STIGA

WORKSHOP MANUAL

e-PARK 220
2018 - 2021

ALPINA Mountfield ATCO CASTELGARDEN

WORKSHOP MANUAL

e-PARK 220

EDITION 2018

TABLE OF CONTENTS

INTRODUCTORY NOTES

The purpose of this manual is to provide a complete set of instructions related to servicing, maintenance, disassembly, repair and installation of the mechanical components for above mentioned machine.

All trained Servicing personnel must use this manual during all adjustment, disassembly and troubleshooting activities.

IMPORTANT NOTE - The information contained herein is destined exclusively to the Service Centres and professional operators, with the required expertise to perform, and use the correct equipment, all the operations described, with the objective of safeguarding machine performance and safety.
The Manufacturer is under no circumstances liable for any damage or injuries due to interventions performed by private individuals or inadequate facilities.

The manual has left out the simplest and quickest operations that can be handled by a good mechanic, while concentrating more on specific aspects with tips and advice on the best servicing procedures.

Please take the time to read through this manual to acquire a basic understanding of the machine, which is necessary for working rationally without making errors or wasting time. All problems related to user procedures are fully covered in the User manual.

All the information provided refer to the original versions of the machines, excluding therefore interventions on equipments which have been subject to modifications that have altered their characteristics or components.

1 - INTRODUCTION

Summary

1.1 HOW TO USE THE GUIDE

1.1.1 Limitation of Responsibility

Despite the efforts made to ensure accuracy in the producing this manual, errors and inaccuracies may be found in the content. The author is not responsible for any missing or incorrect information. The Manufacturer reserves the right to make any modifications to the product without warning or any obligation to promptly update this manual.
The introduction of new procedures or indications in addition to those contained in this Manual are reported to the Service Centres by means of ad hoc bulletins and press releases.

All information contained herein is based on data available at the time of publication.
The drawings and photos included herein, may not correspond exactly to the machine on which the intervention is required.

1.1.2 Structure of the Manual

The manual is divided into chapters, paragraphs and sub-paragraphs.
- The front inside cover provides the table of contents indicating the various chapters.
- Each chapter is dedicated to a specific topic, and is preceded by an index that marks the various paragraphs contained therein.
- Each paragraph is further divided into sub-paragraphs, relative to a single procedure.

Cross-references to other parts of the manual are indicated by the symbol **[☛ ...]** followed by the relevant chapter, paragraph or sub-paragraph number.

1.1.3 Symbols and Definitions used

a) Symbols

They are used to draw the attention of the operator, reminding him to perform the interventions with the necessary attention and caution.

Indicates operations that should be carried out with utmost care to avoid jeopardizing the functionality and safety of the machine.

Indicates operations that should be carried out with utmost care to avoid injury to operators.

➤ Highlights all those operations that require different working methods depending on the type of machine, subsequent modifications and accessories fitted.

☛ Indicates the cross-reference to other parts of the manual, followed by the number of the relevant chapter, paragraph or sub-paragraph.

b) Safety terminology and notes

Some paragraphs are preceded by a definition that highlights their importance:

NOTE *General reference for the correct maintenance execution and methods.*

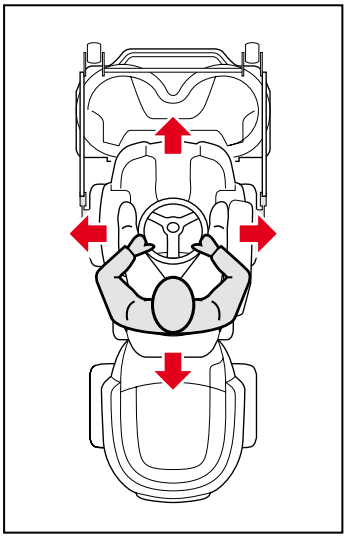
IMPORTANT *Specific procedures or information necessary to avoid damage to the machine or equipment.*

WARNING! ***Non-observance will result in the risk of injury to oneself or others.***

DANGER! ***Non-observance will result in the risk of serious injury or death to oneself or others.***

c) Spatial references

Whenever reference is made to a position on the machine “front”, “back”, “left” or “right” side, this refers to the positions of the seated operator.



d) Abbreviations and glossary

The following abbreviations are used in this manual

Rh / Lh	= Right / Left
Min / Max	= Minimum / Maximum
Chap.	= Chapter
Par.	= Paragraph
PTO	= Power takeoff

The terms “*Cutting deck*” or “*Equipment*” refer to the cutting-means assembly, connected to the machine PTO by means of a belt.

1.2 WORK SAFETY INSTRUCTIONS

1.2.1 Qualification of operators

All maintenance, disassembly and repairs must be carried out by expert mechanics who are familiar with all the accident prevention and safety regulations after reading through the procedures in this manual.
Regarding the electrical system in general, the motors and the electronic management equipment, the interventions must be carried out by competent personnel in the electrical and electronic field, well versed in the use of information systems.

1.2.2 Preparing to work

Before starting any work, it is very important to provide adequate preparation to achieve more efficient work. A clean work area at the beginning of each intervention makes for quicker and easier repairs.
To reduce the nuisance of having to search for tools or parts out of place, place the parts removed on a clean work surface, with all the fixing bolts arranged in their order of disassembly.
Organisation is a key element for correct reassembly. The required utensils, tools and components must be gathered before starting work.
Interrupting a job to locate tools or components is a useless waste of time.

1.2.3 Precautions during servicing

The operations described in this manual do not entail particularly hazardous situations besides the normal hazard related to mechanical operations and that can be avoided by taking the necessary care and attention normally required for this type of work.

As well as following the usual accident prevention regulations that apply to most repair shops, we recommended you:

- remove the ignition key before beginning any repair work;
- protect hands with suitable protective gloves, especially when working near the cutting unit;
- let the electric motors to cool down before starting any repair or maintenance work.
- do not wear rings, bracelets, necklaces or similar items when working on batteries, as they may cause a short circuit or fire;
- when working near batteries and electric motors, take the utmost care not to perform actions that could cause accidental contacts with live cables and cause short circuits or fires;
- do not dispose of waste with high environmental impact . Dispose of all waste in accordance with the laws in force;
- ensure that other persons cannot accidentally carry out actions that may physically endanger those working on the machine.

1.3 SERVICE CENTRE PROCEDURES

1.3.1 Machine registration

The Warranty registration card must be completed, signed and returned at the time of purchase. This activates the warranty card.
Claims that meet the requirements will be honoured during the limited warranty period.

1.3.2 Validity and interventions under warranty

The Manufacturer acknowledges the interventions performed under warranty as per the terms, procedures and limits stated in the contract.

1.3.3 Exceptions to the use of the Warranty

• The warranty does not cover damages caused by:
- Lack of knowledge and familiarisation of the accompanying documentation on the part of the user.
- Carelessness.
- Incorrect or prohibited use or assembly.
- Use of non-genuine spare parts.
- Use of accessories not supplied or approved by the manufacturer.

• The warranty does not cover components normally subject to wear and tear such as blades, belts and so on.
• With regard to the drive unit, motor, batteries and electronic equipment, the warranty terms stipulated by the respective manufacturers apply.

The purchaser is covered by national legislation of the Country he resides in. The legal rights of the laws that refer to the purchaser are not limited by this product warranty.

1.3.4 Service repairs outside warranty

For each intervention on the machine, the Service Centre must compile a report containing the serial number, a summary of the problems, the repairs carried out and any spare parts used for each repair done on the equipment.
A copy of these reports must be retained and made available to the Manufacturer together with the replaced parts in case of any subsequent disputes with Customers.

1.3.5 Fault notification

The Manufacturer welcomes any notifications of faults that recur with particular frequency. It gives the opportunity for a careful inspection of the problem and the implementation of corrective action at production level.
Similarly, the Manufacturer will report any faults discovered on the machines produced, with recommendations for the most suitable procedures for their remedy.

1.3.6 Spare parts requests

When requesting spare parts, the code number must be given, referring to the exploded charts for the year of manufacture, shown on the product identification label.

2 - INFORMATION FOR SERVICE CENTRES

Summary

2.1 GENERAL INFORMATION

2.1.1 Identification of the machine and main components

a) Machine

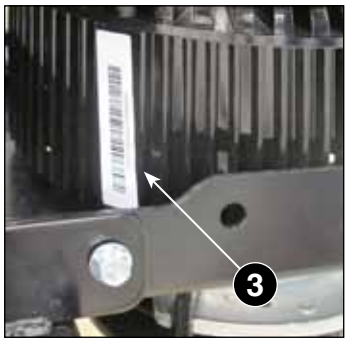
Each machine has a label (1) behind the seat which shows the technical specifications, the model and the serial number.
The model and serial number must be shown on each repair sheet when requests are made under Warranty, and are indispensable for spare part orders.

b) Transmission

The machine is equipped with a transmission unit powered by an integrated electric motor. This component is supplied by an external manufacturer and is built to precise technical specifications that set it apart from other similar products manufactured by the same manufacturer. The serial number on the label (2) allows the product and its characteristics to be correctly identified and must be always mentioned when ordering spare parts or requesting information from the Manufacturer.

c) Blades' motor

The electric motor operating the blades is supplied by an external manufacturer and it is built to precise technical specifications that set it apart from other similar products produced by the same manufacturer. The serial number on the label (3) allows the product and its characteristics to be correctly identified and must be always mentioned when ordering spare parts or requesting information from the Manufacturer.



2.1.2 Safety measures to be adopted

All the machines are manufactured in accordance with the strict European safety regulations in force. To maintain these levels of safety in the longer term, the Service Centres should work to this end by making appropriate checks every time there is the chance to do so.

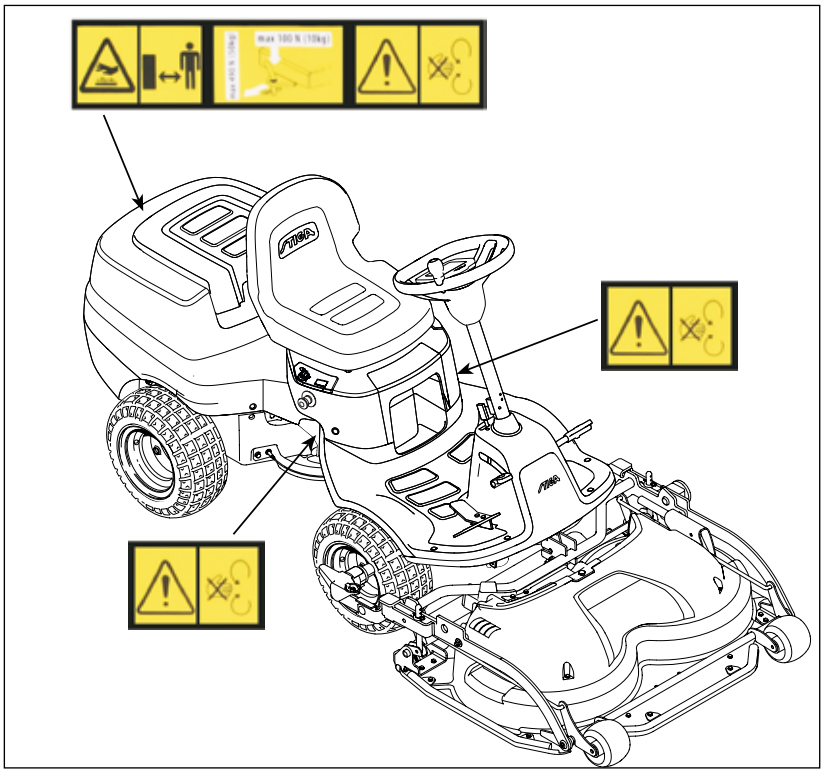
In particular, every time there is work done on the machine the Service Centre should:

• check:

- the correct functioning of the safety devices;
- that the casings and protection covers have not been removed;
- that the labels with instructions or provisions have not been removed or have become illegible (these form an integral part of the safety system).

• and also:

- restore to proper working order any safety devices which have been manipulated or removed;
- reassemble inefficient, damaged or missing casings and protection covers;
- replace all illegible labels, following the illustration below;
- clean the inside of the cutting deck with water and a non-metal bristle brush;
- touch up the painted parts where the paint is scratched or missing;
- not endorse any repair or modification on the machine or the motor which results in a change in performance or use that is incorrect or different from the purpose for which it was designed and approved;
- warn the Customer that failure to comply with the above points automatically voids the warranty and the responsibility of the Manufacturer.



2.1.3 Basic equipment

All the operations can be carried out with the tools normally available at any good motoring Servicing Centre.
In regard to the electric and electronic part it is necessary to have suitable control instruments as indicated in the specific chapter of this manual [☛ 8] - [☛ 9].

2.1.4 Handling and lifting the machine

DANGER! *The machine must never be lifted by means of a hoist or other means of lifting involving ropes.*

IMPORTANT *For all the operations involving the partial lifting of the machine the cutting deck must be removed.* [☛ 7.1]

a) Front part lifting

WARNING! ***Engage the parking brake and place two wedges behind the rear wheels to prevent the machine from moving.***

– Lift the machine by means of a jack acting under the front axle of the machine

– Stabilize the machine with one or two stands placed in correspondence of load-bearing elements of the front part of the frame.

b) Rear end lifting

WARNING! ***Position two wedges in front of the front wheels to prevent the movement of the machine.***

– Raise the machine using a jack underneath the towing bracket.

– Stabilize the machine with one or two stands placed in correspondence of load-bearing elements of the rear part of the frame.

2.1.5 Tightening torque settings

The table shows the tightening torque settings for screws and nuts to be applied according to their size, except for different situations indicated in the manual regarding a specific procedure.

Threading	M5	M6	M8	M10	M12
Tightening torque	6 Nm	10 Nm	24 Nm	47 Nm	84 Nm

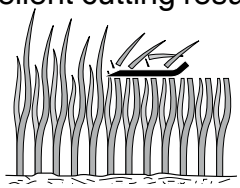
2.2 SPARE PARTS

2.2.1 Non-original spare parts

Use original spare parts only. Replacement of any machine component with anything other than a part authorised by the Manufacturer can adversely affect performance, working life or safety of this machine and will void the Warranty.
The manufacturer disclaims all liability for any claims or damages, albeit under warranty, property damage, personal injury or death resulting from the use of unauthorised spare parts.

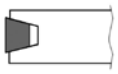
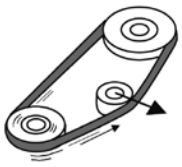
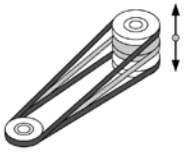
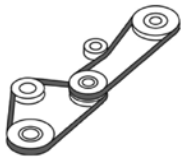
2.2.2 Characteristics of the original blades

The original blades have design, material and processing characteristics optimised for use on the equipment for which they were designed; these characteristics are not present in so-called "compatible" spare parts.
The table emphasises the reasons why it is important to choose an original blade, useful when making such decisions.

Requirement	Remarks
No breakage of the blade ends. 	Using steel balls, the manufacturer simulates what can happen when mowing over any foreign bodies on the lawn. This can ruin the blade edge, but no component can come loose, fall off or be hurled away.
No breakage of the blades. 	The impact test is the most severe durability test that any lawnmower can be subjected to. An iron tube is placed exactly inside the blades when the mower is running. The blade may deform but it will never, under any circumstances, fall off or break. This test verifies that blades and other components meet the high safety requirements.
Excellent balance. Minimum noise. Minimum vibrations. 	The blades and blade ends supplied by the authorised dealer all have exactly the same weight. The blades and blade ends supplied by the authorised dealer are all perfectly balanced. This guarantees minimum noise and vibrations, for maximum machine operating life. This also ensures that the machine complies with the noise and vibration regulations.
Excellent cutting result. 	The blades and blade ends supplied by the authorised dealer are optimised for the application for which they are intended. In short, this means that the blades are suitable for the shape of the casing and to the number of revolutions to provide the best possible cutting result.

2.2.3 Characteristics of the original belts

The standard belts on the market have different characteristics compared to the requirements of the original spare belts, supplied by the authorised dealer. The latter are designed and manufactured in close cooperation with the belt supplier and the machine manufacturer.
The table emphasises the reasons why it is important to choose an original belt, useful when making such decisions.

Example	Belts available on the market	Original spare belts	Notes
Adhesion on the pulley. 	The belt rests with the sides inclined against the walls of the pulley. There must be a gap between the belt and the bottom of the groove.	The belt rests with the sides inclined against the walls of the pulley. There must be a gap between the belt and the bottom of the groove.	Same requirements. The original spare belts ensure perfect adhesion on the pulley.
Acceleration. 	Some belts only engage with the pulleys when the motor is running at operating speed and this generates excessive heat.	The belt follows the speed of the motor in continuous acceleration until the maximum speed is reached.	Standard belts are made of natural rubber and only capable of withstanding temperatures up to 70°C. Original spare belts are made of chloroprene rubber capable of withstanding temperatures up to 90°C.
Length. 	Manufactured in standard interval lengths.	Made in a specific length designed to ensure perfect adhesion to the pulley.	The distance between the pulleys is fixed. The belt tensioner ensures that the original belt maintains optimal tension.
Floating pulley on cutting equipment. 	Designed to transmit power between aligned, parallel and fixed pulleys.	The original Power Take Off (PTO) belt is designed to work even if the pulleys move up and down and tilt at the same time.	The equipment follows the ground beneath it and this means that the pulley is constantly moving. To withstand extreme operating conditions, the original belts are made of fibre reinforced rubber.
Curvature in two directions. 	Designed to curve around the pulley in one direction.	Most of the belts installed on the machines have tensioning rollers that act on the outer side of the belt. This means that while the belt is being used it must tilt both inwards and outwards.	All the original belts, which work with tensioning arms acting on the external side, are equipped with reinforcements. The reinforcement is designed specifically for these specific cases.
Noise. 	Made without special requirements for this specific factor.	The original belts are carefully selected to limit the increase in noise produced by the machine during operation.	Depending on the function, one of the following belt types is suitable: • Coated • Anti-friction • Open sided

2.3 SERVICING

2.3.1 Servicing program

The Instruction Handbook has a number of operations to be carried out by the Customer for a minimum of basic maintenance, and other operations not always within his capacity.
For this reason, the Service Centre should be responsible for keeping the machine in perfect working order, by means of a periodic maintenance program, to be carried out at pre-established intervals (for example at the end of the season or in anticipation of a long period of inactivity), according to the following table which indicates the main interventions.

