicle (i.e. indicator lights, controls, relays, etc.).
- Assembly of a protective shield on the electric retarder is compulsory for ADR (Transport of Hazardous Substances) vehicles (refer to regulations in force).
- **It is compulsory for the supply voltage for the equipment installed to be equal to the rated voltage of the vehicle.** The installation of equipment with a 12 volt power rating on our vehicles (24 volt rated voltage) is not permitted unless a voltage dropper is added.
- Under the circumstances that additional lights are fitted, the installation must not damage the fluidtight sealing of the junction boxes.
- **Operating without a battery is forbidden.**

1.15.2 Wiring harnesses

- Use to the full the wiring runs already set up by the manufacturer (i.e. conduits, tubes, sleeves, etc.) and comply with the limit of their capacity.
- Any wiring harness added by the bodybuilder must be protected by a sealed sheath (smooth and thick or ringed) and can be routed along with the original wiring runs for the vehicle provided that it does not adversely affect the mechanical mountings for the original harnesses. For vehicles for the transport of hazardous goods, use the protective equipment authorized by the regulations covering the transport of hazardous goods.
- If you are obliged to route wires close to a source of heat (i.e. engine, exhaust system, etc.), the minimum clearance to be complied with is 200 mm.
- Never route a wiring harness over projecting angles.
- Never attach a wiring harness to moving parts (even slight movement).
- The section of the cables being used must be suitable for the use in question. Their cross-section should be selected in accordance with the maximum current on-line (5 amperes per mm²).
- The length of the wiring harnesses should be long enough to allow the electrical appliance which is connected to be taken off (i.e. main display unit, tachograph, etc.).
- The numbering of the wires must be in accordance with the manufacturer's standard.
- The link between the sheath and the connector must be fluidtight.

1.15.3 Electrical connections

- Any additional connection requires protection that is suitable for the use for which it is intended (even if the power supply provided for the customer by RENAULT V.I. is already protected by a fuse).
- Any electrical connection must be properly wired on the power lines supplied by the manufacturer to the bodybuilder's equipment (refer to the servicing and maintenance handbook for the vehicle in question).
- Tapping into the various wiring harnesses supplied by RENAULT V.I. is completely FORBIDDEN (for example vehicle rear lights, external marker lights, contactors, pressure switches, relays, etc.).
Reminder: a 12 V tapping at the middle point between the two batteries is strictly FORBIDDEN.
- The electrical connections of the various wiring harnesses of the bodybuilder must be made using a fluidtight junction box or otherwise using sealed connectors. If connections have to be made on circuits hooked up to electronic equipment:
 - Ensure that you comply with the polarity recommended.
 - No inductance current must pass through the circuits which have been added.
 - All the earths must be connected up to the available "EARTH" points provided and not to the bodywork of the vehicle.
- After work on junction boxes, the seal must always be as integrally effective as the original seal.
- Any power supply requiring a direct connection to the batteries must be capable of being isolated by a battery cut-out (for example: tail lifts) and protected by a fuse sited as near as possible to the batteries. Suitable connection terminals should be used.
- The + power supply is taken from the master switch, or failing this, from the battery terminal for vehicles without a master switch, **BUT IN NO CASE FROM THE ALTERNATOR OR STARTER MOTOR TERMINAL.**
- Power supplies to auxiliary equipment: i.e. telephone, fax, etc. The quality of the installation is the responsibility of the installer (i.e. reception, static, interference, etc.)
- Preferably, you should use connectors approved and distributed by RENAULT V.I. (i.e. type, sealing properties, rating, number of channels, etc.)
- Connectors for equipment should be positioned near the bottom, whilst avoiding areas subject to splashing (i.e. wheelarches, etc.).

1.15.4 Available power supplies

All our vehicles are equipped with the available power supply protected by fuses and these are at the disposal of bodybuilders and equipment manufacturers.

These power supplies are described in the vehicle driving and maintenance handbook (supplied with every vehicle), in the Workshop Repair Electrical Manual, and in this document (all these documents are available from the RENAULT V.I. dealer network).

1.15.5 Flasher units

Should the flasher unit become inoperative due to failure to comply with the instructions contained in this document, the coverage granted by the warranty will be lost.

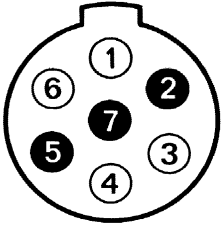
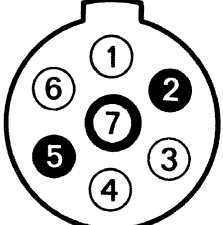
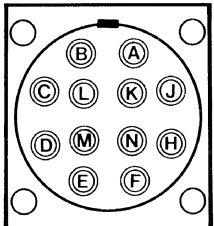
The flasher units are designed for a maximum rating which is marked on the unit.

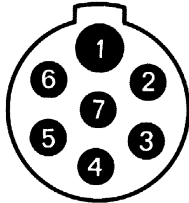
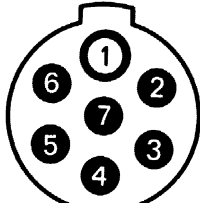
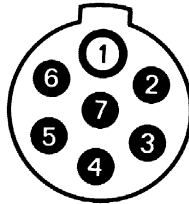
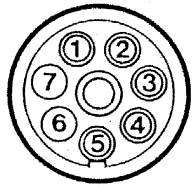
Do not exceed this power rating.

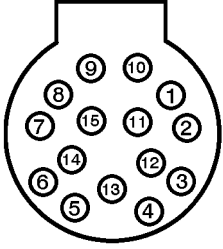
Connection

In order to make the connections correctly, consult either the identification marks which are located close to the terminals, or the wiring diagram on the label which is affixed to the flasher unit cover.

1.15.6 List of standard power sockets

SUPPLY VOLTAGE	DESCRIPTION AND STANDARDS	SOCKET DIAGRAM (front view)
12 Volts	<p>12 N type socket (Standard: - BNA.R.43.407 dated April 1982 - ISO 1724).</p> <p>1 - LH direction indicator light. 2 - Rear fog light. 3 - Earth. 4 - RH direction indicator light. 5 - RH rear side and marker light and number plate illumination lamp. 6 - Stop light. 7 - LH rear side and marker light and number plate illumination lamp.</p>	 <p style="text-align: center;">600037</p>
12 Volts	<p>12 S type socket (Standard: - BNA.R.43.410 dated August 1982 - ISO 3732).</p> <p>This is a supplementary socket which is assembled in addition to the 12 N socket.</p> <p>1 - Reversing light. 2 - Not allocated. 3 - Earth. 4 - Supplementary + power supply. 5 - Earthing monitor. 6 - Positive (+) power supply. 7 - Not allocated.</p>	 <p style="text-align: center;">600038</p>
24 Volts	<p>12-pin socket (Standard: - BNA.R.43.405 dated March 1961 - DEFA 1457 b. - DCEA 5.556. - NATO).</p> <p>A - LH black-out side light. B - LH direction indicator lights. C - RH black-out side light. D - Earth E - Rear side and marker lights and number plate illumination lamp. F - Black-out stop light. H - Not allocated. J - RH direction indicator lights. K - Battery + power supply. L - Earth. M - Stop lights. N - Not allocated</p>	

SUPPLY VOLTAGE	DESCRIPTION AND STANDARDS	SOCKET DIAGRAM (front view)
24 Volts	<p>24 N type socket (Standard: - BNA.R43.406 dated January 1976 - ISO 1185).</p> <p>1 - Earth. 2 - LH rear side and marker light and number plate illumination lamp. 3 - LH direction indicator lights. 4 - Stop lights. 5 - RH direction indicator lights. 6 - RH rear side and marker lights and number plate illumination lamp. 7 - Trailer braking light.</p> <p>Terminal 7 is scheduled in certain countries for supplying power to regulation trailer brakes. Under no circumstances must it be used as an earth terminal.</p>	 <p>600040</p>
24 Volts	<p>24 S type socket (Standard: - BNA.R43.409 dated April 1982 - ISO 3731).</p> <p>This is a supplementary socket which is assembled in addition to the 24 N socket.</p> <p>1 - Earth. 2 - Not allocated. 3 - Reversing light. 4 - Power supply. 5 - Earthing monitor. 6 - Supplementary power supply. 7 - Rear fog light.</p>	 <p>600041</p>
24 Volts	<p>24 P (oil tanker) type socket (Standard: - BNA.R.10.120 dated June 1977)</p> <p>This is the socket for ADR (Transport of Hazardous Substances) vehicles which is assembled in addition to the 24 N socket.</p> <p>1 - Earth. 2 - Valve lighting. 3 - Reversing light. 4 - Positive (+) power supply. 5 - Insulated earth. 6 - Not allocated. 7 - Rear fog light.</p>	 <p>600042</p>
24 Volts	<p>ABS specific type socket (Standard: - ISO 7638)</p> <p>1 - Power (30A). 2 - Control power supply (2A). 3 - Control earth (2A). 4 - Power earth (30A). 5 - Information (2A). 6 - Free. 7 - Free.</p>	 <p>600563</p>

SUPPLY VOLTAGE	DESCRIPTION AND STANDARDS	SOCKET DIAGRAM (front view)
24 Volts	<p>15-way type socket (Regulation ADR 1999 IP54)</p> <p>1 - LH direction indicator lights 2 - RH direction indicator lights 3 - Rear fog light 4 - Earth 5 - RH rear side/parking and marker and registration plate lights 6 - LH rear side/parking and marker and registration plate lights 7 - Stop lights 8 - Reversing lights 9 - 24V "+" power supply</p> <p>Since July 1999, the 15-way socket replaces 24N and 24P sockets. Channels 10, 11, 12, 13, 14, 15 are unaffected.</p>	 <p style="text-align: right; font-size: small;">60 1990A</p>

The 15-way socket can be mounted on vehicles equipped with 24N and 24P sockets with the use of a 15-way 24N/24P adapter ref. N° 50 01 851 060 available from the RENAULT V.I. Spare Parts department.