Intervention Type	Servicing		[☛ ...]
	First time	Hours/Months of use	
Tripping of the safety devices check	5	50 / 12	[2.4.1]
Tyre pressure check	5	50 / 12	[2.6.1]
Belt PTO check [1)]	5	50 / 12	[6.2.1]
Steering adjustment	5	50 / 12	[4.2.2]
General lubrication	5	50 / 12	[2.5]
Shaft lubrication on front wheels and quick couplings.	–	100 / 24	[2.5]
Transmission check [2)]	–	100 / 24	[--]
Test driving	–	50 / 12	[2.3.2]

Operation Notes:

1) Check that the PTO belt engages the rotation of the implement at the pre-set time and that it is not slipping during normal load operation. If necessary adjust.
2) Verify that the unit is operating correctly and without abnormal noises.

2.3.2 Test driving

If a cutting device or other equipment is provided, they must be installed before performing the test drive with the machinery. Drive the machine for a few minutes

– Check all functions. More specifically check that all safety devices are properly functioning.
– Make sure that there are no vibrations or abnormal noises; check that the steering, controls and pedals are working properly.

2.4 CONTRTOL OF SAFETY DEVICES

2.4.1 Logic of intervention of the safety systems

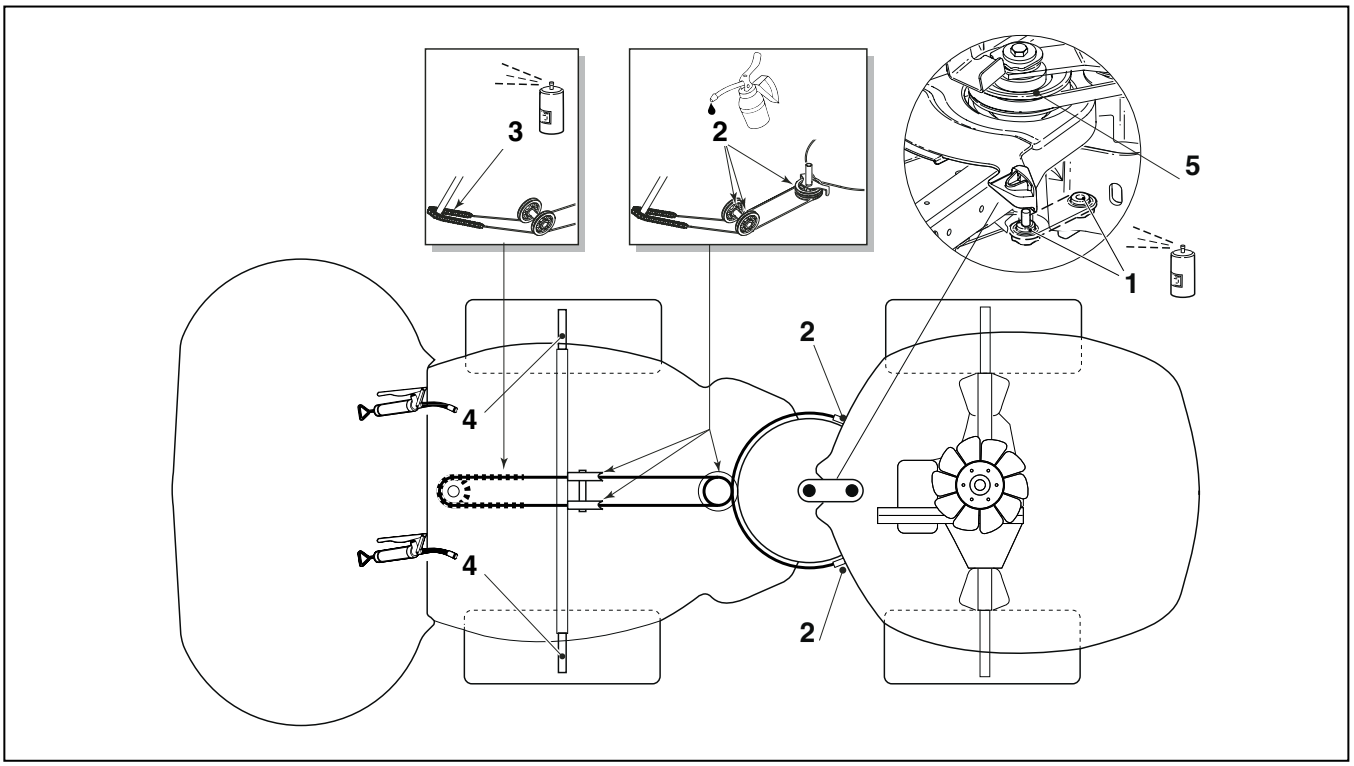
The safety systems intervene according to two basic criteria:
– To prevent ignition if ALL safety conditions are not met;
– To stop the machine operation (shutdown) if ONE or MORE condition is not met.

The table shows some typical situations.

Situation	Action	Result
• Operator seated. • Parking brake engaged. • Power take off deactivated • Emergency button deactivated	Rotate the key in the start position.	The machine starts without any error message.
• Machine switched on or in motion.	The operator gets up from the seat.	All services are deactivated and the "No operator" icon appears on the display. To reactivate all services push the parking brake pedal.
• Operator not seated. • Parking brake engaged.	Try turning on the machine	The machine starts but the "No operator" icon appears on the display.
• Operator seated. • Parking brake not engaged.	Try turning on the machine.	The machine starts but the "Wrong start-up" icon appears on the display.
• Machine on. • Power take off activated.	The operator gets up from the seat.	The power take off is deactivated and the "No operator" icon appears on the display.
	Move the mechanical lifting pedal to the transport position.	Power take off is deactivated.
• Cutting deck in maintenance position.	Try to plug in the power take off.	Power take off does not engage.
• Emergency button activated.	Try turning on the machine	The machine switches on but the traction control and the power take-off control do not work.
• Machine on.	Drive the machine forwards and backwards and release the drive pedal	The machine must slow down to a standstill.

2.5 LUBRICATION

All lubrication points listed in the following table must be lubricated every 50 hours of operation and after every washing of the machine



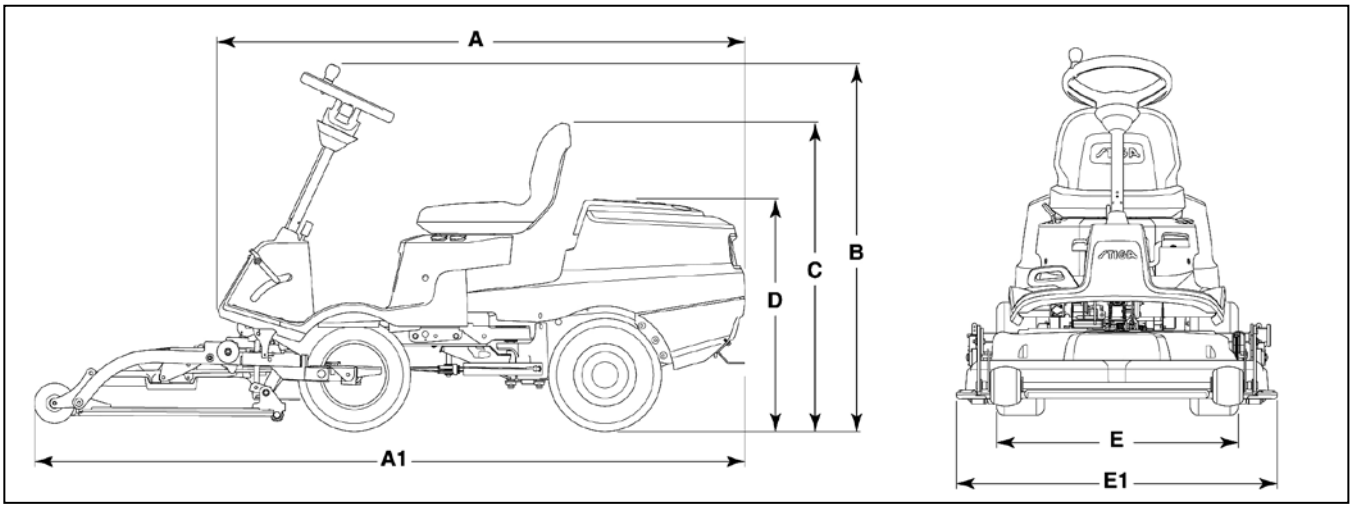
Point	Object	Action
1	Central point	Lubricate with oil
2	Pulleys and steering cables	Clean the cable ends with compressed air and lubricate them with oil while activating the control. Perform the operation with two people.
3	Steering chain	Clean with compressed air and lubricate with universal spray for chains
4	Front wheels axle	Remove the wheels and attachments of the equipment and lubricate the axle with grease.
5	Bearing in the joint	Lubricate with spray oil

2.6 TECHNICAL SPECIFICATIONS AND DIMENSIONS

2.6.1 Technical specifications

Electrical system..... 48 Volt
Batteries pack ..... 4.3 kWh
Charging time (at 100 %)..... 3 h
Working autonomy..... 1.5 h
Blades motor ..... 5 kW BLDC
Blades motor speed ..... 3000 rpm
Traction motor ..... 1,7 kW
Driving speed ..... 9 km/h
Weight ..... 274 Kg.
Front tyres ..... 160 x 50 - 8
Rear tyres ..... 160 x 50 - 8
Tyre pressure ..... 1 bar

2.6.2 Dimensions



A	A1	B	C	D	E	E1
1681	2279	1171	984	741	770	1023

3 - CHASSIS AND COVERS

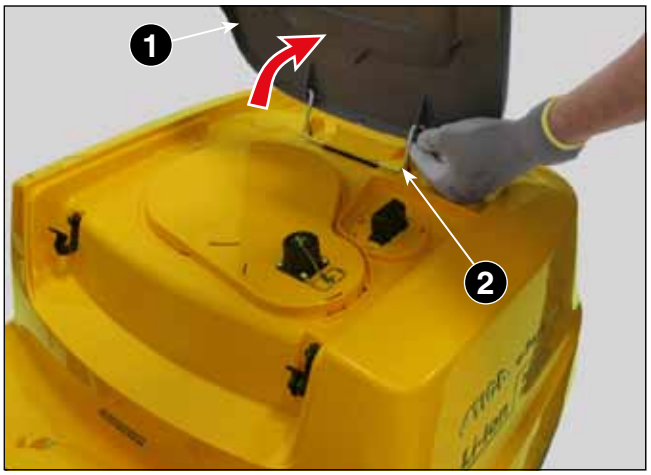
Summary

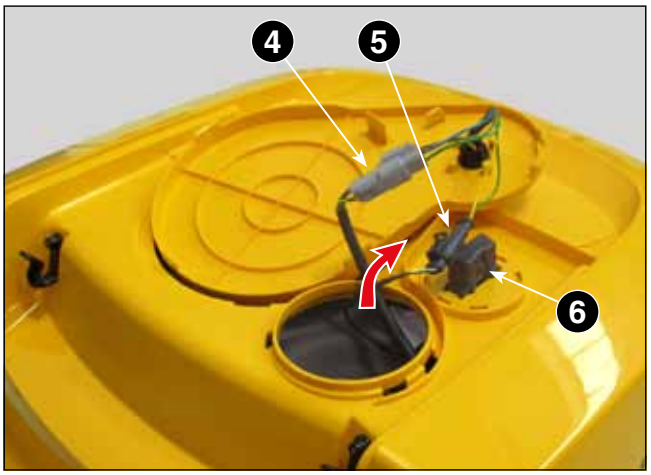
3.1 REMOVAL AND ASSEMBLY OF THE COVERS

3.1.1 Removal of rear cover

NOTE *Removing the rear cover makes the battery compartment and electronic control units accessible*

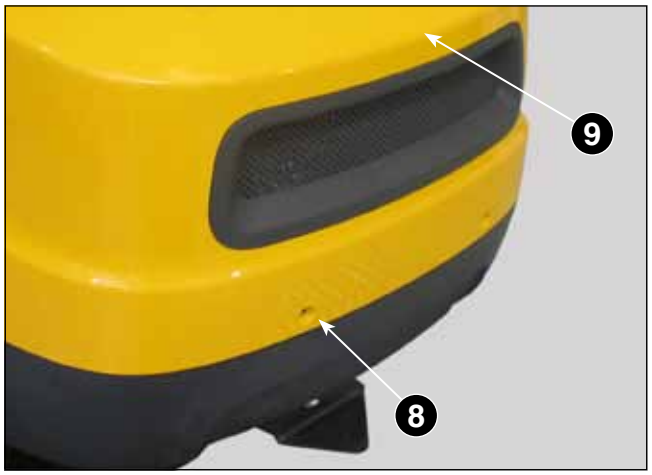
1. Fold over the upper part (1) and remove it by unlatching the hinge (2).
2. Lift the panel (3) to release it from the retaining tabs and lie it on one side.
3. Pull out and disconnect the two connectors (4) and (5).
4. Release the connector (6) from its slot by pressing the retaining tabs.





5. Unscrew the two front screws (7),

6. Unscrew the two rear screws (8) and remove the cover(9).

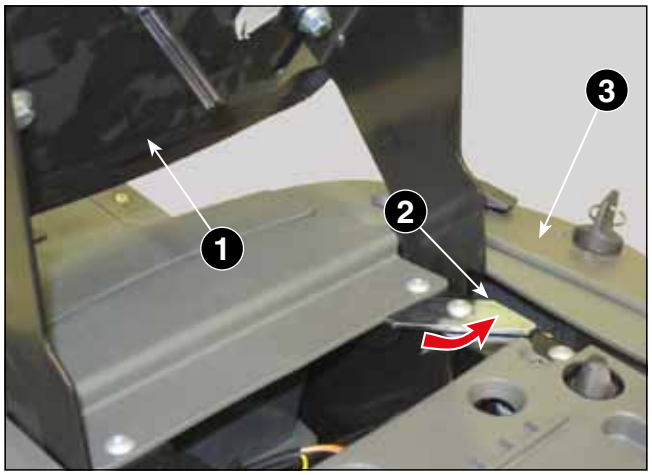


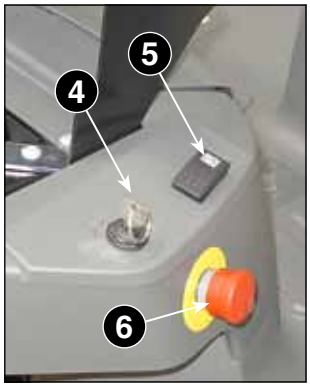
When assembling, perform the above steps backwards.

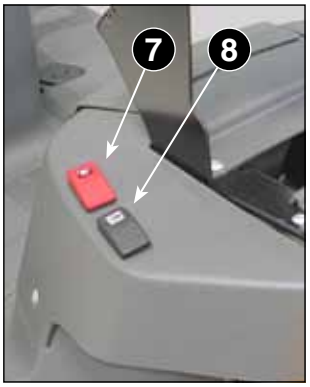
3.1.2 Removing the carter under the seat

1. Fold the seat forward (1) and engage the safety catch (2).

WARNING! ***The safety catch prevents the seat from accidentally falling out while working, which could result in hand injuries.***



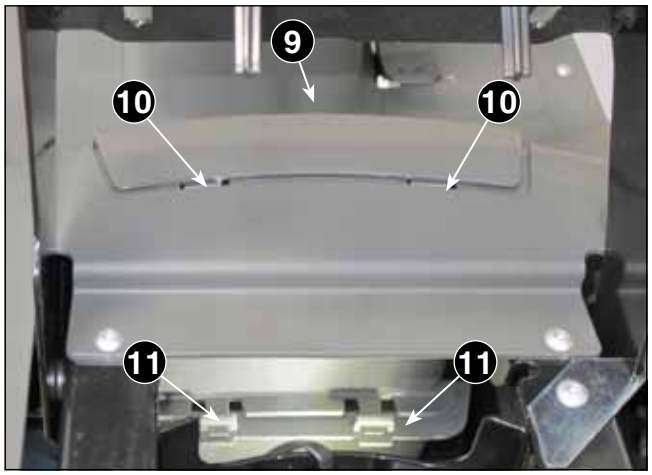




2. Disconnect all control connectors from the lower part of the housing (3):

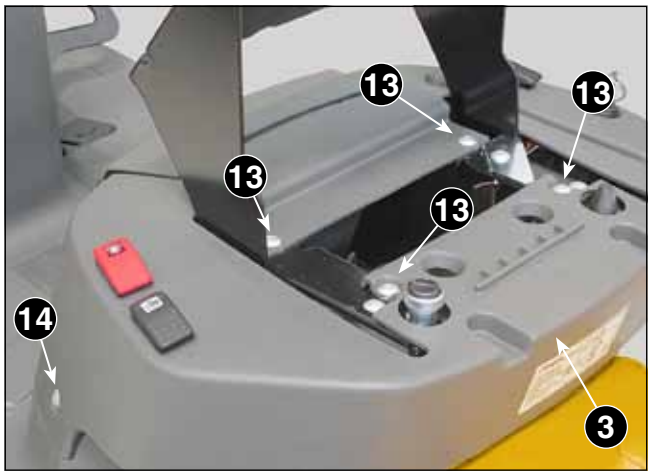
   – on the right side, activation key (4), cruise control (5) and emergency control (6);
   – on the left side, blade engagement switch (7) and height adjustment control of the cutting deck (8).

3. Disengage the upper (10) and lower (11) tab latches securing the compartment (9).



4. Remove the compartment (9), pushing it from the inside out.

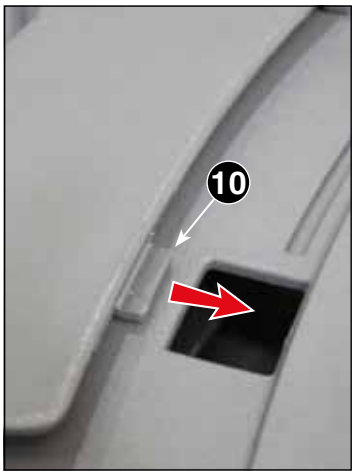
5. Unscrew the four upper screws (13), the two side screws (14) and remove the housing (3).

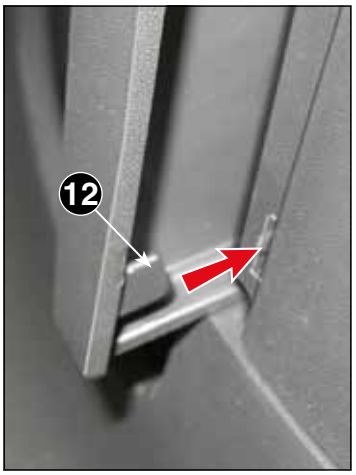


When assembling the compartment (9), make sure to insert correctly into their respective slots the upper tab latches (10), then the two side guides (12) and finally complete the coupling with the two lower tabs (11).