1.15.7 Additional direction indicator lamps

- On tractors and rigids

Should the lamps provided not meet all the requirements of the legislation in force, the bodybuilder may add extra lamps supplied with power by the same circuit as the front lamp or by a special circuit should one be available from the flasher unit. In all cases, comply with the power rating.

We strongly advise you to refrain from fitting any other lamp not required by the regulations.

- On trailers and semi-trailers

The standards in force concerning trailers require only two circuits for the flasher units: one circuit for the RH side and the other for the LH side. No additional lamps must be fitted on the trailer or semi-trailer which run from the monitored trailer lamps.

The addition of extra lamps entails the fitting of new wire runs which have to be drawn from the non-monitored lamp terminals in the flasher unit.

Overloading

Under no circumstances must extra lamps be fitted that exceed the power rating on the flasher unit. The main consequences of such overloading are as follows:

- The service life of the flasher unit is shortened, even when it would appear to be operating normally in spite of the overload.
- Operation is adversely affected by intermittent or permanent sticking of the contacts (the lamps remain lit without flashing)
- The appliance may be **off-circuit for the duration of the overload.**

Protection of the flasher unit (depending on the vehicle equipment)

In the event of excess current, the flasher unit will cease to operate. To return it to service:

- Move the flashing lights control switch to the 0 "off" position.
- Find the cause of the overcurrent (lines or lamps) and remedy it.

You will then be able to use the flashing lights again normally.

1.16 Air-operated equipment

Should it be necessary to add auxiliary equipment not provided by the manufacturer, it must compulsorily be connected to the circuit specifically provided for auxiliary equipment on the vehicle.

The compressed air consumption of such auxiliary equipment should under no circumstances compromise the filling times of the brake circuits laid down by the legislation in force.

The RENAULT V.I. Product Applications Department is at your disposal for any further information you may require.

1.16.1 Regulations

It is forbidden to modify officially approved braking circuits which conform with the standards set out by the Highway Code.

Any modification, without prior agreement from **RENAULT V.I.**, is done under the sole responsibility of the author of such a modification.

1.16.2 Polyamide pipes

1 - Identification marking

Before removing any equipment or disconnecting polyamide pipes, mark the pipe in relation to the connection port on the equipment.

Coding system used on polyamide pipes (RENAULT V.I. standard):

Polyamide pipes are identified with a colour code marked with adhesive tape or by elastic rings.

Brakes code:

Main functions	Sub-functions		
	Constant pressure	Delivered pressure	Signalling pressure
Front service brake	Orange	Orange - White	Orange - Yellow
Rear service brake	Blue	Blue - White	Blue - Yellow
Parking brake	Green	Green - White	Green - Yellow
Trailer brake	Red	Red - White	Red - Yellow
Extra brake	Yellow	Yellow - White	Yellow - Yellow

Coding used on pneumatic appliances (DIN standard)

0 - Air intake	5 - Free
1 - Pressurized supply	6 - Free
2 - Delivered pressure	7 - Antifreeze
3 - Air vent	8 - Lubrication. 81 - Inlet. 82 - Outlet
4 - Signalling pressure	9 - Water cooling. 91 - Inlet. 92 - Outlet

When the figure is followed by a second figure, the latter figure indicates the sequence number.
Example: 41, 42, 43: The figure 4 indicates the signalling function, the figures 1, 2, 3 indicate a sequence number in that function.

2 - Replacement of pipes on braking circuits

The entire length of a damaged polyamide pipe should be replaced by a pipe with identical characteristics (length and diameter), and corresponding with the standard in force. (See technical memo 8655 group 53000, part N° 50 20 034 156 available with spare parts). It must also be provided with colour rings which are identical to those of the tube replaced.

Use an original manufacturer's pipe available from the RENAULT V.I. Spare Parts warehouse.

The routing of a polyamide pipe must be carefully executed. Ensure there is no interference with sharp-edged metal parts and there is no routing close to high temperature units. The pipes must be held at regular intervals by plasticized clamps or run in existing ducting. Non-plasticized attachment clamps are absolutely forbidden. Take care to ensure the minimum radius of curvature of polyamide pipes is observed.

Dimension	4 x 6	6 x 8	9 x 12	12 x 16
Radius of curvature	30 mm	50 mm	70 mm	130 mm

Modification to chassis length

Modification to brake pipe lengths requires braking response times to be checked out, in accordance with the legislation in force, and with agreement from the Type Approvals Department.

Connections for ratchet type pneumatic brake pipes type "RILAX 2000"

For the fitting of this type of connector, refer to and comply absolutely with the technical instruction sheet NT 8852 (method and tooling) available from the RENAULT V.I. Spare Parts Department.

2. GENERAL RULES TO BE OBSERVED WHEN FITTING BODYWORK

Before carrying out any work, protect the cab with a cover.

Our vehicles are equipped with plates, U-bolts or brackets. Preparation work may involve extra drilling or welding.

The principles described below must be adhered to.

2.1 General principles of welding

2.1.1 Precautions

Protection of the batteries

A battery at the end of its charge produces a mixture of oxygen and hydrogen gas. The ignition of this gas presents dangers of battery explosion in the case of the presence of a source of heat nearby. As a result, during a welding operation near the batteries (i.e. engine compartment, front end of the vehicle), take out the batteries and store them in a well-aired location away from the place where welding is being done. This recommendation applies equally for grinding operations.

Soundproofing screens

In the case of welding or use of a disk sander, either provide effective protection or remove the soundproofing screens, if necessary.

Protection of electrical and mechanical items

The vehicle is equipped with numerous electronic circuits: alternator, regulator, flasher units, speed limiter, ABS, etc.

Before any operation involving electric arc welding, make an earth connection by disconnecting the two negative (-) and positive (+) cables from the battery (starting with the earth cable) and connecting them to the frame earth. If the vehicle is equipped with a master switch, this should be kept engaged (circuit closed). Place the earthing clamp as near as possible to the point of welding, but never on rotating parts (prop shaft, fan hub, etc.) or on a subassembly having moving parts (i.e. air compressor, turbocharger, etc.)

Nearby plastic pipes and electrical cables, springs and air-suspension bags are to be protected or removed. This also applies when grinding or drilling.

When reconnecting the battery, observe the polarities, commencing with the positive (+) terminal. Reversal of polarity may cause irreparable damage to electronic components.

2.1.2 Preparation of parts for welding

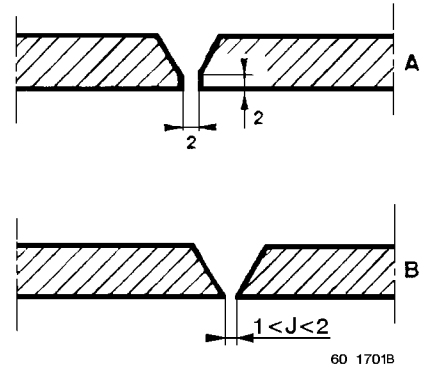
Clean the parts, primarily at the location of the weld and at the connection of the earthing wire. This allows:

- free and regular electrical current flow (regularity of weld bead),
- avoidance of inclusion of impurities in the molten metal (weld quality),
- avoidance of spatter and emission of smoke (safety for the welder).

For conversions (extensions, reductions and reinforcement gussets), we recommend arc welding with electrode type B. When semi-automatic welding is used, the bodybuilder must be able to guarantee weld quality.

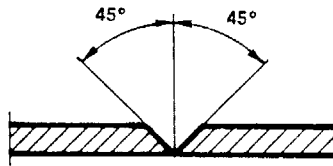
Joint preparation for chassis frames

- A - With electric arc welding
- B - With weld under gas shield (MAG or MIG)

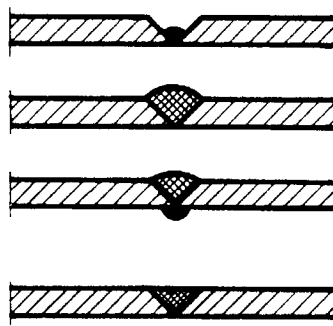


Specific weld method for chassis frames

- Preparation of the edges at 45°

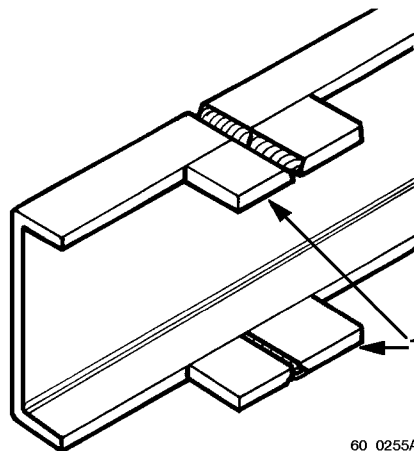


- Tack
- Position slave butts
- Weld on one single side
- Weld on second side
- Welds ground flush on both sides



Slave butts

The object of slave butts is to avoid the starting of cracks at the outside edges of the weld joint. Before final welding align butts with plates of the same thickness as the plates to be joined, holding them in position using quick action clamping devices. They must not under any circumstances be held in position by weld tacks on the plates to be joined.



2.1.3 Welding process

Static or rotary arc welding set

Welding rod usage table

Electrode diameter (in mm)	2.5	3.15 (*)	4 (*)	5
Average current (in amperes)	80	110	160	200

(*) Most frequently used diameters

RECOMMENDED ELECTRODES: **AFNOR** standard A 81.309 (December 1975)

E 435/4 B 26 BH for steels class: A - B - C - D - E

E 515/5 B26 BH for steel class: F

If steels are mixed, take the best performing steel electrode category.

Equivalent standards

AFNOR A 81.309 (12.1975)	ISO 2560	ASME (SFA 5.1) AWS (AS.1.69)	DIN 1913	BS 639
E 435/4 B 26 BH	E 435 B 26 (H)	E 7016	E 453/4 B 10	E 435 B 26 (H)
E 515/5 B 26 BH	E 515 B 26 (H)	E 7018	E 515/5 B 10	E 515/6 B 26 (H)

MIG or MAG semi-automatic set

MIG: Metal Inert Gas (for welding use an inert gas: e.g. Argon)

MAG: Metal Active Gas (for welding use an active gas: 85% Argon + CO₂ mixture).