Complete the assembly by performing the above steps backwards,

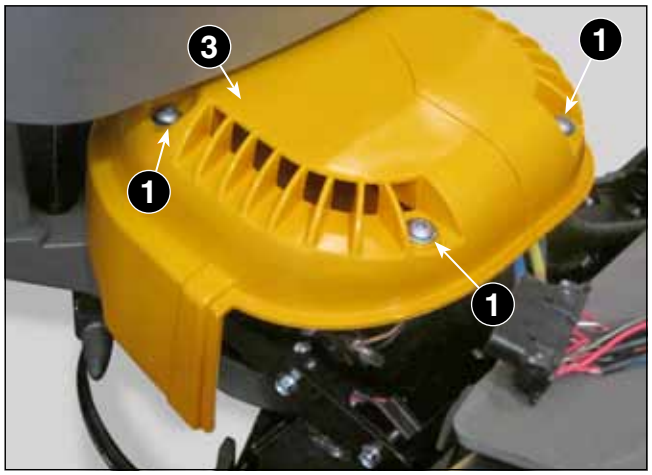
Reset all connectors and verify their proper operation. [☛ 8.3.1]





3.1.3 Removal of the blades motor

1. Remove the rear cover[☛ 3.1.1].

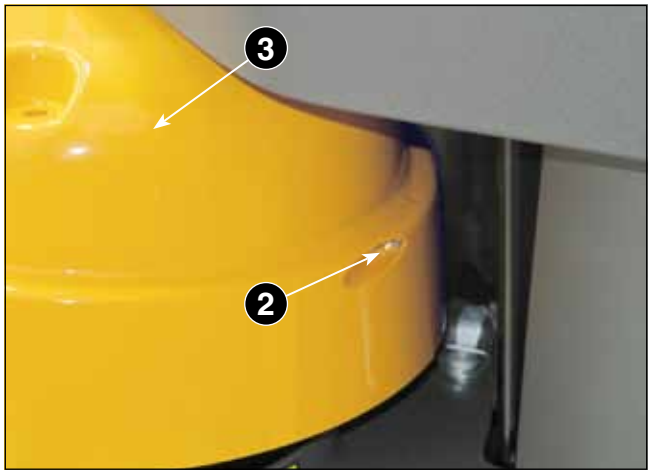


2. Loosen the four upper screws(1).

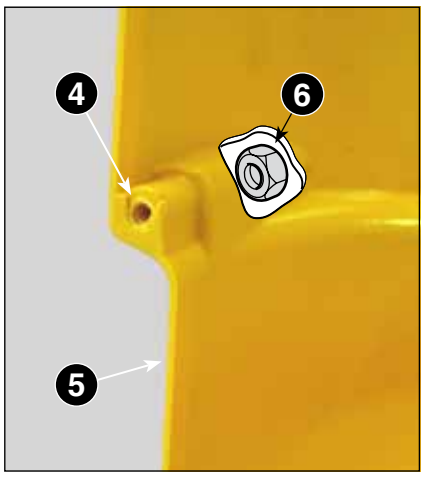
   NOTE *Access to the two front screws is facilitated by steering to the right and to the left.*

3. Loosen the screw (2) on the right side and remove the housing (3) consisting of two half shells.

When mounting, complete in reverse the steps described above, making sure not to exceed the tightening of the screw (2) to avoid striping the thread into the plastic of the of the left half shell



Should this be the case,



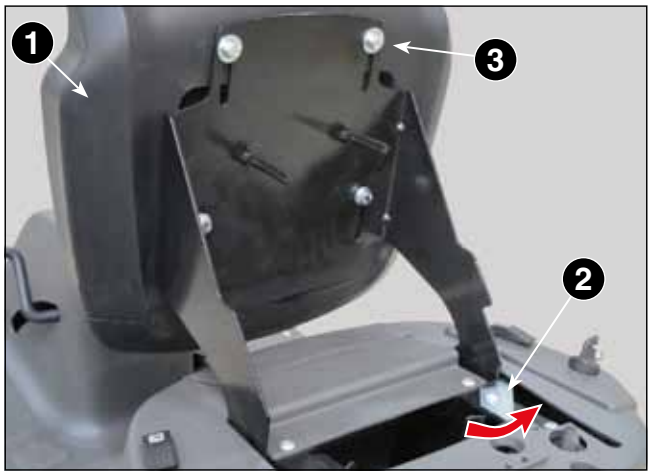
– Rectify the threaded hole (4) of the left half shell (5) with a 6 mm drill bit.

– Replace the selfthreading screw (2) with a M5 x 25 cylindrical head metric screw by adding an M5 nut (6) to be inserted in the hexagonal seat located at the other end of the hole of the left half shell.

3.1.4 Footplate Removal

1. Fold the seat forward (1) and engage the safety catch (2).

   WARNING! ***The safety catch prevents the seat from accidentally falling out while working, which could result in hand injuries.***

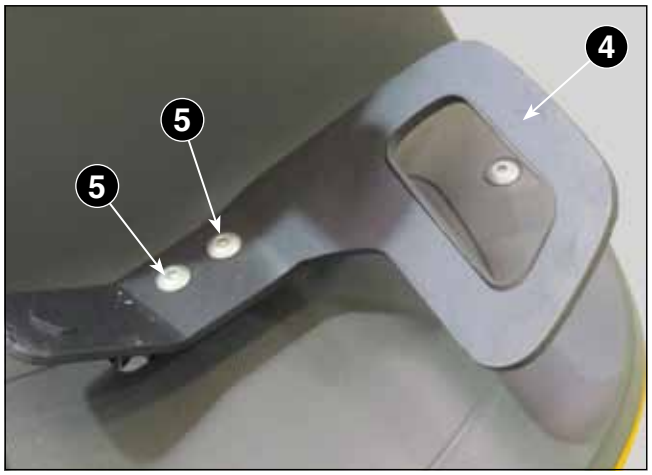


2. Remove the seat (1) secured by four screws (3).

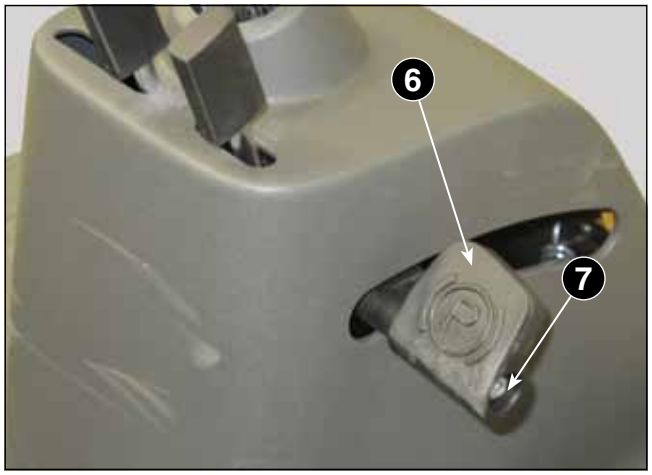
3. Remove the cover under the seat [☛ 3.1.2].

4. Remove the steering wheel and steering shaft [☛ 4.1.2].

5. Remove the drive pedal (4) secured by the screws (5).

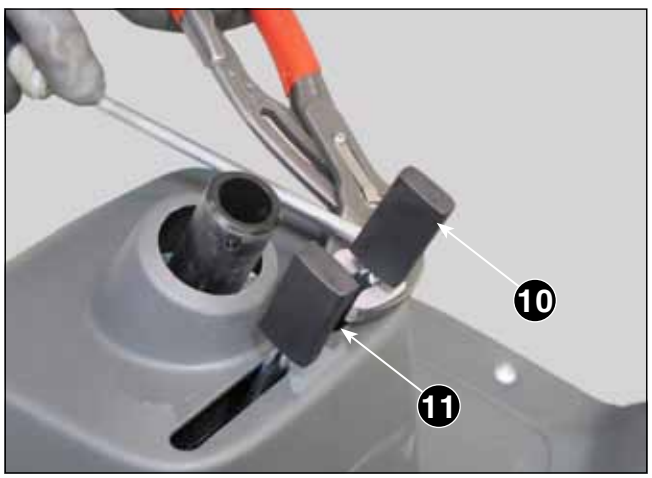


6. Remove the parking break pedal (6) secured by the screw (7).



7. Remove the pedal of the cutting deck lifting mechanism (8) secured by the screw (9).

8. Detach the locking knob of the parking brake (10) and the cutting deck lifting brake (11), pushing them from the bottom to avoid damaging them.



9. Unscrews the two rear screws (12),

10. Unscrew the four front screws (13),

11. Removed the lower part (14) of the footrest (15) the whole footplate can be removed.

When assembling, perform the above steps backwards.

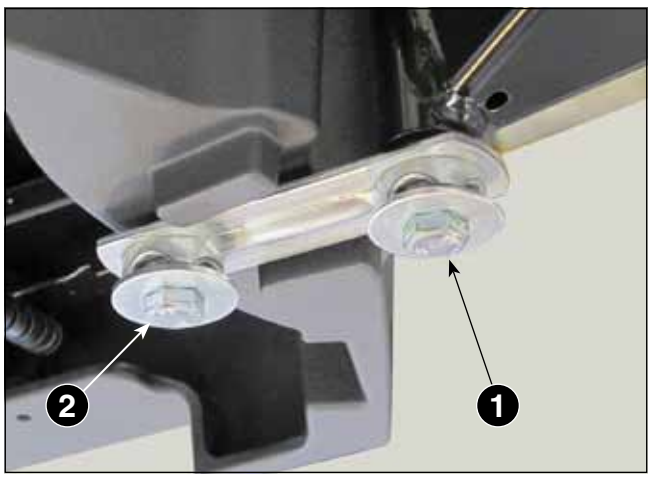
3.2 ELEMENTS OF THE ARTICULATION

3.2.1 Replacing the connecting arm

1. Unscrew the front screw (1 - 17 mm wrench).

2. Unscrew the rear screw (2 - 17 mm wrench).

3. Replace the connecting arm (3) then reassemble in reverse order, tightening the two screws with a torque of 50 Nm.



IMPORTANT *If you find it difficult to tighten the screw (1), lift the front frame to facilitate tightening.*

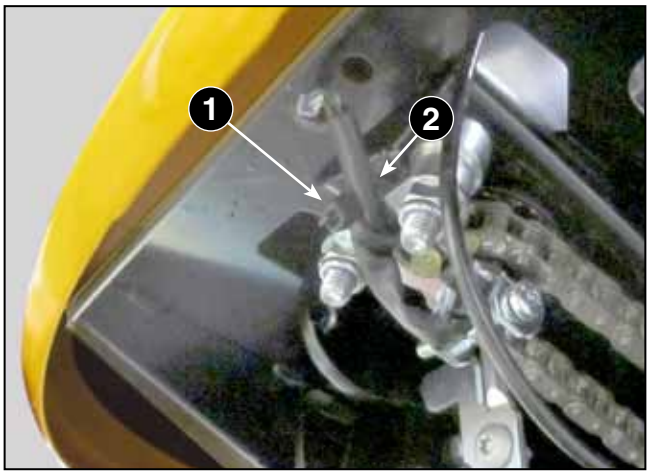
4 - STEERING

Summary

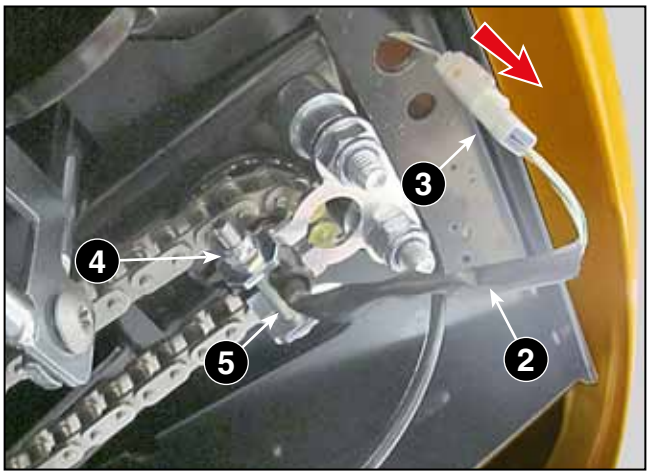
4.1 DISPLAY AND STEERING WHEEL

4.1.1 Removal and assembly of the display

1. Remove the clamp (1) securing the cable (2).

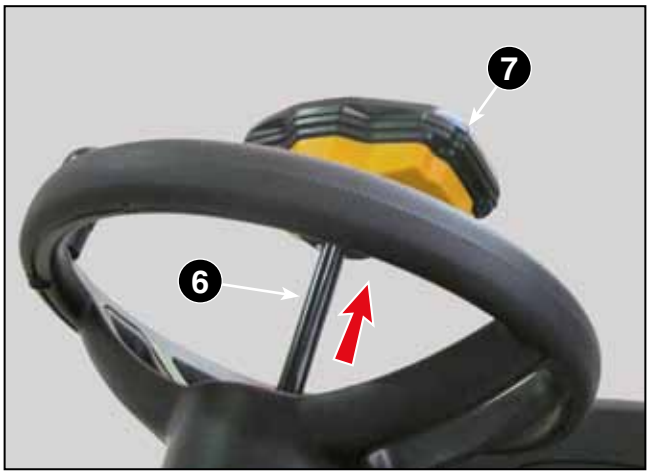


2. Carefully pull the cable out (2) until the connector comes out (3) of the frame hole and disconnect it.



3. Undo the nut (4) and remove the screw (5) that axially stops the rod of the display .

4. Pull out the rod (6) together with the display (7)

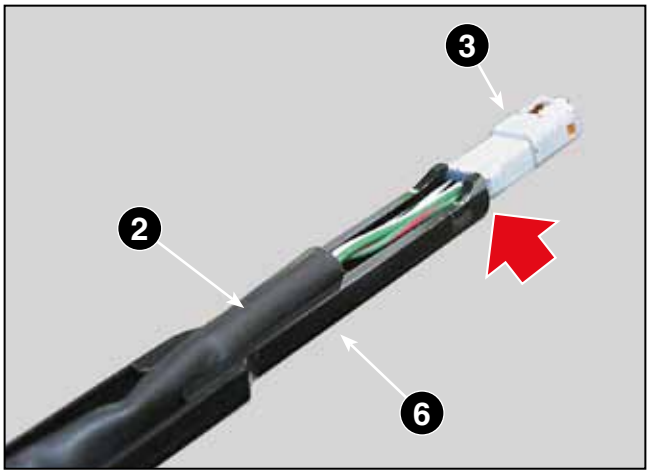


5. Loosen the two screws (8) that fasten the display (7) to the protective cover (9).

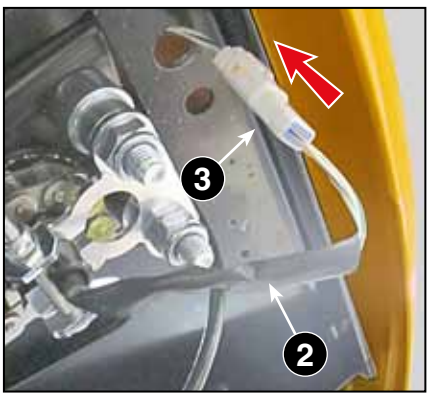
6. Push the display (7) slightly backwards, disconnect the connector (10) and then the display can be replaced, together with the cable (2) and the connectors (3) and (10).

IMPORTANT *The following procedure must be followed to ensure that the rod and the display can be reassembled correctly*

7. Carefully lay the cable (2) along the entire length of the housing in the rod (6).



8. Make sure that the connector (3) remains in contact with the rod terminal, as shown in the drawing.

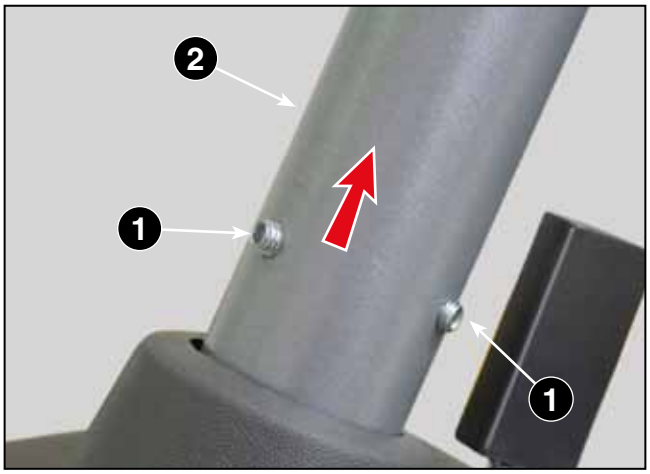


9. Reassemble all removed parts following steps 1 to 4 backwards making sure to:
   - Carefully pull the cable out of the rod, reconnect the connector (3) and return it into the frame hole.
   - Restore the clamp (1) so that the cable (2) does not remain loose.

4.1.2 Removing and replacing the steering column and steering wheel

NOTE *The operation will be made easier by positioning the machine with the two parts aligned with each other and the steering wheel straight.*

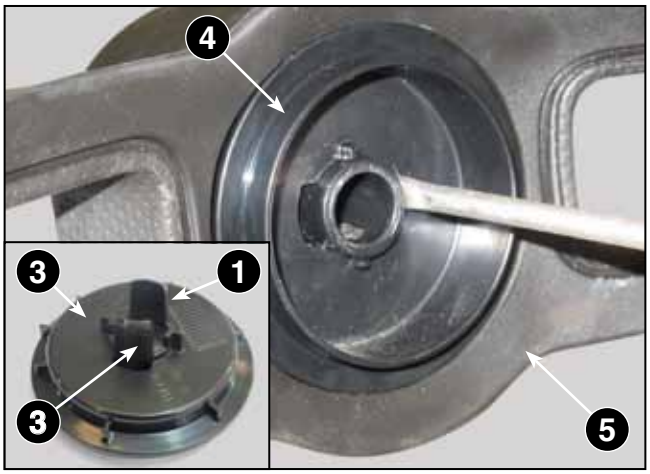
1. Remove the display rod following steps 1 to 4 of the "Removal and assembly of the display" procedure [☛ 4.1.1].