Solid wires, used in semi-automatic welding are defined by standard **NF EN 440 / DIN 8559**.

Wire diameter (in mm)	Thickness to be welded (in mm)
0.8	up to 2
1.0	from 2 to 8

2.1.4 Equivalent steel grades

The four classes relate to hot rolled steel plate with a high yield strength for cold forming, as currently set out in the French and European Standard NF EN 10149-2, which has replaced French Standard NF A 36.231.

High yield strength sheet steel (dispersed carbon)

RENAULT V.I. Specification 31.09-402				
	Class C	Class D	Class E	Class F
UTS in N/mm ² min.	450	500	540	610
YP at 0.2% in N/mm ² min.	355	445	490	560
E % min.	23	20	18	15
KCV at - 20° C J/cm ² min., longitudinal	35	35	35	37,5
Bending, transversal	1 e	1 e	1,5 e	1,5 e
Grain size	n° 5	–	–	–
= European equivalent French standards	S 355 MC NF EN 10149.2	S 420 MC NF EN 10149.2	S 500 MC NF EN 10149.2	S 550 MC NF EN 10149.2
= German standards equivalent DIN	QStE 380TM SEW 092	QStE 420TM SEW 092	QStE 500TM SEW 092	QStE 550TM SEW 092
= British standards equivalent BS	43 F 35 BS 1449	46 F 40 BS 1449		
= American standards equivalent ASTM	Gr. 50 050 YKL ASTM 607–50	Gr. 60 060 YKL ASTM 607–55	Gr. 70	Gr. 80
= EURONORM standards equivalent 149-80	FeE355 TM	FeE420 TM	FeE490 TM	F e E560 TM

2.2 REINFORCEMENT, EXTENSION, REDUCTION OF SIDEMEMBERS

2.2.1 Bans

It is absolutely forbidden to weld onto sidemembers, except for reinforcement, extension, reduction, and the following instructions must be observed:

- Do not weld on the edges of flanges.
- Do not weld in sidemember bending radii.
- In the case of flat irons: no directly opposing welds on the two faces of the same web - only "alternate" or "plug" welds are authorized.
- No welds which are less than 15 mm from the edge of a hole.

Insofar as possible, we advise you to have modifications of the lengths of sidemembers carried out by **specialists**.

- The general rules for welding in the paragraph 2.1 entitled "General Principles of Welding" must be strictly followed.

Only conversions (extensions or reductions) rendering the modified vehicle completely in conformity with a **type approved chassis** are permitted without additional testing, with certification from the vehicle manufacturer.

2.2.2 Reinforcement of sidemembers

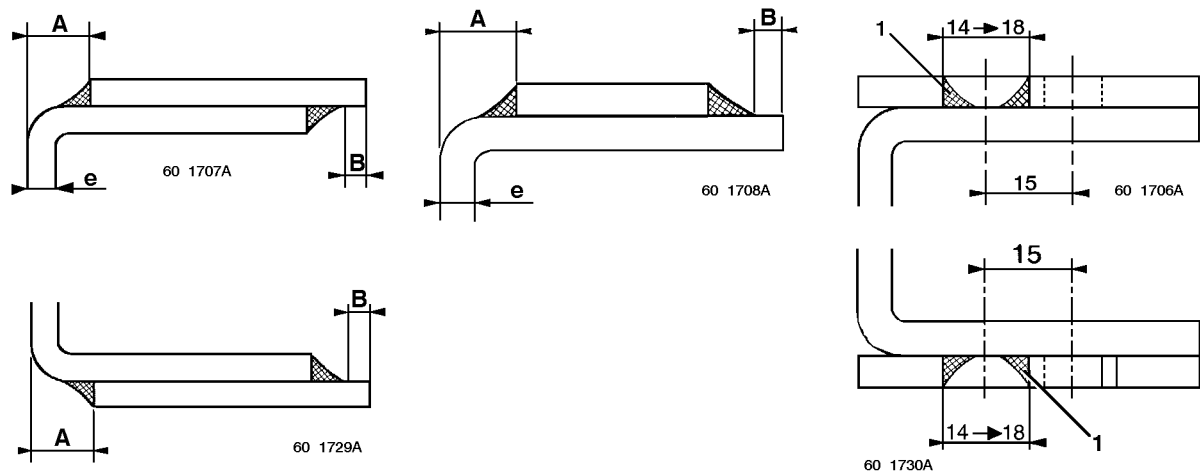
- For inner reinforcements and chassis flange stiffeners, the thickness should be the same as the thickness of the sidemember.

NOTE

The steel grade must be identical to that used for the sidemember.

Examples of stiffeners

Sidemember upper and lower stiffeners



A: Offset of the stiffener in relation to the external face of the sidemember

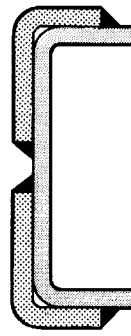
B: Offset of the stiffener in relation to the edge of the sidemember

e: Thickness of the sidemember

1: Welds through round or slotted holes, staggered

Thickness of the sidemember	A	B
$e < 6 \text{ mm}$	10 mm	15 mm
$e \geq 6 \text{ mm}$	15 mm	15 mm

Upper and lower stiffeners using angle-irons

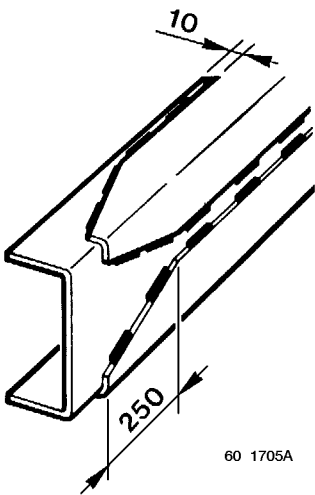


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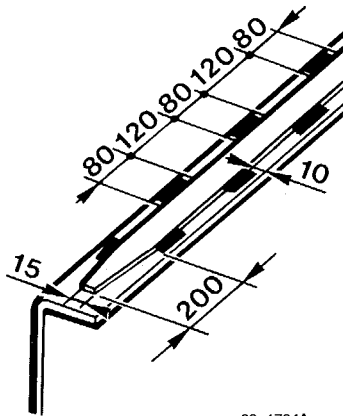
Method of joining

In the case of stiffeners made from flats (on the upper flange or under the lower flange of sidemembers), we recommend attachment by:

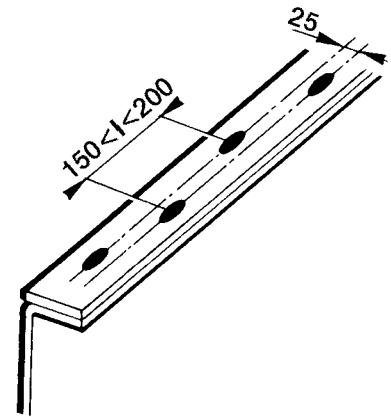
INTERMITTENT BEADS by electric welding: as guidance, 80 mm beads spaced 120 mm apart and staggered.



60 1705A



60 1704A

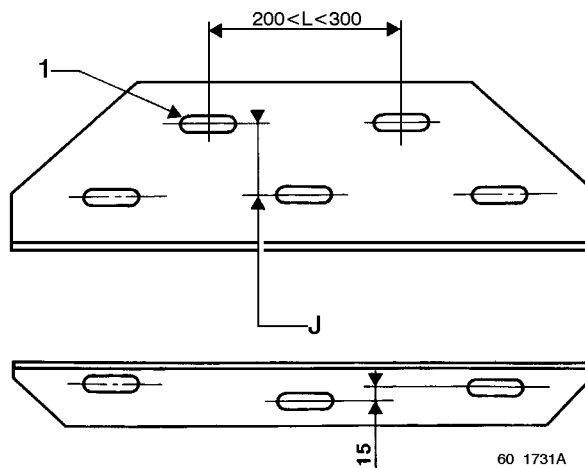


60 1703A

“PLUG” welds: as guidance, round holes diameter 14 to 18 mm or slotted (1) holes diameter 14 x 50 mm to 18 x 50 mm at a “pitch” of 200 mm min. to 300 mm. max., staggered, with good quality weld.

WARNING

No vertical welds on sidemember webs. No transversal welds on sidemember flanges.



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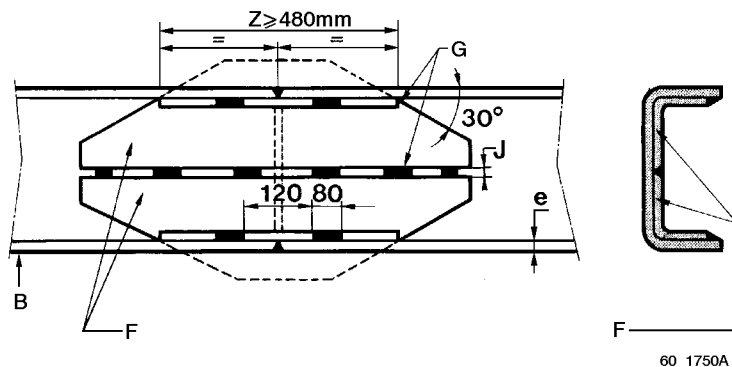
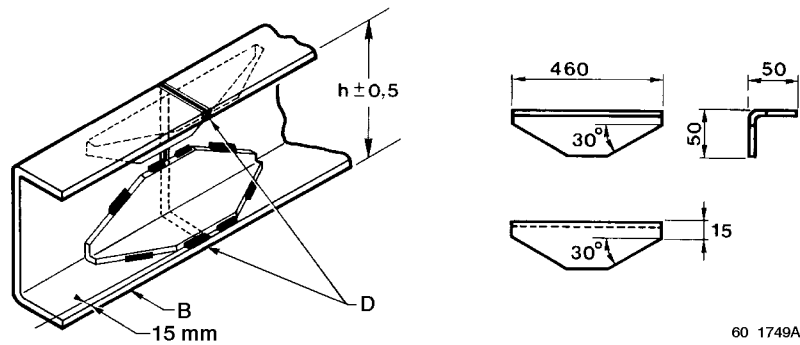
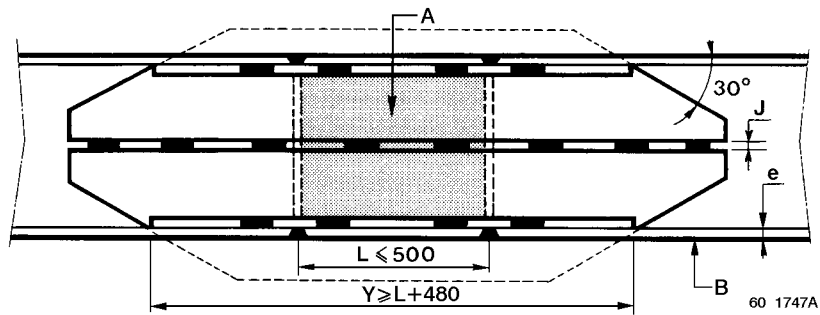
Extension, reduction of sidemembers in the wheelbase

Extension of the sidemembers in the wheelbase

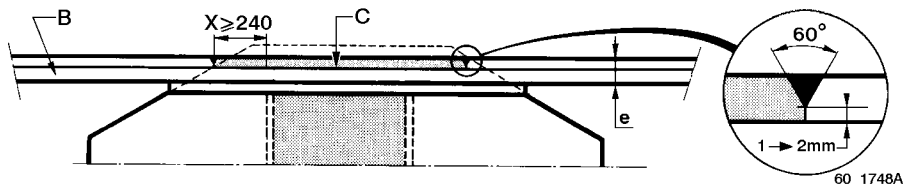
Key

- A – piece of sidemember added,
- B – sidemember,
- C – reconstituted stiffener,
- D – welds projecting beyond flanged edge with butt-ends then longitudinal grinding (elimination of sharp edges),
- e – thickness of the sidemember,
- F – angle-iron of thickness (E) max.: $E \leq (e - 1 \text{ mm})$,
- h – height of the sidemember,
- J – weld penetration clearance (about 2 mm),
- L – max. length of extension,
- X – max. length of projection of the stiffener measured on the edge of the flange (extension),
- Y – min. length of support of the stiffener measured on the edge of the flange of the sidemember (extension).
- Z – min. length of support of the stiffener measured on the edge of the flange (stiffener without extension).

Sidemember without stiffener flat on the flange



Sidemember with stiffener flat on the flange



2.2.3 Modification of the rear overhang

If the bodywork or the equipment fitted do not alter the weight and dimensional characteristics of the chassis entered on the description sheet, the vehicle can be submitted to the Type Approval Department without any action being necessary on the part of RENAULT V.I. (within the permitted limits in force).

- Welding stiffeners are required for drawbar rigids or if the extension is longer than 400 mm for a solo vehicle.

Examples: Drawbar rigid; tail lift; crane at the rear of the chassis; tipper; etc.

- Extension of the rear overhang will also be required when the rear extremities of the bodywork project beyond the maximum authorized value which is indicated on the bodybuilder's drawing and calculation sheets relating to the vehicle.

Crossmembers

Crossmembers should be attached with nut and bolt hardware of the 10.9 SSS protected class as per standard 01714002 and distributed by RENAULT V.I.

Drawbar crossmembers

Please refer to the chapter on "Drawbar crossmembers" in the section entitled "SPECIFIC FEATURES OF THE MIDLUM VEHICLE".

Intermediate crossmembers

In the case of extension of the wheelbase or the rear overhang, it is essential to add crossmembers, so as not to weaken the rigidity of the frame.

Observe the following instructions:

- Between two crossmembers, the spacing must be no greater than the original spacing.
- If the extension to the overhang is longer than 500 mm, the rear crossmember must be moved and an intermediate crossmember fitted which is identical to the others.

2.3 Attachment of bodywork

The bodywork must be correctly attached so that both the static and dynamic stresses are freely transmitted without causing excessive local strain, which could prejudice the reliability of the chassis frame or affect the road behaviour of the vehicle.

The following rules apply to the fastening of various standard bodies fitted to our chassis cabs, such as platforms, vans, tippers, and tankers. For special cases, contact the Product Applications Department.

For body design (i.e. length, load distribution, location of accessories on sidemembers, etc.) refer to the CD-ROM "Information for Bodybuilders" or the 1:20 scale bodywork drawing which we supply upon simple request.

Fastenings should always be tightened progressively and alternately.

The shape of sub-frames or underbodies should always be tapered towards the front (i.e. at the back of the cab), so as to avoid sudden variations in inertia (refer to chapter entitled "Finishing of sub-frame behind the cab").

2.3.1. The following is forbidden

- The use, drilling or welding of spring hangers.
- Any modification of: the chassis, the driveline, or the suspension.
- Fastening of sub-frames to our sidemembers by welding.
- The drilling of stiffener gussets.
- The notching of sidemembers, gussets or crossmembers.
- With the exception of special cases described in this document, the use or modification of our nut and bolt hardware and our riveting for the attachment of a body or sub-frame.
- The attachment of sub-frames by hooks (use U-bolts).

All bodies attached by clamps and brackets must mandatorily have 1 inertia stop to the aft of each sidemember to stop the body from moving in the event of fierce braking, as well as 4 body guides 2 at the front, 2 at the rear).

For bolted fastenings, comply with the following instructions:

- By preference use brackets attached to the chassis.
- Use the fixing bolt holes 11, 13 or 15 mm diameter depending on the particular vehicle, spread out along the length of the sidemembers of the chassis frame.
- Take good note of the attachment principles, set out in the chapter on the "Attachment of sub-frames".

2.3.2 Protection against exhaust heat radiation

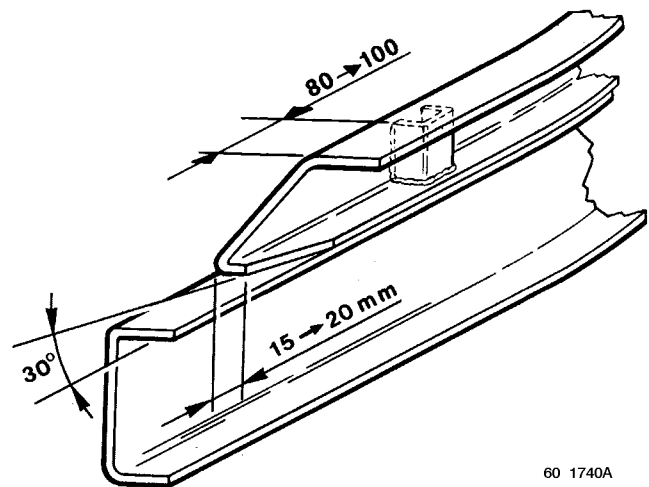
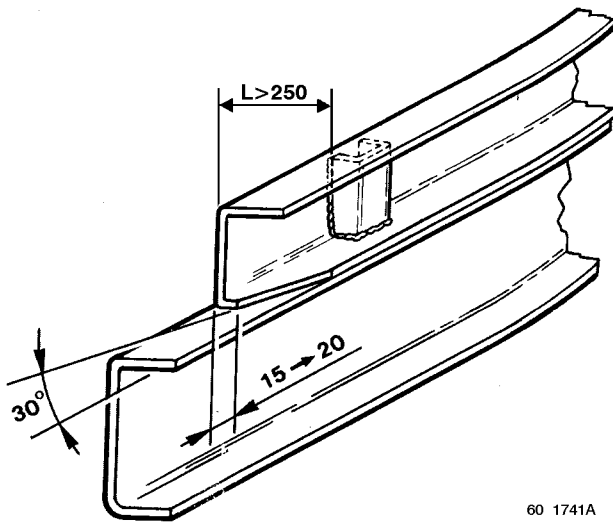
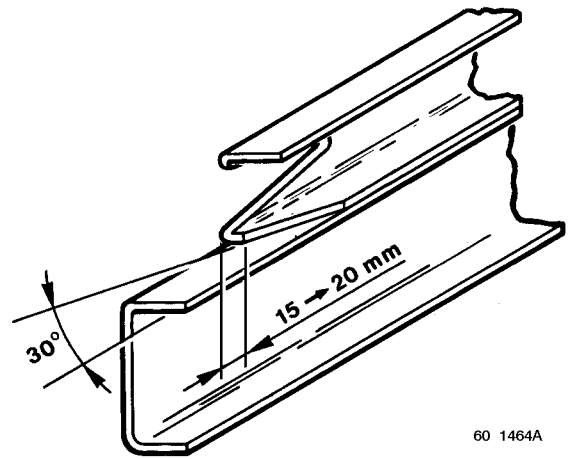
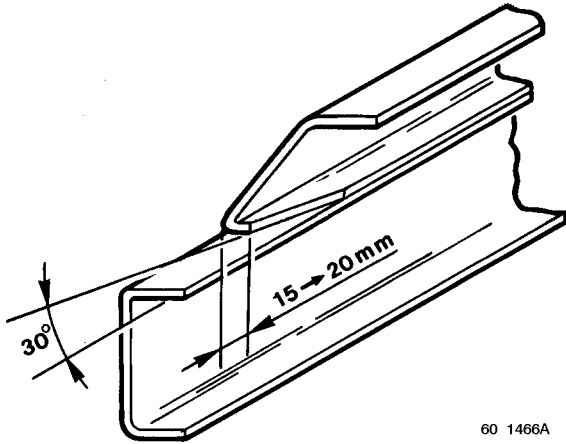
Depending on the features of your bodywork or equipment, the fitting of a heat shield on the original protection is recommended.

2.4 Sub-frame

In order to attach bodywork to the frame of the chassis, you should allow for the fitting of a sub-frame whose module of inertia (I/V) is determined in accordance with the range of vehicle in question (refer to the section entitled "SPECIFIC FEATURES OF THE MIDLUM VEHICLE").