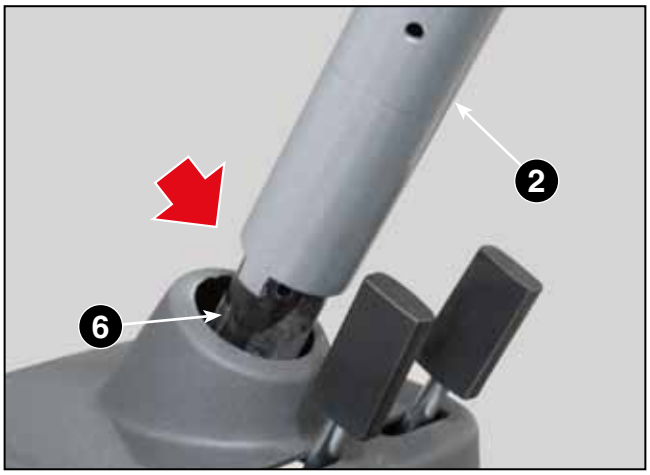
2. Unscrew the three grub screws(1) and pull out the steering column (2) with the steering wheel.

   NOTE *The steering wheel and steering column are supplied as a spare part like a pre-assembled unit. In case of replacement, some parts must be recovered and reassembled on the new component, as shown below.*

3. With the help of a screwdriver, release the two internal tabs (3), remove the cover (4) of the steering wheel (5) and refit it to the new steering wheel by snapping it in.



4. Reassemble the steering column (2) on the steering shaft (6). Position the steering wheel knob at the top, so that the two protrusions are perpendicular to the axis of the machine, in order to be aligned with the corresponding shaft compartments.



5. Screw the three grab screws back in (1) and tighten them well.

   NOTE *The position of the three grab screws along the circumference of the steering column is such as not to allow orientation errors during assembly, the correctness of which is proved by the complete screwing of the grab screws.*

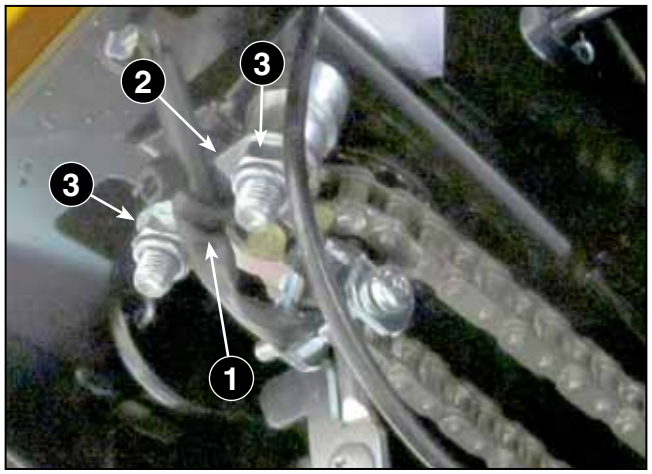
When assembly, carry out the above steps in reverse order, making sure to comply with steps 7 to 9 of the "Removal and assembly of the display" procedure [☛ 4.1.1].

4.2 COMMAND KINEMATISMS

4.2.1 Replacement of the chain and steering cables

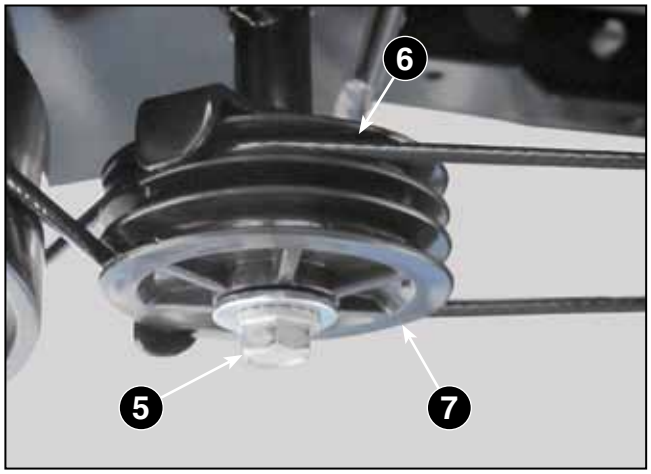
NOTE *Before starting the disassembly operations, it is advisable to note the path of the chain/cable system in order to avoid errors in the repositioning.*

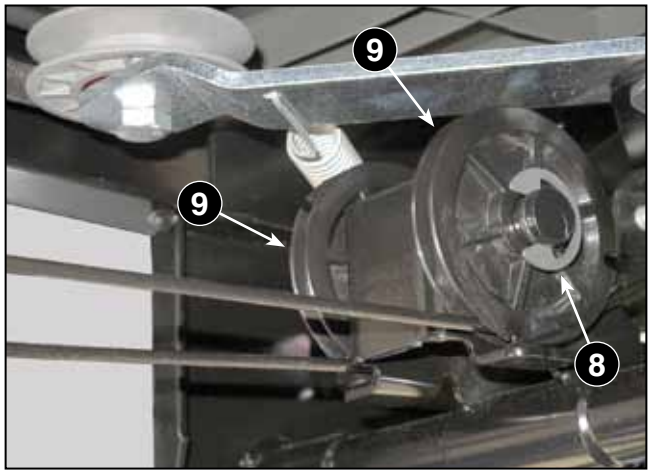
1. Remove the clamp (1) and remove the small plate (2) fixed by two nuts (3).



2. Unscrew both adjusters (4) on both the left and right sides of the machine.

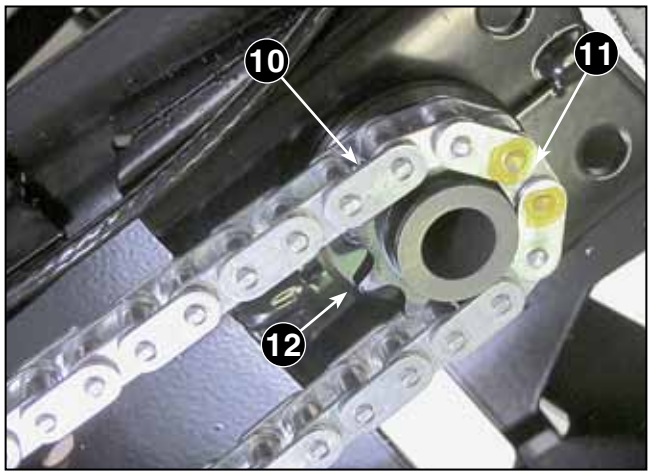
3. Loosen the screw (5) fixing the rear pulleys so that the cable can be removed from both the upper pulley (6) and the lower pulley (7).



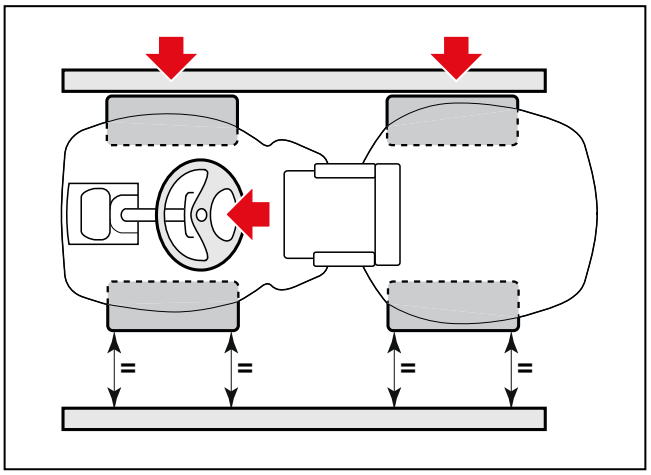


4. Remove the spring rings (8) and remove the two front pulleys (9).

5. Disengage the chain (10) from the pinion (12) and remove the chain/cable assembly

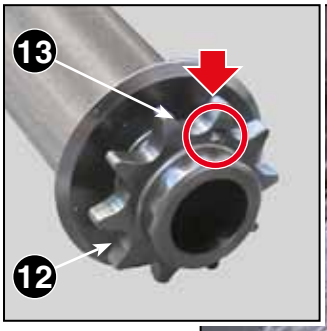


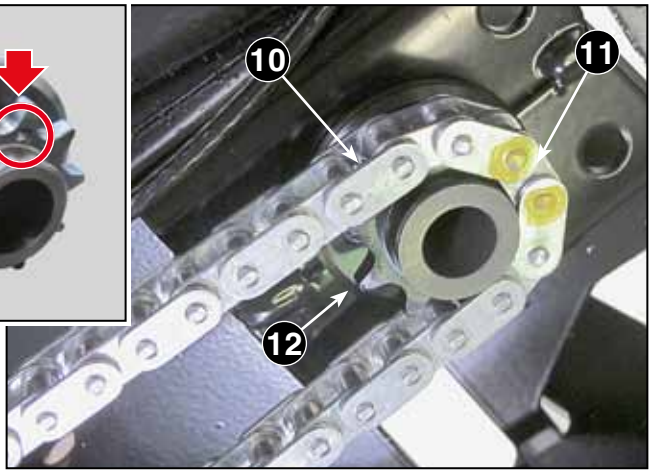
When reassembling:



6. Check that the front and rear of the machine are perfectly aligned, using the steering wheel in the straight position.

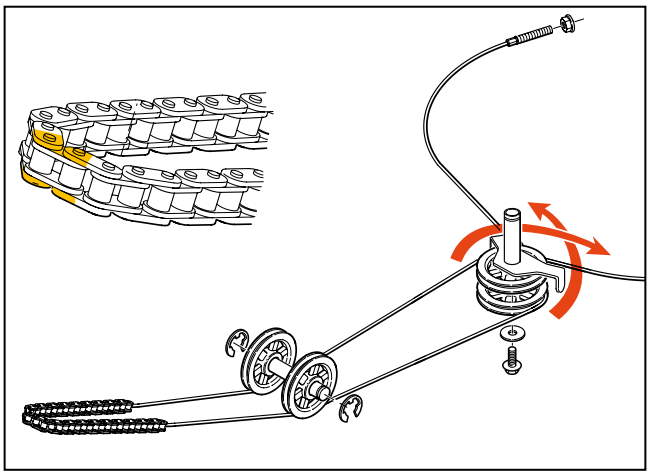
7. Identify the central link (11) of the chain (10), which can be recognised by a different colour, and assemble the chain on the pinion (12) so that it coincides with the marking (13) placed on the pinion tooth.



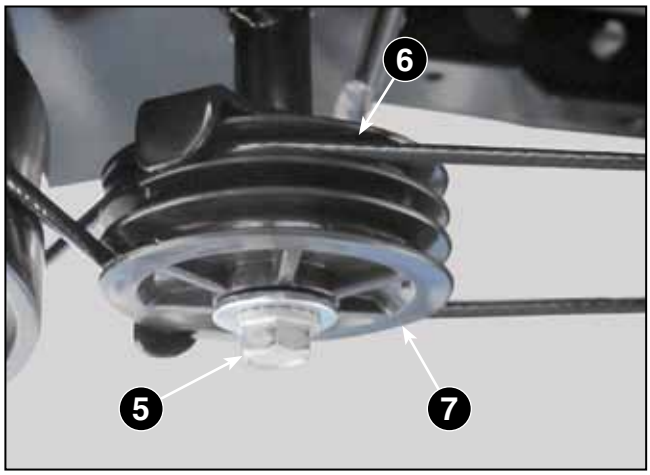


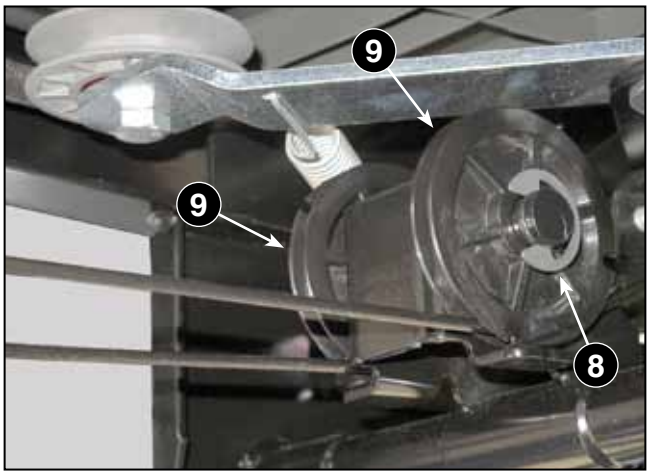
NOTE *With the wheels aligned and the steering wheel straight, the marking must be perfectly centred in the driving direction , in relation to the axis of the machine.*

8. Reassemble the two front pulleys (9) with the cables inserted in their respective grooves and secure them with the two spring rings (8).



9. Wind the two cables in the grooves of the two rear pulleys, following these instructions:
   – right branch = upper pulley = left register;
   – left branch = lower pulley = right adjuster;
   then fully tighten the screws (5).





10. Reassemble the two adjusters (4) on the rear frame and carry out a preliminary tensioning.

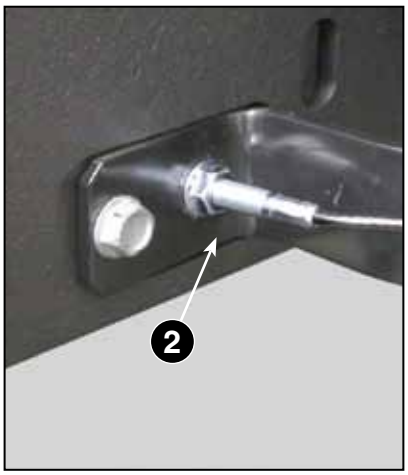
11. When refitting the bracket (2), make sure that the screw (14) that ensures the positioning of the display rod is correctly repositioned and reset the clamp (1).

12. Carry out a cable adjustment [☛ 4.2.2].

4.2.2 Steering cables adjustment

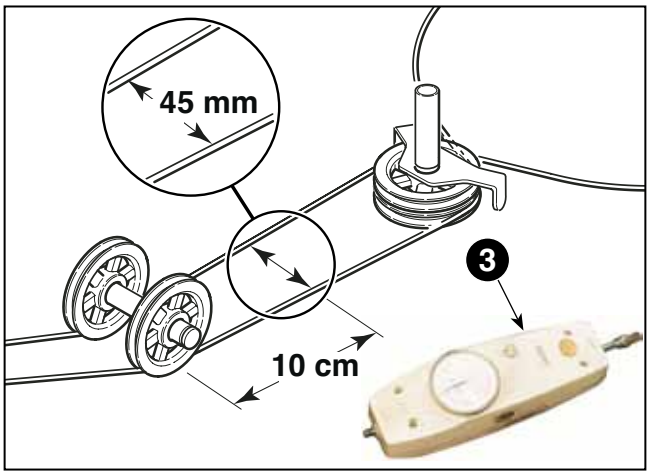
IMPORTANT *This adjustment must be executed acting gradually and alternately between the two registers.*

1. With the machine aligned and the steering wheel straight, regulate the adjusters (1) and (2) at the cable ends to eliminate any play, so that they are properly stretched.



2. Apply a dynamometer (3) to the two cable branches 10 cm from the front pulley. Applying a force of 5-7 kg we must obtain a distance of approximately 45 mm between the cables.

3. Carry out a test drive with the machine and check that the steering wheel remains in the correct position by running along a straight line.



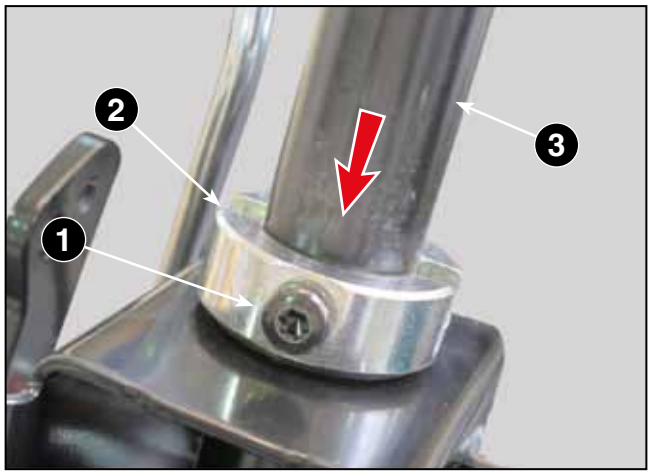
4. If you need to rotate the steering wheel to obtain a straight line, slightly loosen one adjuster first (1) or (2) and tighten the other adjuster (2) or (1) by the same amount, repeating the procedure several times until optimum condition is achieved.

5. Lock the adjusters and check the cables tension again.

4.2.3 Replacing the steering shaft and steering bushes

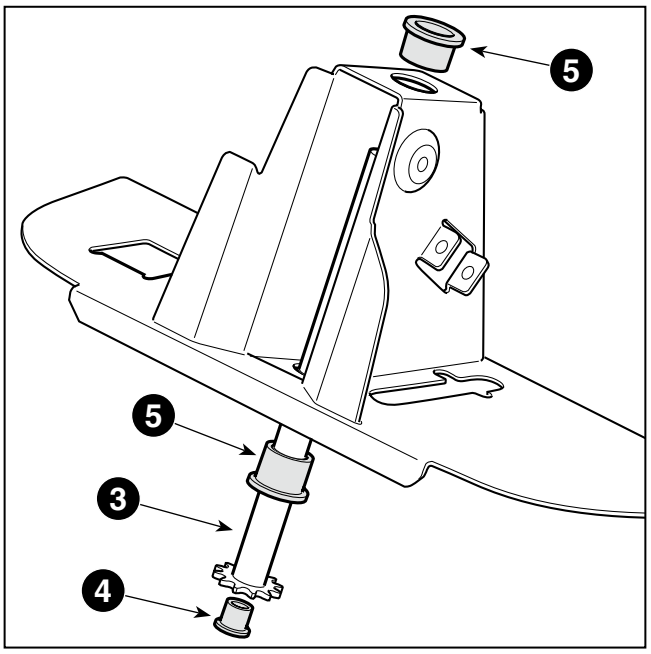
NOTE *The delay in wheel response to steering wheel operation indicates wearing of the control pinion, while the mobility and play felt on the steering column can be attributed to wear on the bushes.*

1. Remove the footplate as instructed in the "Footplate removal" procedure **[☛ 3.1.4]**.
2. Remove the steering wheel display and steering wheel column as instructed in the "Removing and replacing the steering column and steering wheel" procedure **[☛ 4.1.2]**.
3. Release the chain from the steering pinion as described in points 1, 2 and 5 of the "Replacing the chain and steering cables" procedure **[☛ 4.2.1]**.



4. Unscrew the grab screw (1) and remove the ring (2).
5. Remove the shaft from below (3).

When reassembling the shaft (3) remember to reset the bush (4) at the shaft end, which is essential for the correct positioning of the display rod.



If the bushes also have to be replaced (5) they can be removed from their respective mountings without the use of any special tools.

When assembling, perform the above steps backwards.

WARNING! ***After resetting the chain, it is always necessary to adjust the cables*** **[☛ 4.2.2]**.

5 - TRANSMISSION UNIT - WHEELS

Summary

5.1 TRANSMISSION UNIT

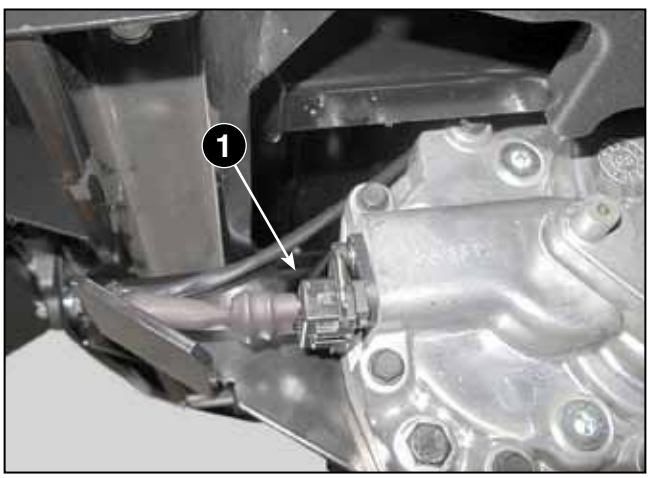
5.1.1 General description

The rear axle consists of a mono-block assembly, which includes the electric traction motor, transmission and differential.
The unit is powered by a 48 V DC source that supplies power to the 1.7 kW three-phase asynchronous AC induction motor with variable speed (max 6000 rpm), coupled with a gear reducer and a differential with separate axles.
Speed modulation and travel direction are controlled by a potentiometer operated by the traction pedal.
The motor is equipped with a temperature sensor connected to the management system.

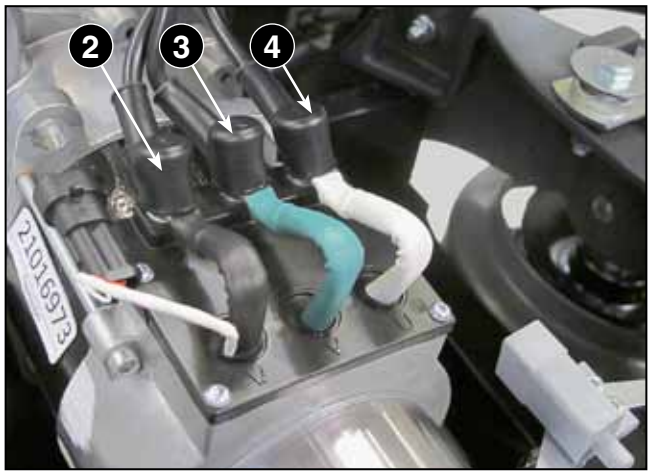
The removal of the transmission unit from the machine is only required in case of replacement or revision by a Manufacturer's Service Centre.

5.1.2 Removing the transmission unit

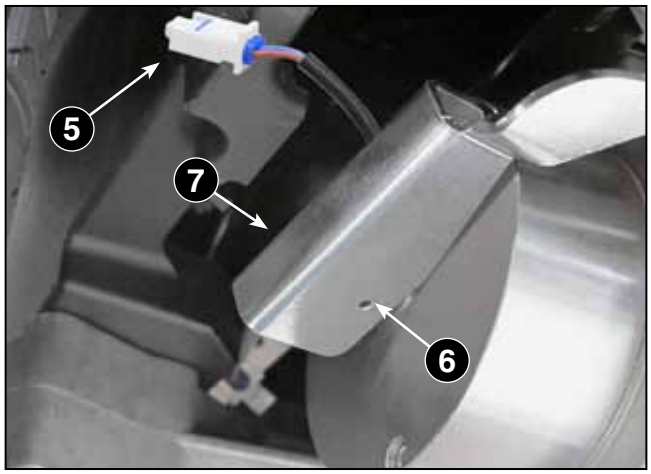
1. Lift the rear end of the machine and stabilize it. **[☛ 2.1.4]**.
2. Dismantle the rear wheels. **[☛ 5.2.2]**.
3. Disconnect the temperature sensor (1).



4. Disconnect the three cables (2) - (3) - (4) of the three-phase power supply and mark them in such a way that there are no errors when reconnecting them.



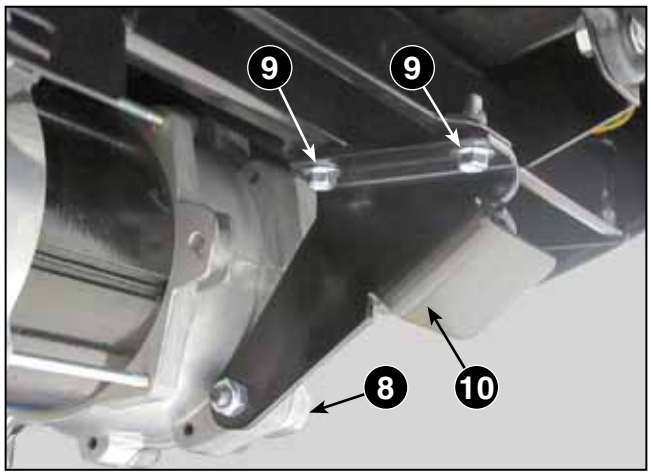
5. Disconnect the connector (5).



6. Pull out the spring pin (6) and remove the linkage (7) of the brake release device with the help of a 3 mm pin punch.

7. Undo the screw (8) the two screws (9) and remove the reaction braket (10).

WARNING! ***The unit is secured to the frame by four screws. Loosen the screws carefully, adequately supporting the transmission unit so as not to cause it to fall.***



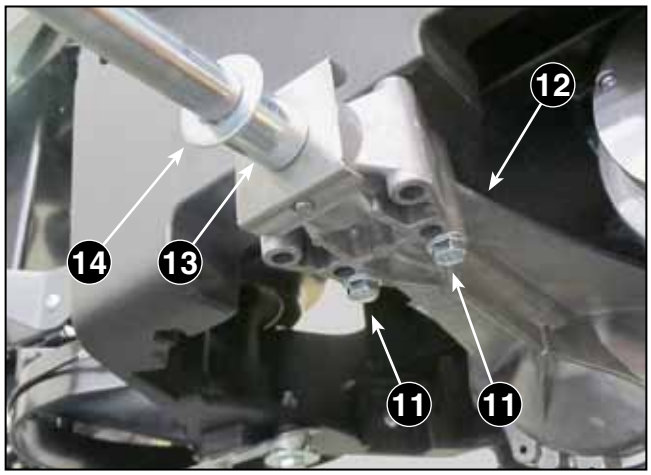
8. Unscrew the four screws (11) and the transmission unit (12) can be removed from the machine

When assembling, repeat the steps described above in reverse order, taking care to:

– properly reposition the spacer (13) and the locating washer (14) on each axle inside the wheels;

– tighten the four screws (11) with a click-type torque wrench set to 25 Nm;

– observe the position of the three cables (2) - (3) - (4) of the three-phase power supply which, if reversed, would prevent the motor from running.



5.1.3 Replacement of the motor brake

The electric motor of the transmission unit is equipped with a brake, which intervenes in the event of a power failure to the motor and therefore has a parking brake function.

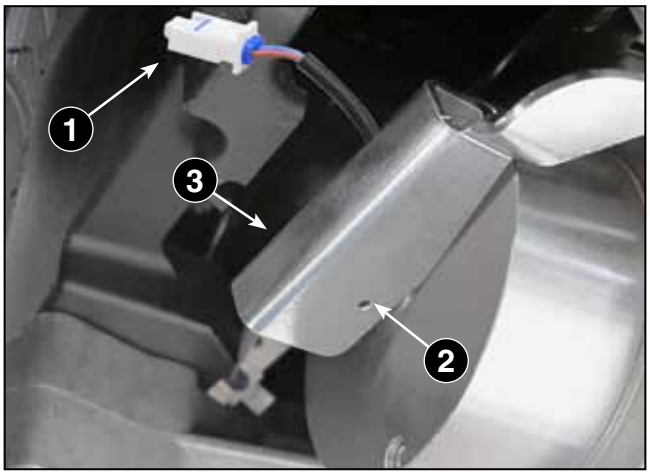
WARNING! ***With the removal of the brake from the transmission unit the function of a parking brake is completely lost and therefore wedges must be placed in front of the front wheels to prevent any accidental movement of the machine.***

WARNING! ***The parking brake should prevent the machine from moving on a slope of 30% (16°) with the driver in position.***

If this is not the case, the brake must be replaced.

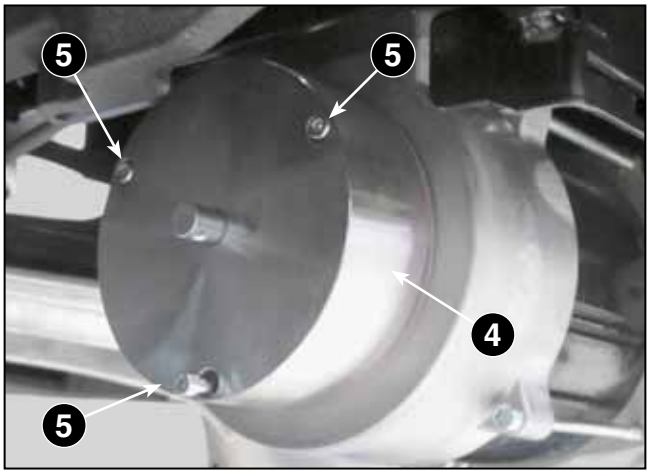
1. Remove the left-hand rear wheel. [☛ 5.2.2].

2. Disconnect the connector (1).



3. Pull out the spring pin (2) and remove the linkage (3) of the brake release device with the help of a 3 mm pin punch.

4. Remove the brake unit (4) by removing the three screws (5).



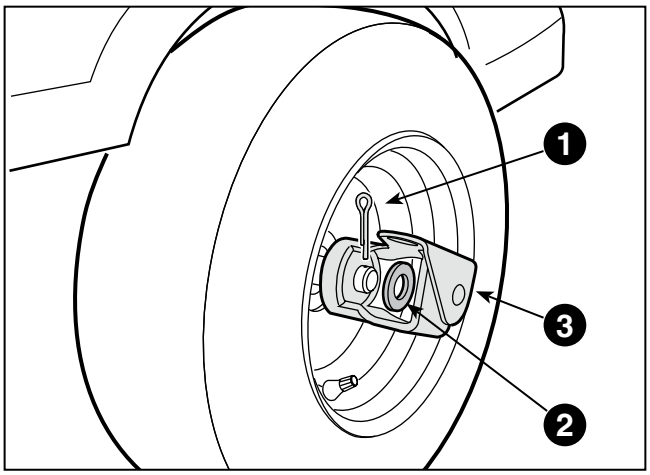
When mounting, reverse the operations described above, taking care to:

– align the new brake so that the cable output with the plug connector (1) is at the top;

– tighten the three screws (5) with a torque wrench of 4.5 Nm.

5.2 WHEELS AND TYRES

5.2.1 Disassembling the front wheels



1. Lift the front part and stabilize the machine [☛ 2.1.4].
2. Pull out the cotter pin (1) and remove the washer (2) and the tool holder (3).
3. Pull out the cotter pin (4) and remove the inner washer (5).
4. Remove the wheel.

IMPORTANT *Always replace broken pins or pins with deformations that may compromise their function.*

5.2.2 Disassembling the rear wheels

1. Lift the rear part and stabilize the machine [☛ 2.1.4].
2. Using a screwdriver, remove the snap ring (1) and the washer (2).
3. Remove the wheel.

5.2.3 Tyres

The tyres used are «Tubeless» type and so any repair following a puncture must be done by a tyre specialist according to the methods used for this type of tyre.

WARNING! ***Always replace deformed rims as they could impair the hold of the tyre.***

6 - BLADES MOTOR - CLUTCH AND PTO

Summary

6.1 BLADES MOTOR

6.1.1 General description

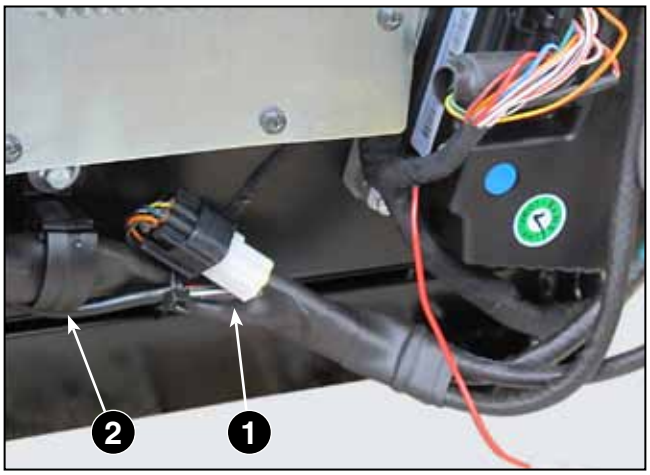
The blades are powered by a three-phase 1.7 kW, 5 kW DC brushless electric motor.
The motor is equipped with a temperature sensor connected to the electronic management system.

6.1.2 Removal of the motor unit from the machine

1. Make the carter moveable under the seat, following steps 1 - 3 - 4 - 5 of the "Removing the carter under the seat" procedure, without disconnecting the control connectors [☛ 3.1.2].

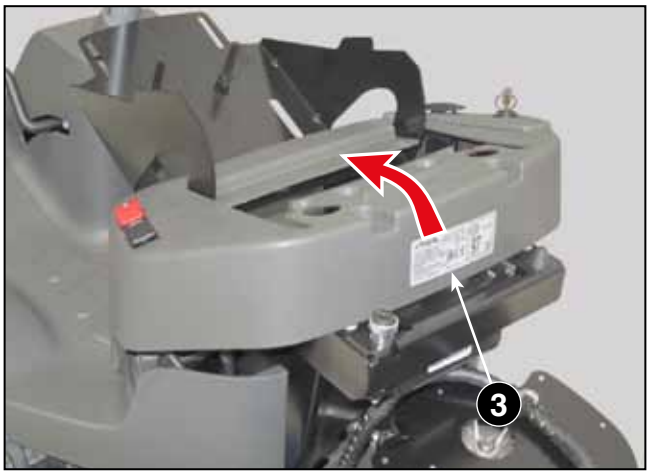
2. Removing the blades motor housing [☛ 3.1.3].

3. Disconnect all the electric cables from the ACE-0 control unit, following the procedure "Replacing the ACE-0 control unit" [☛ 9.5.3]. Disconnect the connector (1) and remove the wiring from the cable clamp (2).

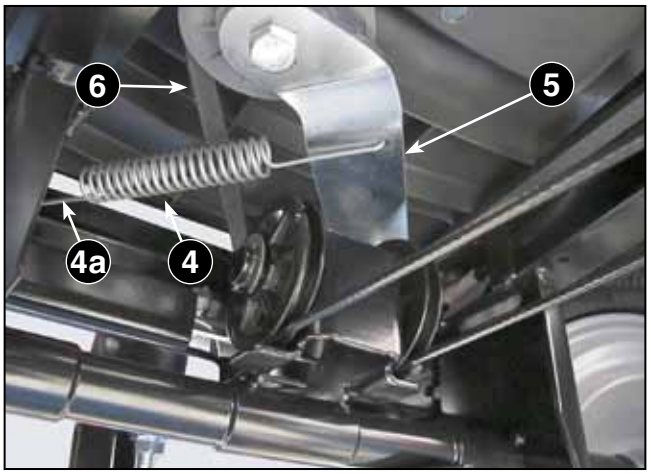


IMPORTANT *These operations must be carried out only when the motor is replaced, while work on the clutch can be carried out with the wiring connected.*

4. Lift and move the housing forward (3) as far as possible, taking care not to force the cables of the right and left electrical wiring.

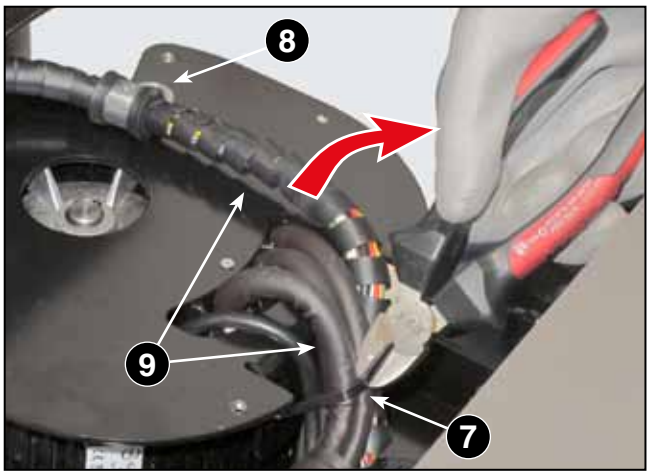


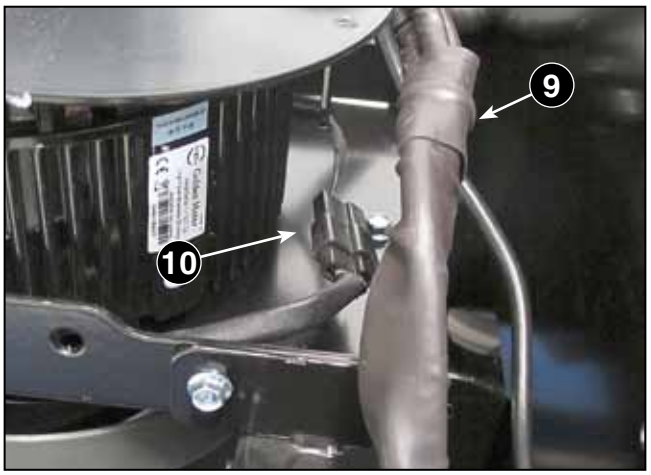
5. Release the left end (4a) of the spring (4) to release the lever (5) of the tensioning strap pulley and release the strap (6).



6. Cut the clamp (7) and unscrew the screw of the cable clamp (8) to free the bundle (9) of the electric cables so that they can be moved to the right of the motor.

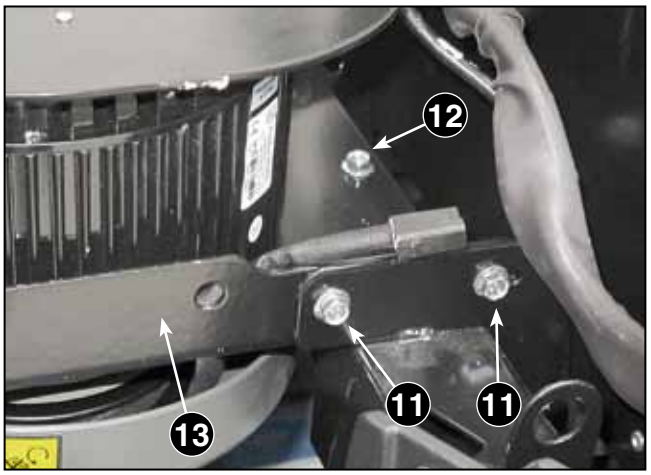
7. Disconnect the connector (10).