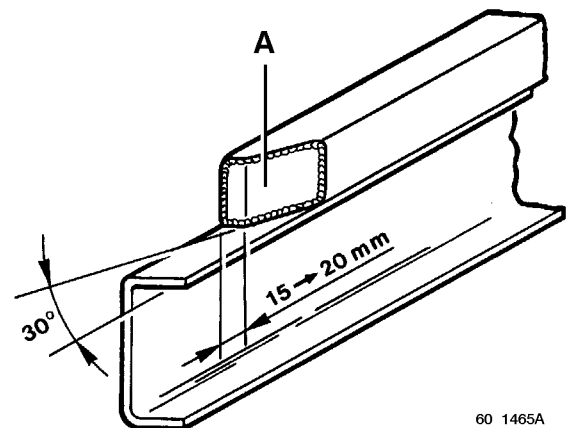
In order to ensure better distribution of the stresses along the sidemembers, you must allow for a cut-out as far forward as possible under the cab.

2.4.1 Finishing of sub-frames behind the cab



When the sub-frame is constructed of square or rectangular tube section, we also suggest the cut-out shown below.

A: Blank off with 1.5 mm thick sheet metal



2.5 Nuts and bolts, tightening torques for parts in steel and cast iron

The torques indicated in the table are the nominal torques (i.e. average value calculated on the basis of the minimum and maximum torque).

Class III is the class covering precision tightening ($\pm 20\%$ of nominal torque) in accordance with Standard 01504002 (coefficient of friction 0.15 ± 003).

The tightening torques are given for nut and bolt hardware that is dry and coated with dacrozet.

Description	Characteristics	Class of Steel	Part Nos.	Tightening torque*
Screw	H 10 x 125 L 30	10.9	50 03 101 460	60 N.m
	H 10 x 125 L 50	10.9	50 03 101 148	60 N.m
	H 12 x 125 L 40	10.9	50 03 101 151	110 N.m
	H 12 x 125 L 45	10.9	50 03 101 749	110 N.m
	H 12 x 125 L 50	10.9	77 03 101 679	110 N.m
	H 12 x 125 L 60	10.9	50 03 101 153	110 N.m
	H 14 x 150 x 40	10.9	50 03 101 161	170 N.m
	H 14 x 150 x 50	10.9	50 03 101 162	170 N.m
	H 14 x 150 x 60	10.9	50 03 101 163	170 N.m
	H 14 x 150 x 90	10.9	50 03 101 169	170 N.m
	H 14 x 150 x 100	10.9	50 03 101 660	170 N.m
	H 14 x 150 x 110	10.9	50 03 101 171	170 N.m
	H 16 x 150 x 50	10.9	50 03 101 103	220 N.m
	Collar screw	H 10 x 125 L 30	10.9	50 03 002 048
H 12 x 125 L 40		10.9	50 03 002 049	110 N.m

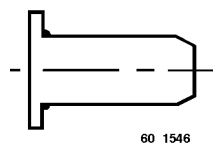
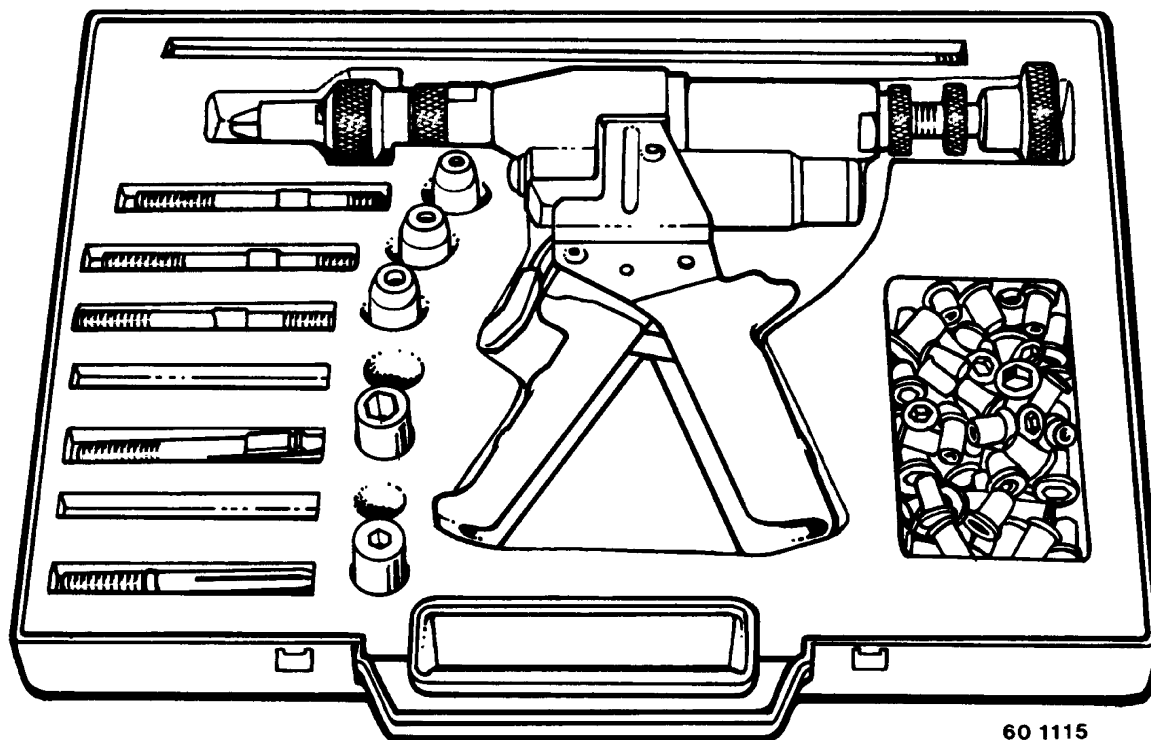
Description	Characteristics	Part Nos.
Cone shaped washer	10 x 20 x 2.2	50 03 058 081
	10 x 24 x 2.8	50 03 058 071
	10 x 27 x 2.8	50 03 058 076
	12 x 30 x 3.2	50 03 058 075
	14 x 28 x 3	50 03 058 069
	16 x 32 x 3.4	50 03 058 034
	16 x 39 x 3.6	50 03 058 070
Flat washer	10 x 22 x 3	50 03 053 453
	10 x 27 x 3	50 03 053 455
	10 x 24 x 2.5	50 03 053 026
	12 x 28 x 5	50 10 054 526
	12 x 32 x 2.5	50 03 053 441
	14 x 30 x 5	50 03 053 014
Cone shaped washer BELLEVILLE	14.5 x 35 x 1.8	00 21 721 040

Description	Characteristics	Class of Steel	Part Nos.	Tightening torque
Nut	10 x 125	10	50 03 032 156	60 N.m
	12 x 125	10	50 03 032 157	110 N.m
	14 x 150	10	50 03 032 159	170 N.m
	16 x 150	10	50 03 032 236	220 N.m
Locknut DRH (flanged)	10 x 125	10	50 03 034 246	60 N.m
	12 x 125	10	50 03 034 248	110 N.m
	14 x 150	10	50 03 034 250	170 N.m

2.6 Addition of equipment to the bodywork

The attachment of equipment to the bodywork must be done with fluidtight crimping nuts.

Tooling and crimping nuts



Crimping nut M6 with hexagonal barrel

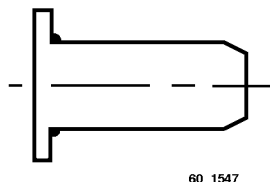
Part N°: 50 03 043 050

Method:

- Drill a 9.2 mm diameter hole (refer to chapter entitled "Drilling of bodywork members for the fitting of accessories").
- Use the OPEX tooling from OTALU SA.
- Punch out the hexagonal.
- Insert the nut for crimping.

Information:

- Tightening torque max. 10 Nm.
- Length of barrel projecting under bracket after crimping: 17 mm.



Crimping nut M8 with hexagonal barrel

Part N°: 50 03 043 052

Method:

- Drill a 11.2 mm diameter hole (refer to chapter entitled "Drilling of bodywork members for the fitting of accessories").
- Use the OPEX tooling from OTALU SA.
- Punch out the hexagonal.
- Insert the nut for crimping.

Information:

- Tightening torque max. 24 Nm.
- Length of barrel projecting under bracket after crimping: 21 mm.

2.7 Rear under-run guard

RENAULT V.I. obtains approval for its equipment to cover the requirements of its range. Their attachment being by means of bolts, this allows them to be moved down along the sidemembers to suit such modifications that the chassis may undergo. This must be observed, along with the maintenance of the attachment method detailed on the 1:20 scale bodywork drawing and compliance with the dimensional requirements under the regulations.

A vehicle which is not equipped at the time of delivery can be fitted afterwards, following a conversion making the fitting compulsory, using items which can be supplied from the Parts Stores of our dealers.

Moving of items of equipment

Modifications of a RENAULT V.I. vehicle for the fitting of bodywork and equipment requires technical approval to be obtained from the Product Applications Department of RENAULT V.I.

3. SPECIFIC EQUIPMENT FEATURES

3.1 Running the engine when stationary

Under the conditions of running an engine for a long period under load, it is vital to fit an additional cooler unit in order to keep the temperature of the engine at a normal level (water temperature approx. 80° C).

The prolonged use of the engine under these conditions can cause malfunctions which could adversely affect the life of the engine.

3.2 Mounting of power take-offs and flanged pumps

RENAULT V.I. power take-offs (PTOs) and their adapter kits should be ordered from the RENAULT V.I. Spare Parts Department. In order to carry out the fitting, refer to the specific information circulars that are available from the Product Applications Department.

Bearing in mind the weight and the large overhang required for certain PTOs having flanged pumps, the rear of these units should be supported by a suitable bracket attached to the rear of the gearbox.