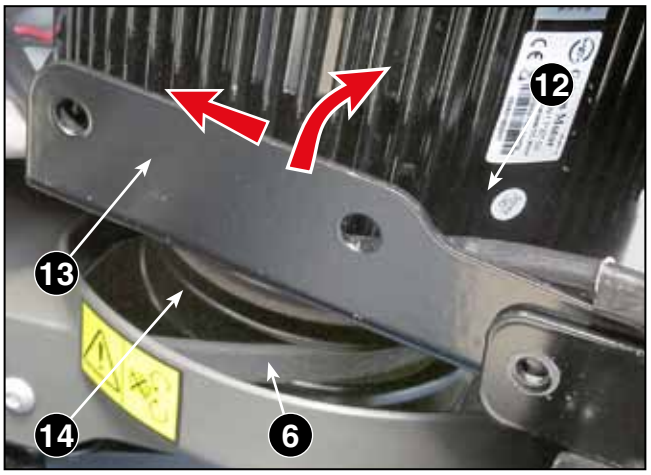


8. Unscrew FIRST the four side screws (11) and LAST the central screw (12) that secures the motor support plate (13).

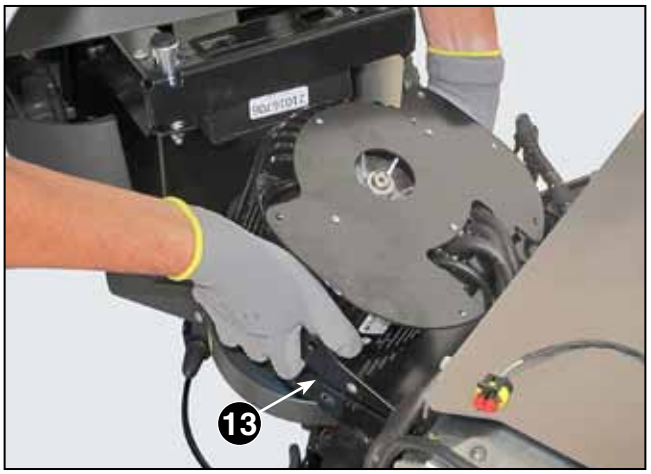
WARNING! ***When removing the central screw (12), carefully support the motor to avoid uncontrolled movements and the risk of injury to the hands.***



9. Slightly lift the front part of the plate (13) and, while holding it up, move it forwards so that the belt (6) is freed from the clutch pulley (14).

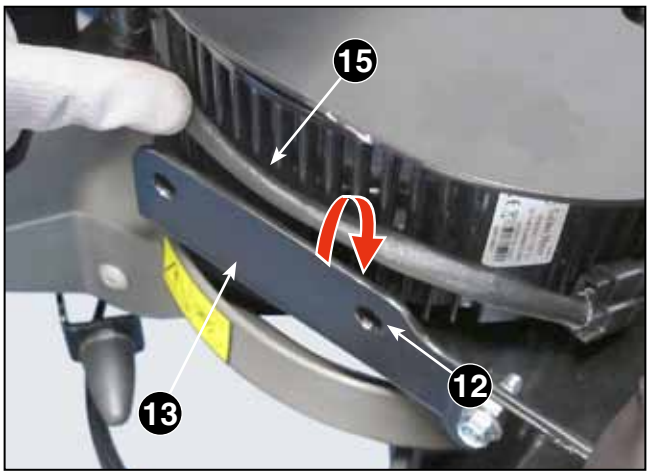


10. Carefully remove the plate (13) and the motor from the left side of the machine.



IMPORTANT *If the electric cables have been disconnected from the ACE-0 control unit, take the utmost care to ensure that they can run freely, without encountering obstacles or hindrances when removing the motor.*

When assembling, repeat the operations described above backwards, taking extreme care to:

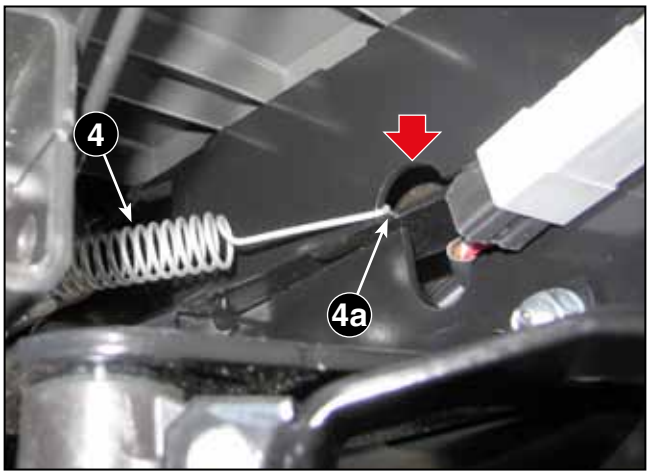


– Reassemble the plate (13) making sure that the belt (6) remains firmly in the groove of the clutch pulley (14).

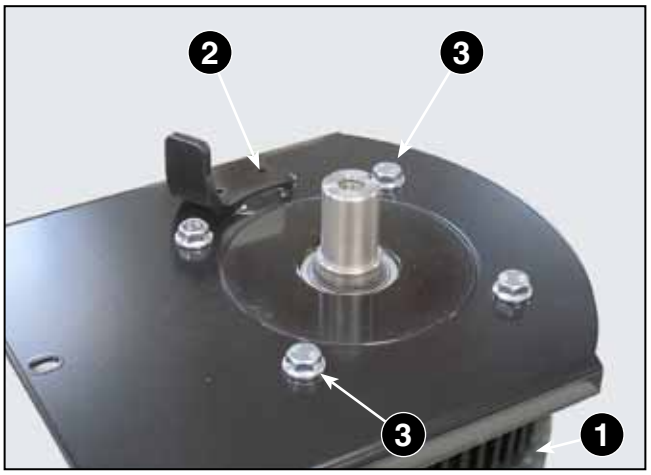
– Reposition the cable (15) against the motor, so that it is contained inside the left fold of the support plate (13);

– Restore the original cable routing and fastening the cables with the cable clamp (7) and cable clip (8);

– Hook the end (4a) of the spring correctly (4) into the half-moon hole in the left wall of the frame.



6.1.3 Removing and replacing the blades motor

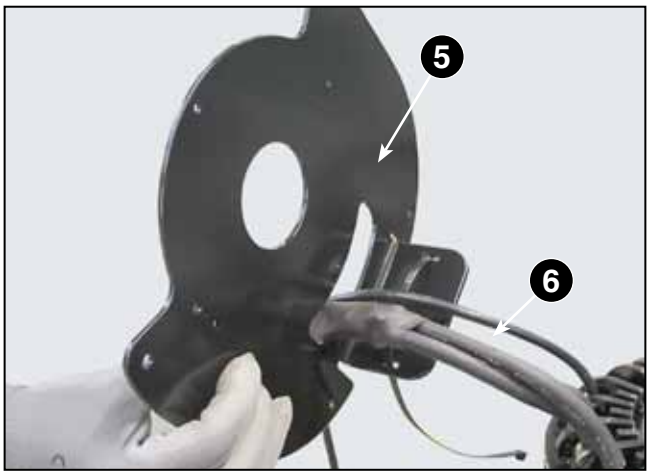


1. Remove the motor unit from the machine, following steps 1 to 18 of the "Removal of the motor unit from the machine" procedure [☛ 6.1.2].

2. Remove the clutch from the plate as described in the "Clutch disassembly" procedure [☛ 6.2.2].

3. Remove the motor (1) from the plate (2) by unscrewing the four screws (3).

4. On the opposite side, unscrew the four screws (4) and remove the upper plate (5).



When assembling, repeat the operations described above backwards, taking extreme care to:

– pass the cable harness (6) through the oval hole in the upper plate (5) before attaching it to the motor;

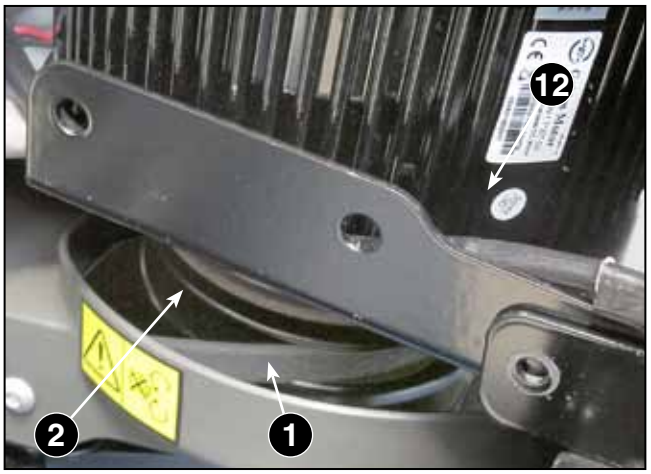
– tighten the four screws (3) with a click-type torque wrench set to 25-30 Nm.

6.2 CLUTCH AND PTO (Power Take-Off)

NOTE *The term "PTO" (Power Take-Off) is used to define the system for picking up and transmitting motion from the motor to the control element of the cutting attachment.*
The system includes an electromagnetic clutch fitted to the motor shaft of the blades and a transmission belt that shifts the motion to an axle with pulleys.

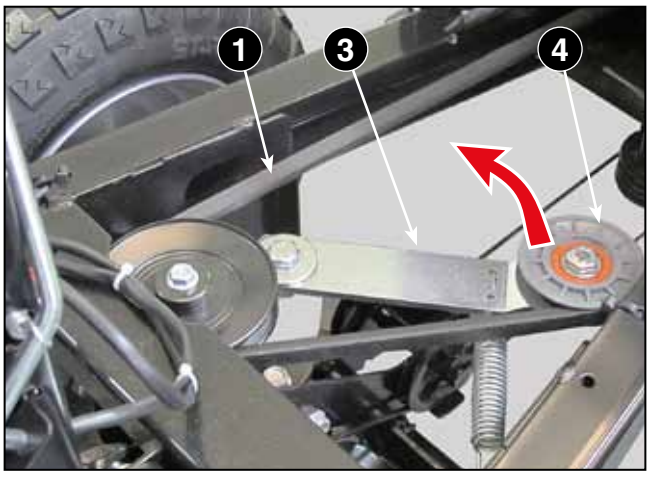
6.2.1 Replacement of the PTO belt

1. Move forward the motor unit of the blades, following steps 1 to 9 of the "Removal of the motor unit from the machine"procedure . [☛ 6.1.2].

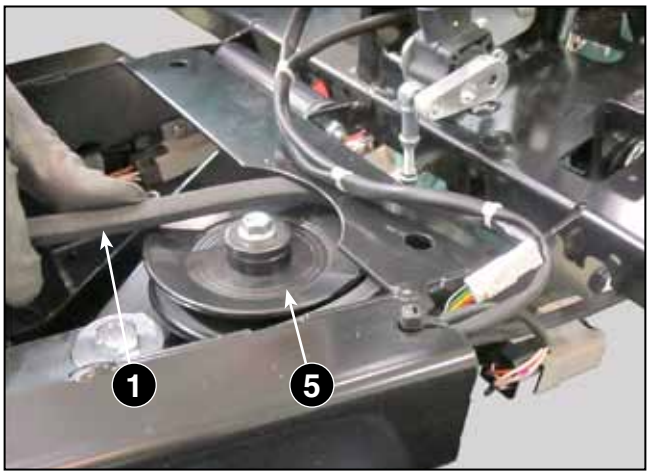


2. Make sure that the belt (1) is released from the electromagnetic clutch pulley (2).

3. Turn the arm (3) of the tensioner towards the centre of the machine so that the belt (1) is free from the gallow pulley (4).



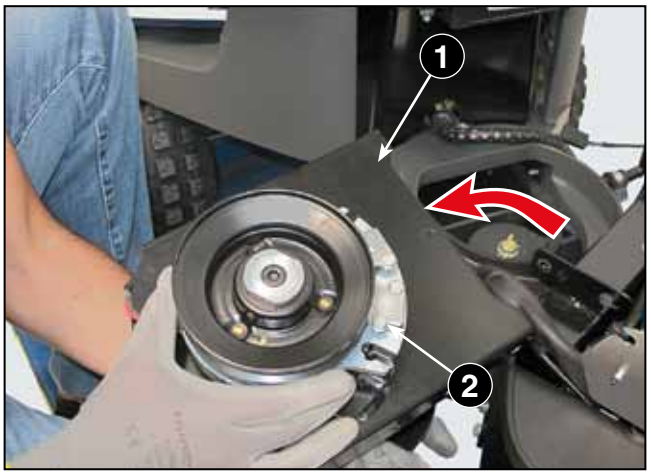
4. Once the belt (1) is completely loosened, it can be removed from the upper pulley (5) of the deflection axis.



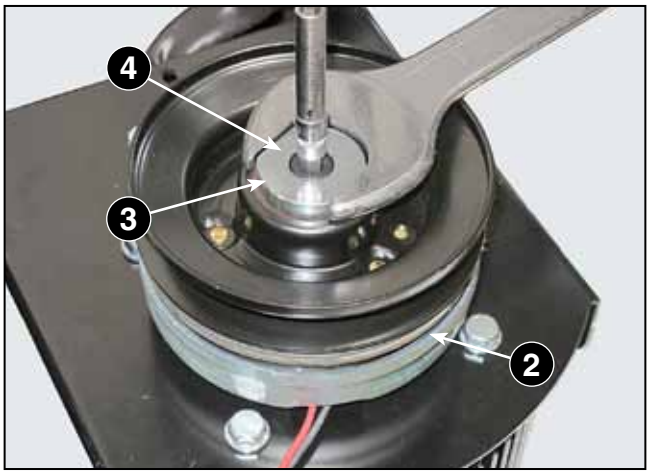
When mounting, reverse the operations described above.

6.2.2 Clutch disassembly

1. Remove the motor unit from the machine, following steps 1 to 10 of the “Removal of the motor unit from the machine” procedure, without disconnecting the cables from the ACE-0 control unit [☛ 6.1.2].

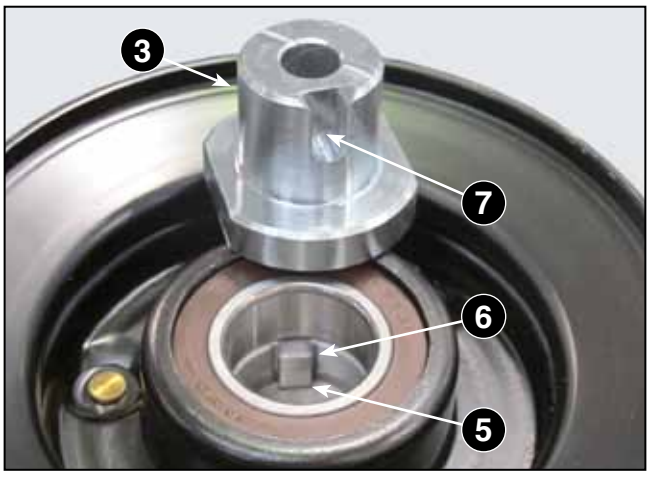


2. After removing the motor unit from the machine, turn the plate upside down (1) and place it on a suitable support to work comfortably on the pulley/clutch unit (2).



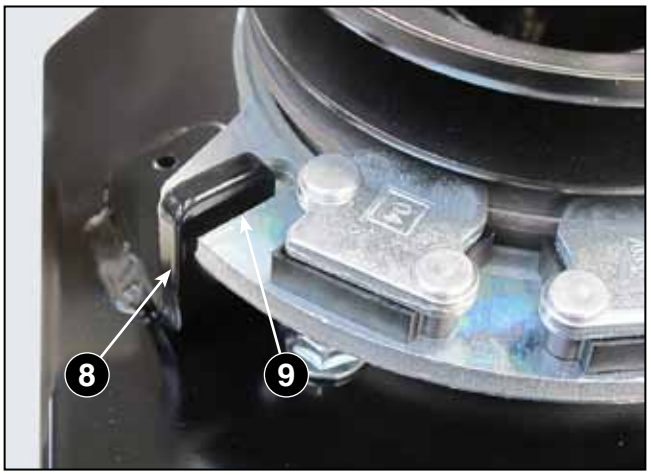
3. While holding the sleeve in place (3) with a 35 mm spanner, unscrew the central screw (4) and pull the sleeve (3) and clutch (2) out from the motor shaft..

When assembling, repeat the operations described above backwards, taking extreme care to:



– Correctly align the motor crankshaft groove (5) with the key (6) of the clutch hub and the clutch hub with the groove (7) of the sleeve (3);

– Align the clutch so that the reaction plate (8) remains inserted in the left slot (9), as shown in the drawing



– Tighten the central screw (4) with a click-type torque wrench set to 60 Nm.

IMPORTANT *This screw is made with special materials and treatments, not found in commercially available screws. When replacing, use only an original spare part.*

7 - MOWING DECK

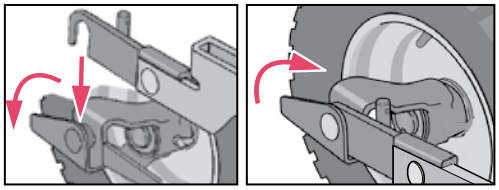
Summary

7.1 CUTTING MEANS

7.1.1 General information

The cutting deck is equipped with two synchronized rotating blades The blade traces overlap and therefore it is fundamental to synchronize them in order to prevent physical interference of the blades while rotating causing damage and dangerous situations.
All shafts and pulleys are mounted on ball bearings sealed with permanent lubrication and do not require lubrication.

The cutting deck is equipped with a quick coupling system to the machine and an electrical device to adjust the cutting height.



For safety purposes and to reduce the risk of physical injury in the event of accidental collisions and to protect important parts, the cutting deck is equipped with force limiters, such as:
– safety bolts between the blades and the blade bar;
– torque limiter between toothed wheels and blade shaft.
– the possibility of positive slipping of the transmission belt on the plastic toothed wheels.