COMPLY WITH THE STANDARD NF ISO 7653

IMPORTANT

It is compulsory at the time of fitting a power take-off to ensure that there is a certain amount of play in the setting adjustment, so as to allow an ideal backlash of 0.15 to 0.25 mm then to fit a gasket or apply paste in order to achieve a good seal and also to top-up the oil level. (Refer to the vehicle maintenance handbook).

Refer to our Product Information Sheet and 1:20 scale bodywork drawing on "power take-offs", which can be requested from our Product Applications Department.

3.3 Front power take-offs (crankshaft nose)

RENAULT V.I. pre-arranged assembly

For belt drive units, pulleys with extra grooves fitted to the engine may be available.

Consult the Product Applications Department to obtain the relevant information and technical approval for the assembly.

3.4 Front and rear power take-offs

3.4.1 Propeller shaft alignment

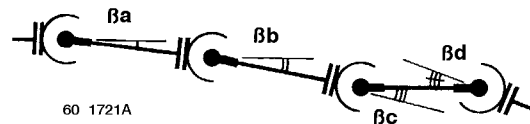
In order to achieve satisfactory propeller shaft alignment, several minimum basic **criteria** have to be observed.

Angularity criteria (or: equivalent angle of inclination β_E permissible for all articulations).

This angle β_E must comply with the following condition:

$$\beta_E = \sqrt{|\beta_a^2 \pm \beta_b^2 \pm \beta_c^2 \pm \dots|}$$

$$\beta_E \leq 3^\circ$$



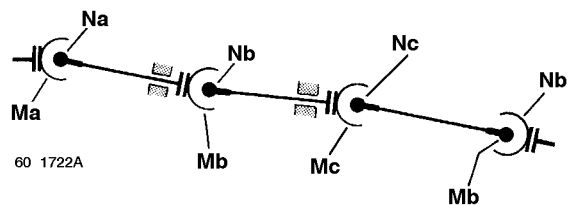
Rule for sign β :

Yoke N° 1 is to be considered as the reference yoke.

$\beta > 0$ when the leading yokes are parallel to the leading yoke (Ma).

Example 1:

$$\beta_E = \sqrt{|\beta_a^2 + \beta_b^2 + \beta_c^2 - \beta_d^2|}$$



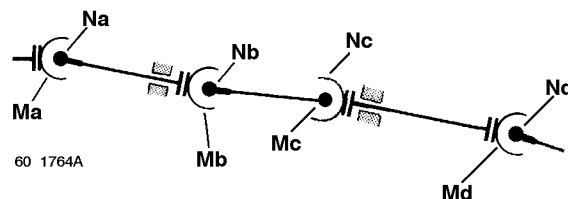
M - Leading yokes

N - Trailing yokes

$\beta < 0$ when the leading yokes are perpendicular to the to leading yoke (Ma).

Example 2:

$$\beta_E = \sqrt{|\beta_a^2 + \beta_b^2 - \beta_c^2 + \beta_d^2|}$$



Angular acceleration criteria θ_1

Calculated criterion for a theoretical maximum speed of rotation (N).

$$\theta_1 = \left(\beta_E \times \frac{\pi}{180} \right)^2 \times \left(\frac{\pi \times N}{30} \right)^2$$
$$\theta_1 \leq 270$$

θ_1 : criterion of acceleration in rd/s²

N: max. speed of rotation in R.P.M.

NOTE

This value is calculated without dynamic amplification of the prop shaft tubes and bearings.

Measured criteria θ_2 :

The angular acceleration or torsional vibrations criteria value θ_2 must not exceed 1500 rd/s² at the PTO output or at any point whatsoever of the driveline for a downstream inertia of I such that $I \leq 0.2$ kg/m².

$$\theta_2 \leq 1500 \frac{\text{rd}}{\text{s}^2}$$

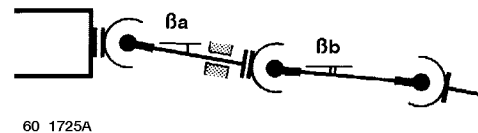
NOTE

This limit value θ_2 takes into account possible dynamic amplification of the driveline.

Transversal stress criteria for prop shaft tubes and bearings.

Example β_1 and β_2 maximum not to be exceeded.

- $\beta_a < 2^\circ$ for a prop shaft with bearing.
- $\beta_b < 7^\circ$ for a prop shaft with sliding yoke.



NOTE

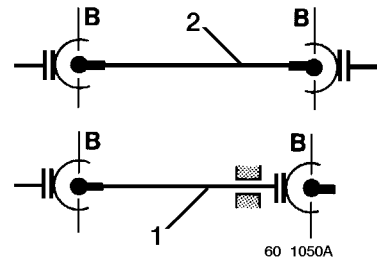
If this 7° value has to be exceeded for space or clearance reasons, the vehicle manufacturer must be consulted.

3.4.2 Propeller shaft balancing

Permissible imbalance value (B):

$$B \leq 3 \frac{g \times cm}{kg} \text{ per balancing plane}$$

- 1 - 1/2 prop shaft
- 2 - prop shaft

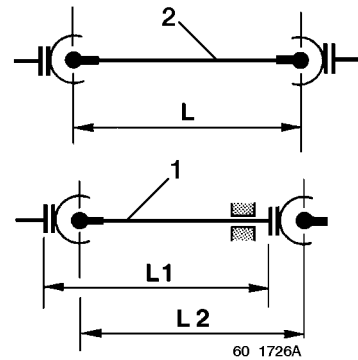


NOTE

$$g = 10m/s^2$$

3.4.3 Maximum permissible length of a prop shaft as a function of the rotating speed (L, L1 or L2)

- L: Distance between centres of articulation of a prop shaft.
- L2: Distance between centres of transmission welds of a half prop shaft.
- L1: Distance between centres of transmission of a half prop shaft.
- L1 = L2



$$L = \sqrt{\frac{K}{Nt \times 1.2}} \quad \text{where} \quad K = 0.75 \times 1.22 \times 10^5 \times \sqrt{D^2 + d^2}$$

- Nt = prop shaft maximum operating speed
- 1.2 = safety coefficient
- D = prop shaft large diameter
- d = prop shaft small diameter

3.5 Vehicle driveline (powertrain)

Any modification to the driveline is forbidden. For special cases, agreement must be obtained from the RENAULT V.I. Product Applications Department.

Any propeller shaft modifications must only be carried out in conformity with the requirements of paragraphs 3.4.2 and 3.4.3.

3.6 Mounting of handling cranes

The installer of the crane is responsible with regard to compliance with the regulations, and also for the stability of the vehicle. The recommendations of RENAULT V.I. are only concerned with the attachment of the equipment.

3.6.1 Mounting on the sub-frame

The mounting of a crane on the chassis behind the cab or in the rear overhang requires **the fitting of a specific sub-frame**.

The sub-frame module is defined in the graph of inertia in accordance with the lifting torque only for a crane mounted behind the cab and on rigid or drawbar rigid vehicles (refer to the next page).

For all mountings of cranes in the rear overhang, off-limits and on tractors, consult the RENAULT V.I. Product Applications Department.

The sub-frame must be in **one single piece**, starting from the back of the cab, and extending as far back as the rear tip of the overhang. The front end must be finished in a single or double bevel (refer to the chapter 2.4.1 entitled "Finishing of the sub-frame behind the cab").

Should the crane be mounted in conjunction with another item of mobile equipment, one **single sub-frame** shall be designed in accordance with that item of equipment **which places the most strain on the side-members**.

3.6.2 Graph of the moment of inertia of the sub-frame as a function of the lifting torque

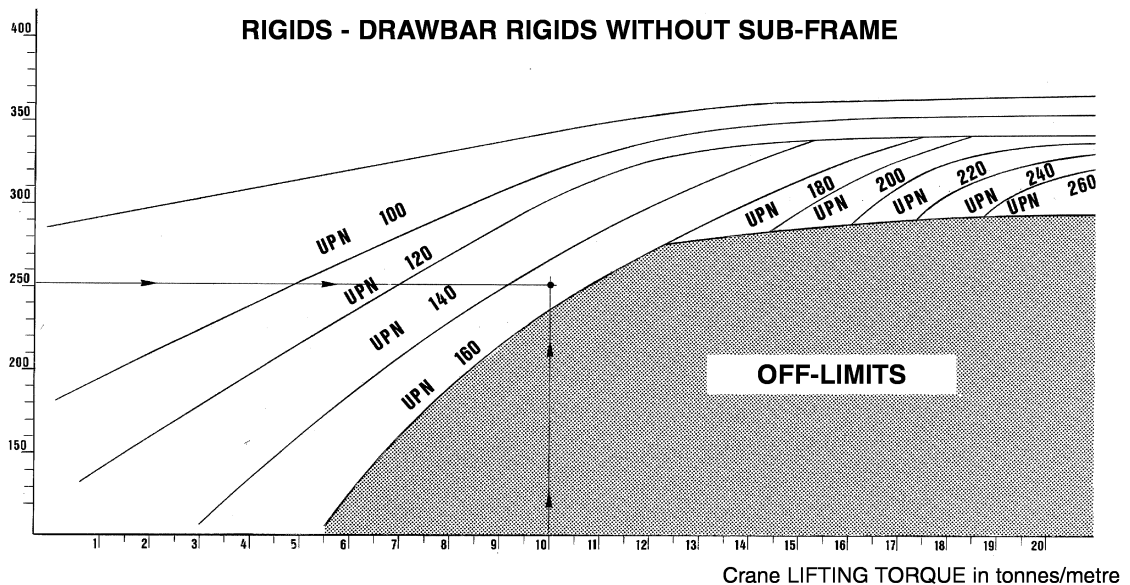
Example:

A chassis with sidemembers 252 mm long, fitted with a crane having a lifting capacity of 10 tonnes per metre. The chassis requires a sub-frame built of size 160 U-section beams (— direction of reading).

NOTE

The U-section can be replaced by any other steel section offering equivalent total inertia.

Height of sidemember



NOTE

The U-section beams (UPN) can be replaced by any other steel section offering **equivalent total inertia (I/V)**.