7.1.2 Removing and reassembling the blades

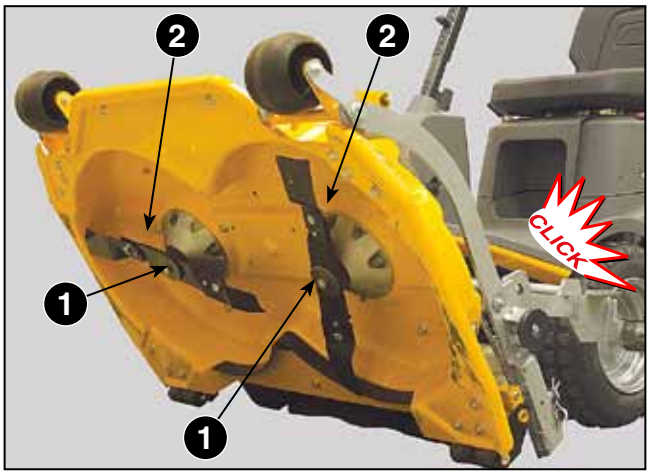
WARNING! ***Always wear protective gloves when handling the blades and protect eyes when sharpening.***

WARNING! ***The blades are connected to each other; the rotation of each blade engages the rotation of the other.***

WARNING! ***When replacing, replace both blades on the same blade bar to avoid balance losses. Always check the integrity of the blades for cracks or tears and always replace damaged blades.***

1. Move the cutting deck to the "MAINTENANCE" position and make sure it is stable before proceeding.

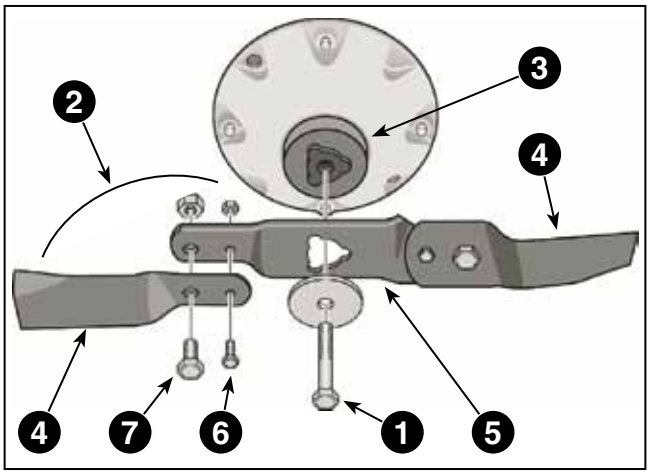
2. Using a 17 mm spanner, unscrew the two screws (1) and slide out the two bar/blade units (2).



3. When manually turning the shafts (3), check that they are not damaged and do not show off-centre movements during rotation.

4. Remove the blades (4) from the blade bar (5) by unscrewing the fixing screws (6) and the safety screw (7).

IMPORTANT *In the event of a collision, the safety screws (6) could brake off, bending the blades backwards. In this case, the safety screws must be replaced with original spare parts and NEVER with commercial screws whose characteristics do not meet the design parameters.*

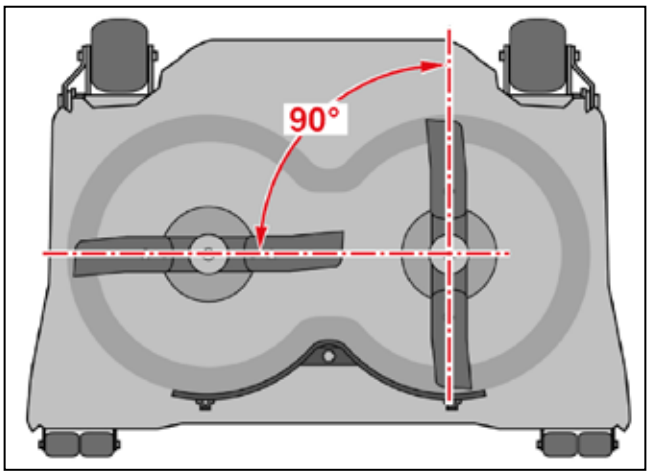


When reassembling:

5. Reassemble the blades (4) on the blade bar (5) as shown in the image, with the cutting edges facing the rotation direction.

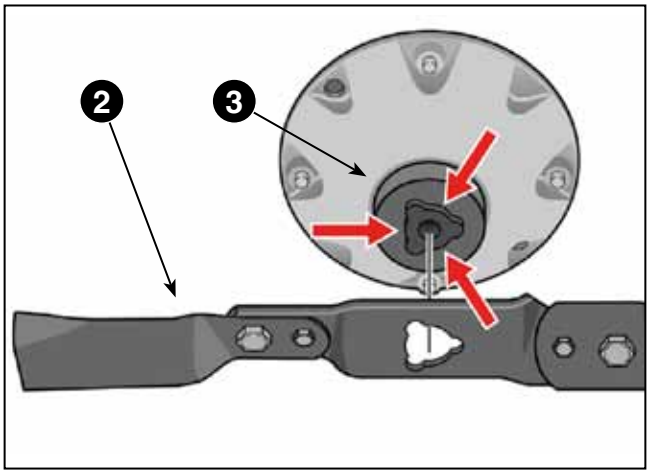
6. Tighten the screws (6) using a click-type torque wrench set to 9.8 Nm.

7. Tighten the blade securing screws (7) on the blade holder bar (5) using a click-type torque wrench set to 45 Nm.



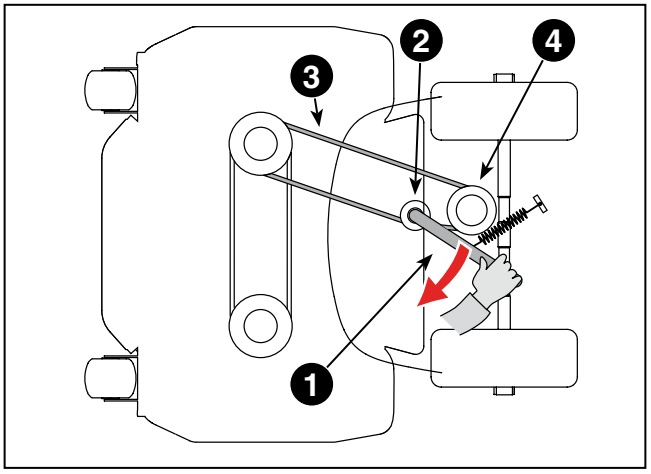
8. Reassemble the two blade bar/blade units (2) on the shafts of the cutting deck (3) so that the blades are oriented at 90° to each other, using the possibility of rotating the blade holder bar in three positions arranged at 120° towards the shaft hub.

9. Tighten the securing screws (1) of the cutter bar (2) using a click-type torque wrench set to 45 Nm.



7.1.3 Replacing the belts

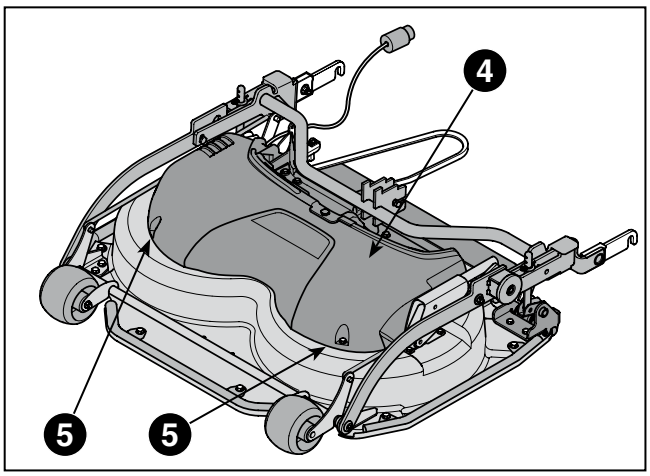
- **Removing the blade drive belt**

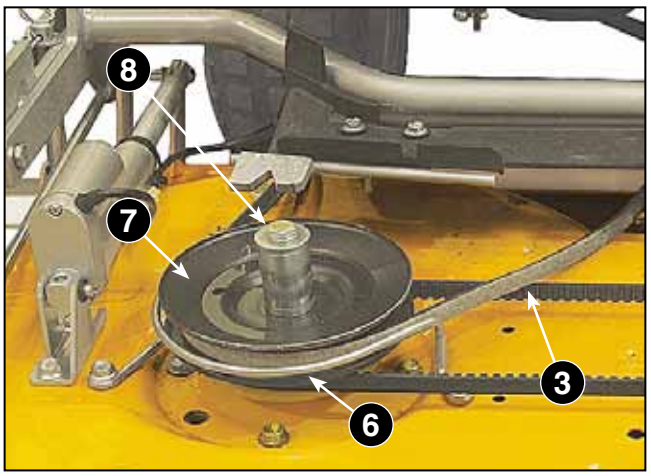


1. Working from the bottom of the machine, pull the lever (1) of the gallow pulley outwards (2) to loosen the belt (3) and remove it from the lower pulley (4)

2. Remove the belt housing (4) unscrewing the screws (5) with a 12 mm socket wrench.

3. Remove the belt guide (6) and remove the belt (3) from the pulley (7).



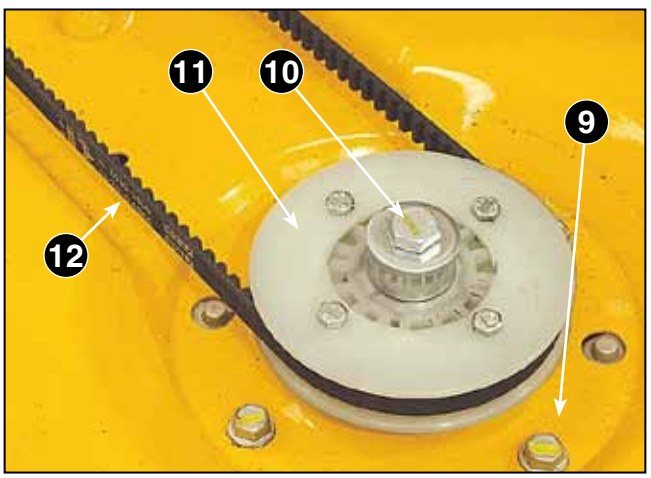


- **Removing the belt for the blade connection**

4. Unscrew the screw (8) and remove the pulley (7) from the shaft.

5. Loosen the four screws (9) of the left-hand bearing bracket by a couple of turns, unscrew the screw (10) and remove the left-hand pulley (11) together with the belt (12).

- **Functional checks and assembly**

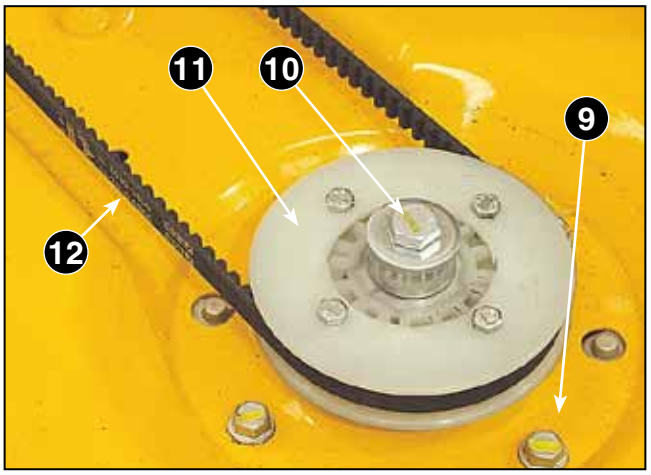


6. Before reassembling the belts, carry out the following checks on the functionality of the cutting deck;

   – Check the condition of the two blade shaft bearings by grasping and forcing radially each pulley and blade-holding bar, making sure that there is no radial play.
   – Rotate each shaft. No abnormal bearing noise should be heard.

NOTE *The bearing housings cannot be removed and for individual spare parts are not available. If a malfunction is detected in the bearings, the entire bearing housing must be replaced.*

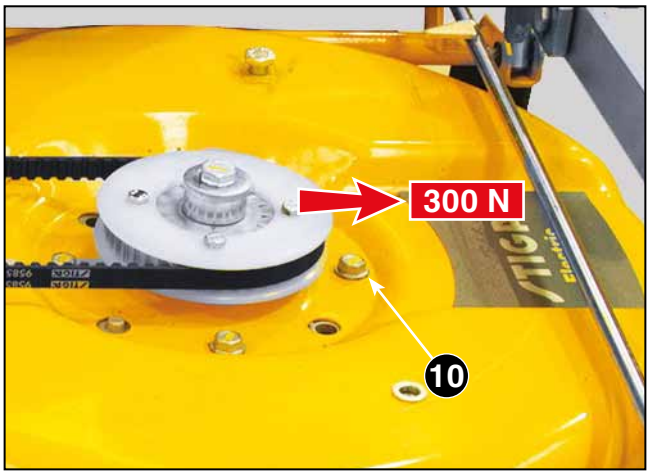
– Check the torque limiter between the toothed pulleys and the blade shaft as described in the "Blade synchronization" procedure. [☛ 7.1.5].



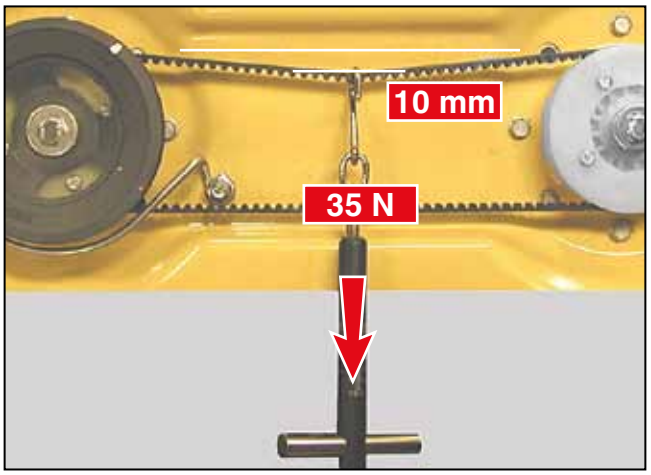
7. Reassemble the blade connection belt (12) and the pulley (11).

8. Before tightening the four screws (9), tense the belt, which is done by moving the left support sideways. There are two ways to do this:

• **Option A**
– Tighten the belt by pulling the left-hand bearing bracket with a force of 300 N (30 kg), then tighten the four screws (9) of the bearing bracket.



• **Option B**
– Tighten the belt by pulling on the left-hand bearing bracket and tighten the four screws (9) of the bearing bracket.
– Apply a force of 35 N (3.5 kg) to the centre of the belt. The belt will flex 10 mm. Otherwise, loosen the screws (9) and repeat the operation until the correct result is obtained.



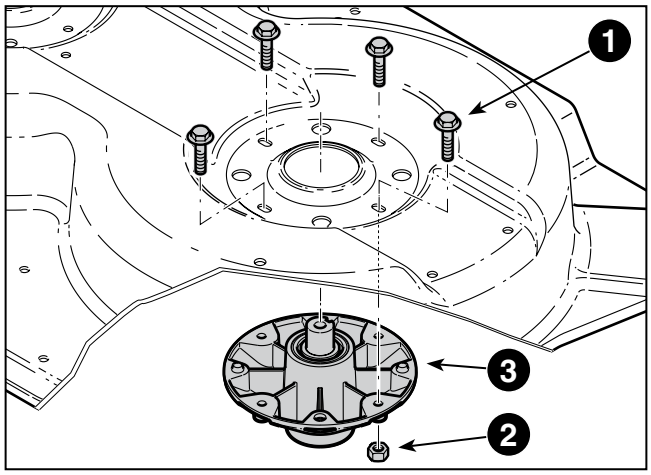
9. Complete the assembly by following steps 1 - 4 described above backwards.

10. Verify that the blades orientation meets the correct synchronization parameters indicated in the "Synchronizing the blades" procedure. [☛ 7.1.5].

7.1.4 Replacing the hubs

1. Install the blades, following steps 1 to 4 of the "Removing and reassembling the blades" procedure. [☛ 7.1.2].
2. Remove the belts and pulleys from the blades, following steps 1 to 5 of the "Replacing the belts" procedure. [☛ 7.1.3].

3. While holding the screw head (1) in place, unscrew the four nuts (2) and remove the bearing hub (3) and the blade shaft.



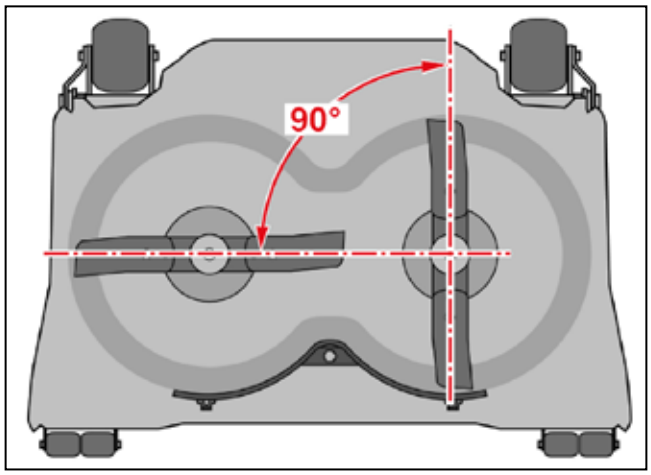
NOTE *The bearing housings cannot be removed and for individual spare parts are not available. If a malfunction is detected in the bearings, the entire bearing housing must be replaced.*

To reassemble, follow the operations described above backwards, taking care to:

– tighten the nuts (2) using a a click-type torque wrench set to 38-45 Nm.

7.1.5 Synchronizing the blades

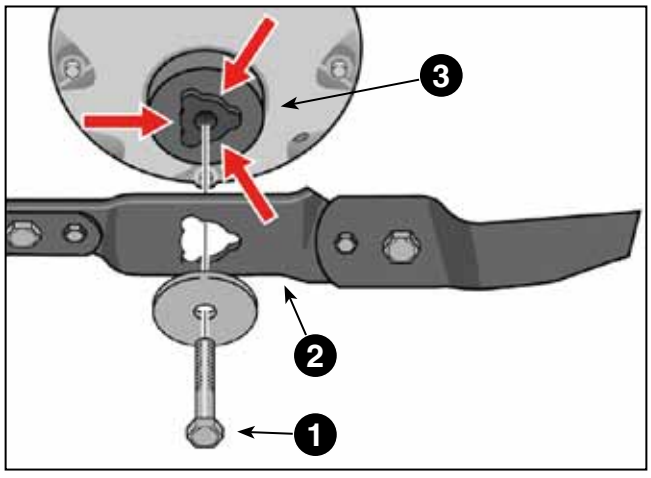
The cutting deck is equipped with synchronized blades. If one of the blades hits a solid object (such as a stone) the synchronization may be altered with the risk of the blades coming into contact with each other.