UPN 100 : I/V = 41200 mm ³	UPN 160 : I/V = 116000 mm ³	UPN 220 : I/V = 245000 mm ³
UPN 120 : I/V = 60700 mm ³	UPN 180 : I/V = 150000 mm ³	UPN 240 : I/V = 300000 mm ³
UPN 140 : I/V = 86400 mm ³	UPN 200 : I/V = 191000 mm ³	UPN 260 : I/V = 371000 mm ³

WARNING

Before undertaking the mounting of a crane on a vehicle, it is essential to make calculations to check the load distribution, and to determine the new maximum body length of the vehicle, whilst complying with:

- The plated gross vehicle weight (GVW).
- The maximum plated axle loads.
- The maximum rear overhang indicated in the Type Approval Department's descriptive sheet and the body-work diagram.

Sould such limits be exceeded and in all cases where the work does not comply with the type approval department descriptive sheet, special authorization must be requested from the RENAULT V.I. Product Applications Department.

In addition to this, the bodybuilder will be responsible for commissioning the equipment.

3.6.3 Crane in the rear overhang

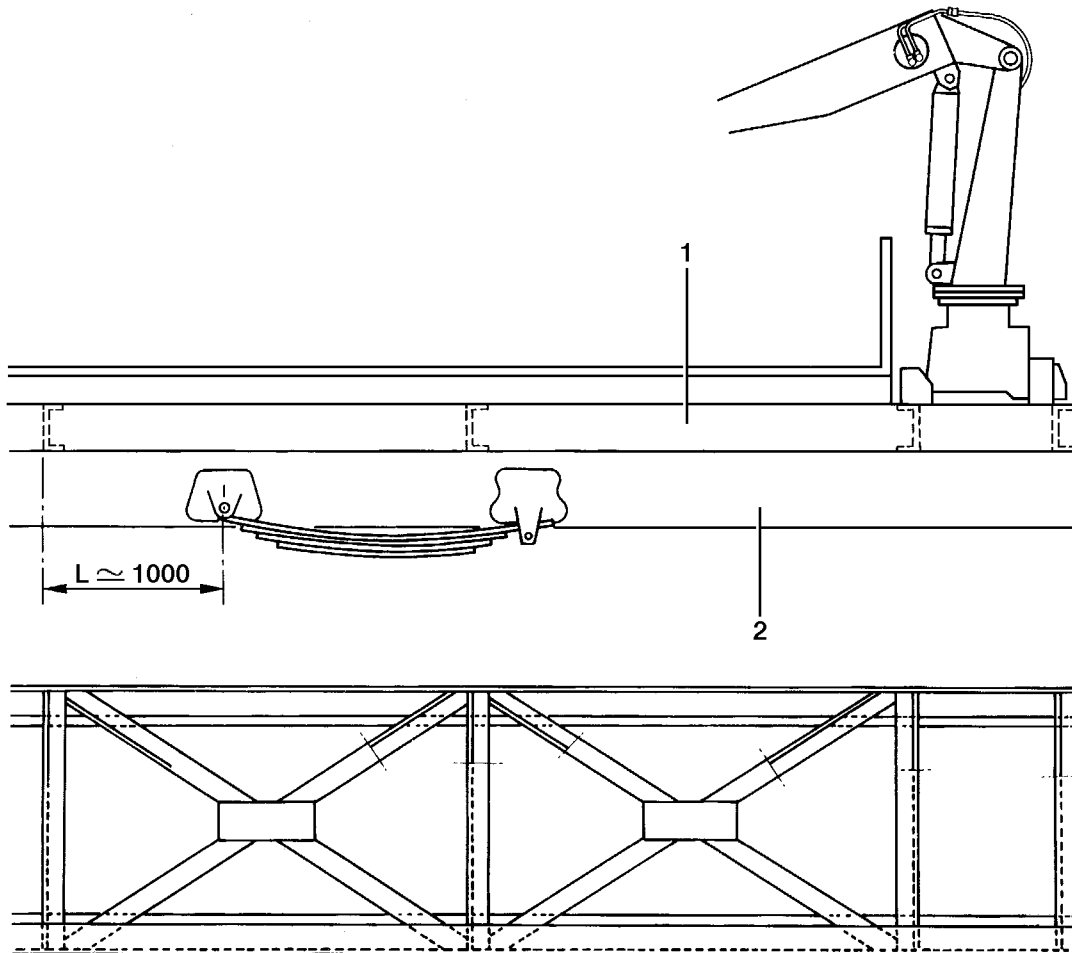
The installer of the crane is responsible with regard to compliance with the regulations, and also for the stability of the vehicle. The recommendations of RENAULT V.I. are only concerned with the attachment of the equipment.

The sub-frame required for such assemblies must be diagonally braced in accordance with the diagram below, using **U-section beams with a module that is immediately lower** than that recommended for the sub-frames.

Example: A sub-frame made of size 140 U-section beams shall be diagonally braced with size 120 U-section beams.

For a crane mounted in the rear overhang, in addition to the recommendations contained in the "WARNING" paragraph above, the following must also be observed:

- The minimum front axle load, for a vehicle fitted with a body and equipped with crane.
- The maximum plated front axle load shedding: 5% of the value of the weight of the chassis cab on the front axle.



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- 1 - Sub-frame
- 2 - Vehicle chassis

3.7 Tail lifts

3.7.1 Sub-frames

In the majority of cases, the mounting of a tail lift involves the fitting of a sub-frame to the vehicle. Such a sub-frame must reinforce the entire length of the chassis, with the bevelled front end being located as far forward as possible under the cab.

The module to be used for the sub-frame must be determined for tail lifts:

- without landing legs, for a capacity of 400 to 2,000 kg
- with landing legs, for a capacity of 1,000 to 2,000 kg
- by referring to the graph of inertia of the sub-frame depending on the load to be lifted, plus the information contained in the paragraph entitled "Special Recommendations", which also deals with tail lifts with a capacity of 1,500 kg without landing legs and tail lifts with a capacity of 2,000 kg with or without landing legs.

3.7.2 Attachment

The tail lift is to be fastened in position with bolted plates. In all cases, the design of the attachment should involve that of the body sub-frame as well. Nut and bolt hardware is to be of class 10.9 fine pitch with a diameter of 12 mm. The plates are to be fastened in position with at least 6 nuts and bolts on each side of the chassis and by 3 bolts and nuts or only by welding to the sub-frame.

If necessary, it may be necessary to wedge the tail lift beam or plate on the lower flange chassis sidemember, so as to avoid flexing of the sidemember.

NOTE

Do not weld the bolted plate to the chassis.

WARNING

In all cases of conversions for tail lifts, it is absolutely essential to calculate the new length of body, to ensure compliance with:

- The maximum plated gross vehicle weight (GVW).
- The maximum load on the front axle, with the vehicle fitted with its body and equipped with tail lift.
- The maximum plated loads on the front and rear axles.
- The maximum rear overhang indicated in the Type Approval Department's descriptive sheet and the bodywork diagram.

If any loads are exceeded, you should consult the Product Applications Department.

3.7.3 Electrical connections for a tail lift

Electrical connections should comply with the recommendations set out in the chapters entitled "Fitting of specific equipment" and "Electrical equipment".

3.7.4 Special recommendations for tail lifts from 1500 to 2000 kg without landing legs

1,500 kg tail lift

- This is only possible using our chassis with a GVW equal to or greater than 16 tonnes.

2,000 kg tail lift

- This is only possible using our chassis with a GVW equal to or greater than 19 tonnes.
- For off-limits and for vehicles with a lower capability, consult the Product Applications Department.
- **Should the under-run guard have to be modified, care should be taken to ensure compliance with regulations in force.**

3.7.5 Graph of the moment of inertia of the sub-frame as a function of the lifting torque

- Draw a straight line joining the type of tail lift in question (lower part of the graph) to the mark corresponding with the height of the sidemember in mm.
- Draw a straight line from the value of the sidemember height.
- Read the value for the sub-frame at the intersection of these two lines.

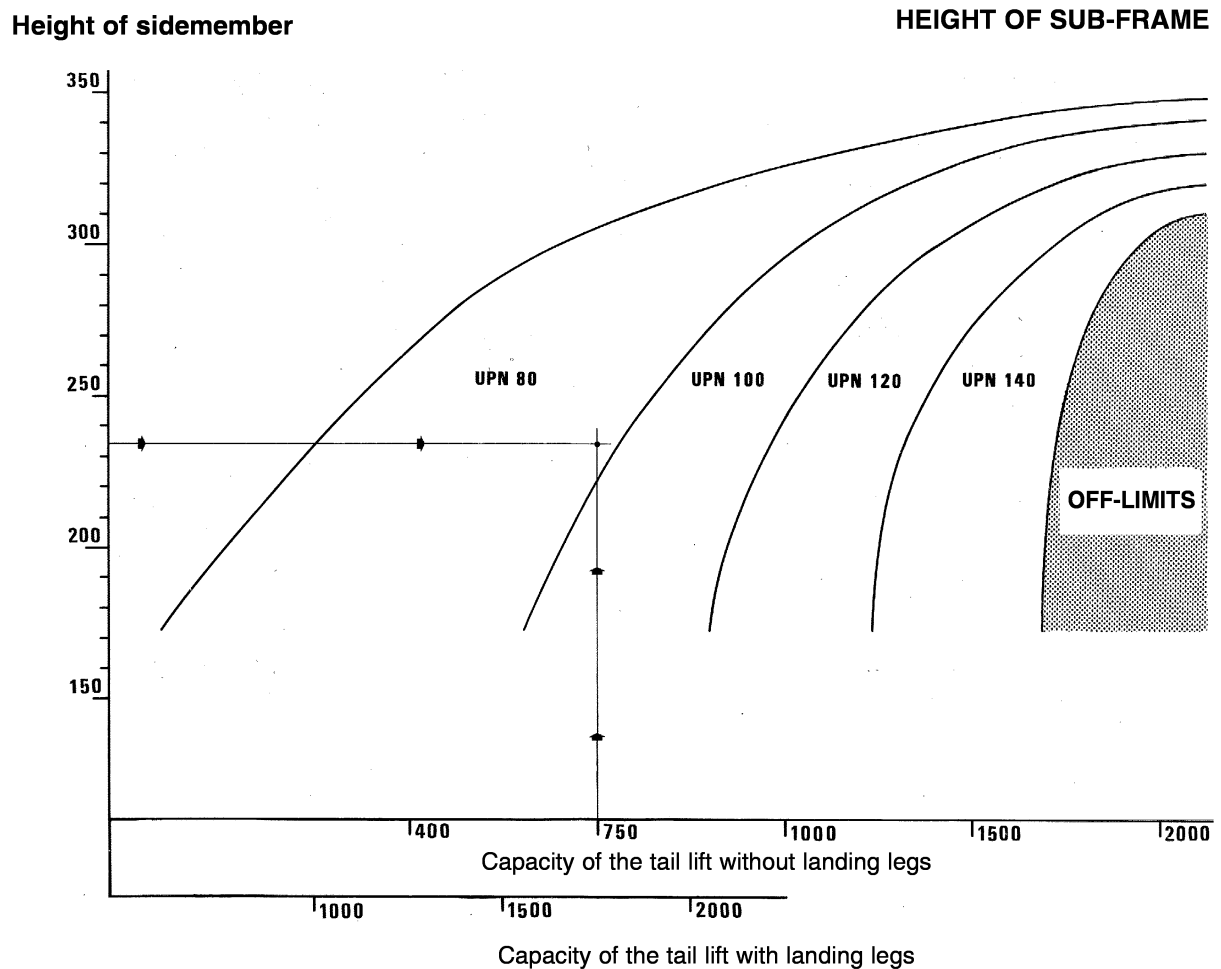
NOTE

For the mounting of tail lifts on 6 x 2 vehicles, it is essential to consult the RENAULT V.I. Product Applications Department.

Example:

Take a chassis with 234 mm high sidemembers, equipped with a 750 kg tail lift.

It requires a sub-frame made of size 80 U-section beams.



NOTE

The size 80 U-section beams can be replaced by any other section which gives an equivalent inertia (I/V).

UPN 80 : $I/V = 26500 \text{ mm}^3$

UPN 120 : $I/V = 60700 \text{ mm}^3$

UPN 100 : $I/V = 41200 \text{ mm}^3$

UPN 140 : $I/V = 86400 \text{ mm}^3$

3.8 Sub-frame box section

The recommended box sections should:

- be constructed in sheet metal which is as **thick or thicker** than that used for the sub-frame.
- stretch **over the entire rear** of the sub-frame, starting gradually at least **one metre in front of the foremost spring hanger** of the rear spring.

WARNING

If the sub-frame is to be constructed in a material other than commercially available U-section beams, we approve all other sections on condition that the modulus of inertia of the "truck sidemember + sub-frame" section, measured at the centre-line of the rear axle, be at least equal to the modulus which we recommend (refer to the previous page).

It is forbidden to make any butt welds on the sub-frame in the area defined **as follows**:

- from the centre-line of the rear axle up to 500 mm to the aft of the rearmost spring hanger of the rear spring, in the case of 4 x 2 and 4 x 4 vehicles.
- from the centre-line of the middle axle up to 500 mm to the aft of the centre-line of the rear axle, in the case of all other vehicles.

3.9 Fitting of specific equipment (for example: fridge, tail lift)

3.9.1 Electrical connections

Refer to the recommendations for use (chapter on "Electrical equipment" in the General Section).

The power supply cable should be in one single piece, with a cross-section calculated for a max. rating of 5 Amps per mm². The power supply must be protected by a fuse and controlled by a specific master switch during fitting. It is compulsory for the cables to be connected to the battery terminals. The fuse and the master switch must be located as close to the battery connection as possible (in order to keep to a minimum the length of unprotected line).

The electric power and auxiliary wiring must compulsorily be independent from that of the vehicle network.

For this, you should contact the Product Applications Department in order to obtain its permission.

In the case of conversion of an independent self-contained unit on the front end of the body, an access ladder and platform for maintenance purposes should be provided.

3.9.2 Installation of PTO's or generators with a voltage of more than 24 V

Comply with the standards in force and with the safety regulations covering installations and safety of the person (decree dated 14/11/1988). The protective earth is to be made on the equipment, and never on the vehicle structure.

3.10 Tapping on diesel fuel tank

It is forbidden to drill the tank for the installation of a tapping point.

3.11 Hitch coupling for rigid drawbar trailers

3.11.1 Fitting of an additional crossmember

If the rear crossmember fitted is too high, there is the possibility of fitting a second crossmember underneath the other.

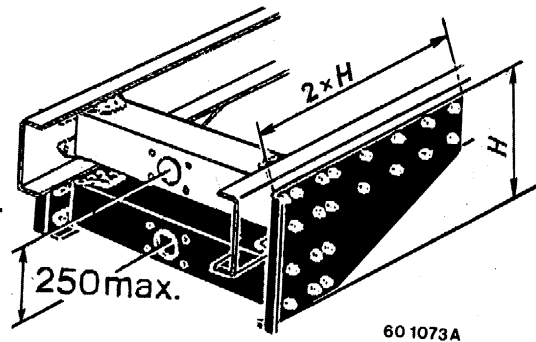
The fitting of this must be carried-out using reinforcement plates on the side rails of the sidemembers of the chassis. The attachment bolts of the upper crossmember are used for location of the reinforcing plates. In addition, two rows of eight bolts are to be fitted to each side which are attached to the sidemembers.

The crossmember is mounted on the reinforcement plates and has the same alignment as the crossmember used on the standard vehicle. Use all the holes in the crossmember for the attachment of this. Put in a spacer on each side to take up the space between the new crossmember and the reinforcement plate.

3.11.2 Minimum thickness

of reinforcing plates

Thickness = 1.2 x thickness of the sidemember.



3.12 Fifth wheels (baseplates and couplings)

plings)

Tractor chassis are normally supplied as original equipment with **bolted angle irons**. In this case they allow for the longitudinal positioning of the baseplate for the fifth wheel on the chassis, in order to ensure **good load distribution** on the tractor axles.

The fifth wheel is located on these angle-irons by the use of a crossmember and/or a baseplate (in certain cases the baseplate is sufficient).

The fitting of the fifth wheel must allow for the manoeuvring of a swan-necked semi-trailer in accordance with the ISO Standard in force.

The bedplate and the baseplate must be independently mounted, with a **minimum strength equal to that of the attachment for the fifth wheel**.

Baseplates for each type of vehicle are available in several heights from the Spare Parts Department.

Refer to the Product Applications Department.

3.12.1 Mounting standards

Comply with the standard in force.

Kingpin 50 mm (2") dia.

The attachment of the fifth wheel to the chassis must be done using 12 bolts size **M 16**, quality class 10.9.

Kingpin 90 mm (3.5") dia.

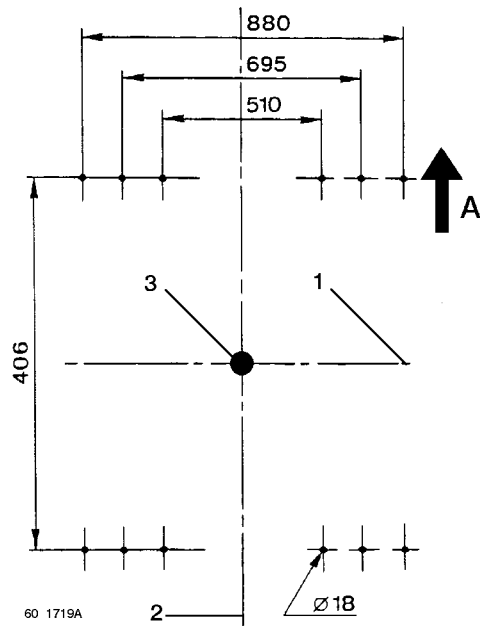
For details of the attachment of the fifth wheel, refer to the Product Applications Department or comply with the recommendations of the supplier.

These values apply equally for the attachment of the baseplate.

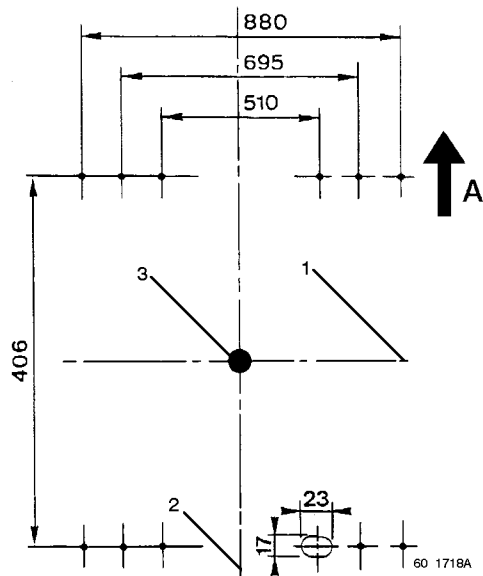
As far as swan-necked semi-trailers are concerned, which are not constructed in accordance with the ISO Standard in force, the attachment of the fifth wheel must take into account the instructions given above, whilst **conforming with the capability of the tractor to manoeuvre**, i.e. it must not come into contact with parts of the chassis, such as mudguards, rear lights, registration plates, the back end of the chassis, the tyres, etc.

If the movement of the fifth wheel towards the front causes any interference of the mounts of the baseplate with those of a crossmember, you are obliged to refer to the Product Applications Department.

Drawing for drilling the baseplate for the attachment of the fifth wheel using 12 bolts \varnothing 16 mm (DIN Standard 74081)



Drawing for drilling the baseplate for the attachment of the fifth wheel by 12 bolts \varnothing 16 mm with slotted holes (Standard NF R 41-171 dated October 1986)



- A - Direction of movement of vehicle
- 1 - Lateral axis
- 2 - Longitudinal axis of the tractor engine
- 3 - Kingpin axis