⚠ **WARNING!** ***Always check the synchronisation after a collision. The blades correctly synchronized must be staggered by 90°, as shown in the drawing.***

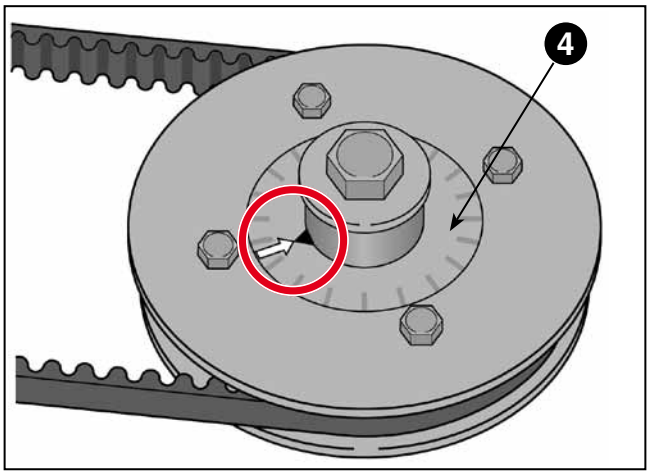
If a check reveals a different situation than the optimal 90° orientation, this may be due to:

– Slippage of the positive drive belt on the toothed wheels.



– A blade element not mounted correctly on the blade shaft. In this case, remove the central screw (1), remove the blade bar (2) from the shaft (3) and reassemble it in one of three positions so as to restore 90° orientation between the blades.

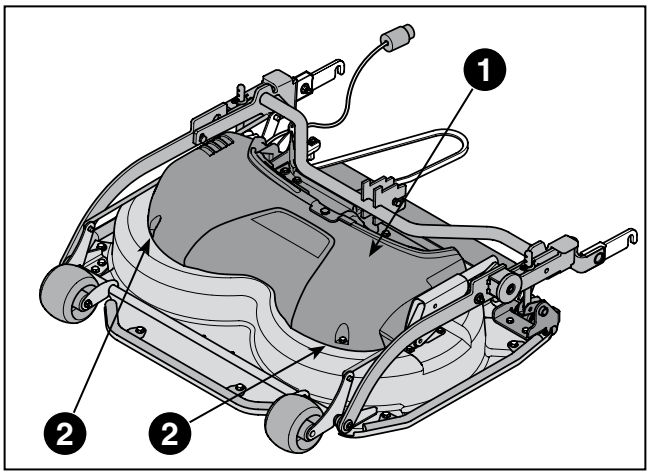
– Release of the torque limiter (4) between the gear wheels and the blade shaft. In the normal situation, the arrows must be turned in the opposite direction to each other as shown in the image. If the torque limiter is released, the arrows do not point in the opposite direction.



7.2 LIFTING SYSTEM

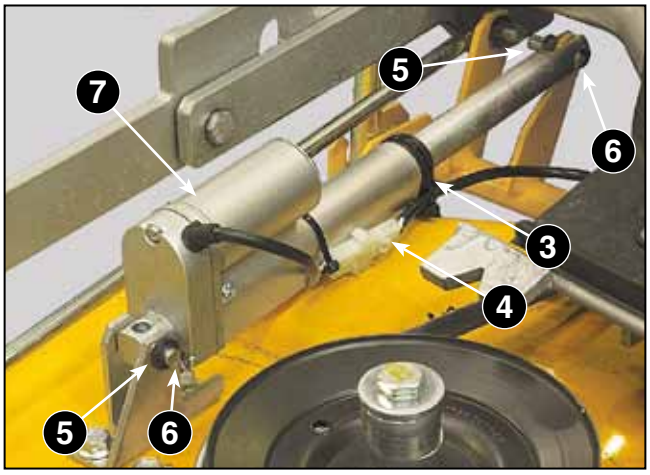
7.2.1 Replacing the lifting actuator

1. Remove the cover of the cutting deck (1) fixed by the two screws (2).



2. Remove the clamp (3) and disconnect the connector(4).

3. Remove the spring rings (5), pull out the pins (6) and remove the actuator (7).



When mounting, perform the above steps backwards

8 - ELECTRICAL SYSTEM

Summary

8.1 GENERAL INFORMATION

8.1.1 Introductory Note

This chapter deals with the controls and interventions on the electrical system regarding safety systems, micro switches, fuses, relays and wiring in general.
The entire electronic traction and blade management system, the control units and the batteries are dealt with in a specific chapter of the manual. **[☛ 9 - ELECTRONIC MANAGEMENT - BATTERY]**

8.1.2 Safety regulations

WARNING! ***The presence of live elements requires particular attention when working on electrical components, in order not to create situations of danger during the execution of the work and to restore the operating safety conditions for the user.***

- Do not wear rings or similar metal objects as this may cause a short circuit or fire due to accidental contact with live parts.
- Do not leave metal tools in areas where accidental contact with live parts may occur, as this may cause a short circuit or fire.
- All electrical cables are fastened to the frame with cable clamps. When an operation involves

removing a clamp, it is then necessary to install a new clamp in its original position.
– Do not leave any electrical wiring loose. Loose electrical cables can cause unnecessary wear to the insulation and cause short circuits and fire.

8.2 TROUBLESHOOTING

8.2.1 Problems during use

This table provides a guide in identifying the problems that may arise during use, attributable to the components of the electrical system, with an indication of corrective actions to solve them. Before searching for an electrical fault, it is advisable to carry out some preliminary checks to exclude the most trivial causes:

– Check the integrity of the fuses and relays.
– Check the wiring for damage, cracks or abrasions in the insulation, and secure the connectors to the components.

Problem	Probable cause	Solution	[☛ ...]
The blades cannot start	Problems with micro switches, relays, or power switches	Check and/or replace	[8.3.1]
Blades do not stop when operator leaves seat	Micro switch of the seat not connected or defective	Check and/or replace	[8.3.1]
The blades do not stop when the mower deck is raised	Micro switch not connected or defective	Check and/or replace	[8.3.1]
Blades do not stop within 5 seconds	Electromagnetic clutch malfunction	Check and/or replace	[8.3.3]
Electrical cutting height adjustment does not work	Faulty switch and/or actuator	Check and/or replace	[8.3.2]

8.2.2 Problems caused by electrical components

This table analyses the possible faults produced by all the components, indicated on the display on "SERVICE" mode or under normal machine operating conditions.

Component	Situation / Action	Display Indications on "SERVICE" Mode			Display indications on "OPERATOR" mode	Effects on the machine
		AC-0	ACE-0	Notes		
Parking brake released switch	Disconnected / Check connector terminals	0	0	MANUAL BRAKE always active	(P) struck through	Traction does not work; brake release lever in correct position
Brake pedal switch	Disconnected / Check connector terminals	0	0	BRAKE always active	The icon (P) remains active even when the brake pedal is released.	Traction does not work; brake release lever in correct position
Cutting deck height adjustment switch	Disconnected / Check connector terminals	0	0	No signal	No yellow arrow on the symbol	Cutting deck height adjustment does not work
OPC switch	Disconnected / Check connector terminals	0	0	BLADE always off	No OPC icon appears	OPC does not work; no warning light on theSWITCH OPC if pressed

Component	Situation / Action	Display Indications on "SERVICE" Mode			Display indications on "OPERATOR" mode	Effects on the machine
		AC-0	ACE-0	Notes		
Cutting deck lifting switch	Disconnected / Check connector terminals	0	0	The icon "CUTTING DECK UP" does not appear when the pedal is pressed down.	The icon "CUTTING DECK UP" does not appear when the pedal is pressed down.	OPC does not work; no warning light on theSWITCH OPC if pressed
Cruise control switch (Cruise Control)	Disconnected / Check connector terminals	0	0	The "CRUISE" icon does not appear	The icon "CRUISE" does not appear	The speed maintainer device does not work
Bipolar CURRENT PRESENCE CONNECTOR (under the bonnet, connected to the electrical plug wiring)	Disconnected / Check connector terminals	0	0	"PP" is always deactivated.	The icon "PP" does not appear	Charge with plug on the vehicle, not on the wall
Bipolar CURRENT PRESENCE CONNECTOR (under the bonnet, connected to the electrical plug wiring)	Disconnected / Check connector terminals	0	0	"PP" is always deactivated.	Display ON, the icon SEAT appears The charging phase does not appear	Vehicle does not charge (charge with plug on vehicle and wall); display ON; key OFF
223V three-pole VOLTAGE or faston connector on the filter (under the hood, between the charger and the electric plug)	Disconnected / Check connector terminals	-	-	Display OFF	Display OFF	Vehicle does not charge (charge with plug on vehicle and wall); display OFF; key OFF
223V three-pole VOLTAGE or faston connector on the filter (under the hood, between the charger and the electric plug)	Disconnected / Check connector terminals	0	0	"PP" ON	The "PP" icon appears.	Vehicle does not charge (charge with plug on vehicle and wall); display ON; key ON
CLUTCH connector (black connector near the blade motor)	Disconnected / Verify terminals on connector	0	0	"BLADE" ON	The "PTO" icon appears.	The blade/belt does not work, but the blade motor works
FAN connector	Disconnected / Check connector terminals	0	0			The traction controller's FAN does not work
"TRACTION CABLE CONNECTOR A (black bipolar connector close to AC-0) "SAFETY BRAKE ERROR" White bipolar connector on traction Check electrobrake	Disconnected / Check connector terminals	254	224		GENERAL ERROR appears	Traction does not work
"TRACTION CABLE CONNECTOR B (white 8-pin connector near AC-0)	Disconnected / Check connector terminals	65	0	MOTOR TEMP =180° even when the motor is cold	(P) struck through	Traction does not work
MOTOR TRACTION TEMPERATURE (black bipolar connector on the traction)	Disconnected / Check connector terminals	65	0	MOTOR TEMP =180° even when the motor is cold	OVERHEATING	Traction does not work

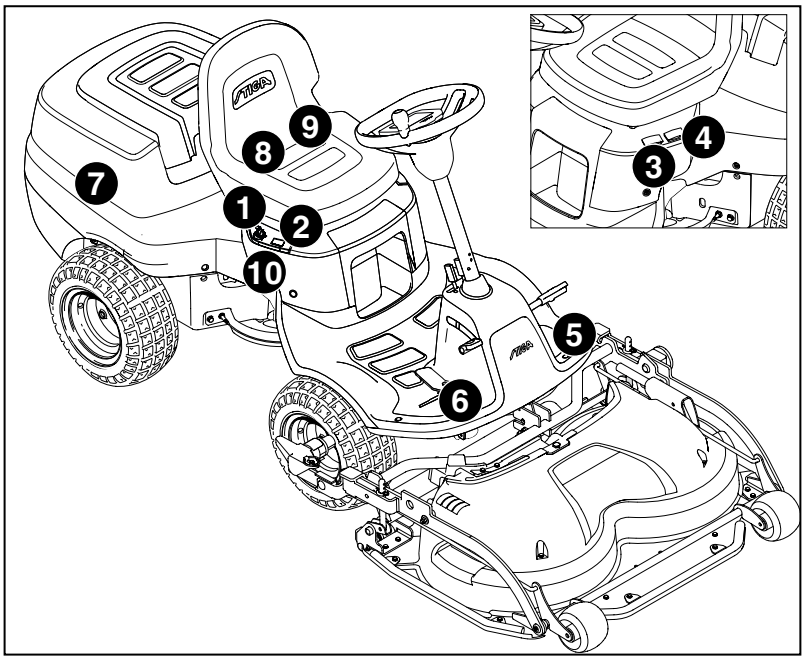
Component	Situation / Action	Display Indications on "SERVICE" Mode			Display indications on "OPERATOR" mode	Effects on the machine
		AC-0	ACE-0	Notes		
TRACTION CONTROLLER CONNECTOR B (large squared connector under the seat)	Disconnected / Check connector terminals			No Service	BLADE ERROR	Traction does not work; motor blade does not work (clutch works)
TRACTION CONTROLLER Connector A (large rectangular connector under the seat)	Disconnected / Check connector terminals			No Service	SEAT ICON	Traction does not work; motor blade does not work (clutch works)
ACCELERATOR PEDAL SENSOR	Disconnected / Check connector terminals	232	0	"0" "0" Pedal	GENERAL ERROR appears	Traction does not work; motor blade does not work (clutch works)
KT Relay	Connector disconnected, coil open, contact open	8	38		GENERAL ERROR appears	Traction does not work; motor blade does not work (clutch works)
RELAY DELAYED TEMPERATURE OR OPC RELAY or KM RELAY	Connector disconnected, coil open, contact open			No Service	SEAT ICON	Traction does not work; motor blade does not work (clutch works)
CLUTCH RELAY	Connector disconnected, coil open, contact open			No error reported	No error reported	The traction works, the blade motor only works by holding down the OPC button
BLADE RELAY	Connector disconnected, coil open, contact open			No error reported	No error reported	Traction works, the blade motor does not work even if the red light on the OPC button is on
KZTP COIL	Disconnected / Check connector terminals	8	38		GENERAL ERROR appears	Traction does not work; motor blade does not work (clutch works)
KS COIL	Disconnected / Check connector terminals	8	38	KZTP OPEN	GENERAL ERROR appears	Traction does not work; motor blade does not work (clutch works)
Auxiliary contact KZTP	Disconnected / Check connector terminals	252	38	KZTP OPEN when pedal is released	GENERAL ERROR appears when traction is attempted.	Traction does not work; motor blade does not work (clutch works)
Parking brake released switch	Disconnected / Check connector terminals	0	0	MANUAL BRAKE always active	(P) struck through	Traction does not work; brake release lever in correct position
Brake pedal switch	Disconnected / Check connector terminals	0	0	BRAKE always active	The icon (P) remains active even when the brake pedal is released.	Traction does not work; brake release lever in correct position

8.3 SWITCHES AND WIRING

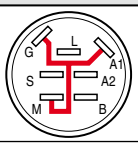
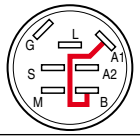
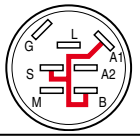
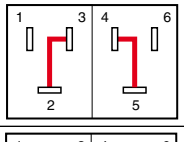
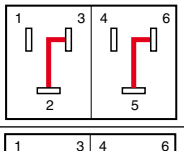
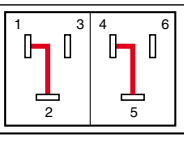
8.3.1 Checking the switches and micro switches function

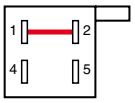
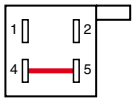
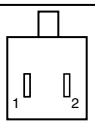
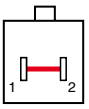
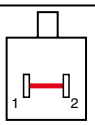
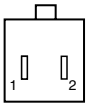
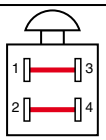
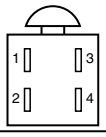
Switches either open a circuit to stop current flow or close and allow current to flow through.

- A normally open (NO) switch prevents current flow until the switch is switched on, completing the circuit and allowing current to flow through it.
- A normally closed switch (NC) allows current to flow until the switch is actuated, breaking the circuit and stopping current flow through it.



To check the operation of a switch or micro switch you must have an Ohmmeter-dependent tester.
Disconnect the connector and connect the tester tips to the different contacts of the component concerned; the reading must correspond to what is indicated in the following table, where the red continuous line indicates the internal electrical continuity.

Component	Condition		Diagram	Readings
1. Ignition key * This intermediate position of the key is not used.	Position «O»	*		M - G - A1 = 0
	Position «C»	*		B - A1 = 0
	Position «I»	*		B - S - A1 = 0
2. Cruise Control Switch 3. PTO switch 4. Lifting command switch	Free			2 - 3 = 0 5 - 4 = 0
	Pressed "forward"			2 - 3 = 0 5 - 6 = 0
	Pressed “backward”			2 - 1 = 0 5 - 4 = 0

Component	Condition	Diagram	Readings
5. Cutting deck lifting micro switch 6. Brake micro switch 7. Parking brake micro switch	Free		4 - 5 = ∞ 1 - 2 = 0
	Pressed		4 - 5 = 0 1 - 2 = ∞
8. Seat micro switch (Black)	Free		1 - 2 = ∞
	Pressed		1 - 2 = 0
9. Seat micro switch (Grey)	Free		1 - 2 = 0
	Pressed		1 - 2 = ∞
10. Emergency switch	Free		1 - 3 = 0 2 - 4 = 0
	Pressed		1 - 3 = ∞ 2 - 4 = ∞

8.3.2 Check the height control system of the cutting deck

The malfunction of the electrical control can occur in two ways.

a) If it does not work in only one direction (up and/or down) the control switch must be replaced. [☛ 8.3.4].

b) If it does not work in both directions, connect the power of an external 12 Volt battery directly to the contacts of the connector (1) of the actuator, alternating between the "negative" and "positive" positions.

If the actuator operates in both modes, check the connections and wiring; if not, replace the switch.

8.3.3 Checking the function of the electromagnetic clutch

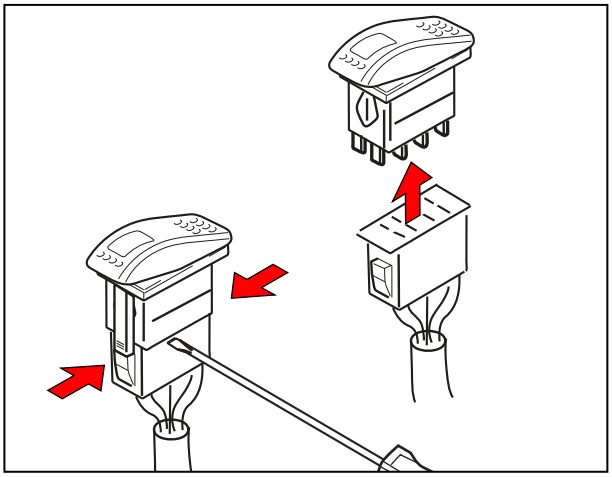
The electromagnetic clutch is used to connect or disconnect, via a switch, the equipment used on the machine. In addition, the clutch is designed to activate a brake on the output shaft, when it is disengaged.

- The field coil is mounted to a bearing support and does not rotate.
- The rotor is attached to the power output shaft and rotates around the field assembly.
- The assembly is connected to the output pulley.
- The armature unit is assembled close to the brake unit rotor.

The clutch is engaged by applying current to the coil connection. This results in a current flowing through the coil, magnetizing the coil pulling the armature onto the rotor with sufficient force to hold the two pieces together, connecting the output and the input shafts firmly together. The force of the armature against the rotor pulls it away from the brake, hence releasing the brake.

The check is made by measuring with an Ohmmeter the resistance of the coil which must be 3.2 Ohm, with a tolerance of ± 5%.

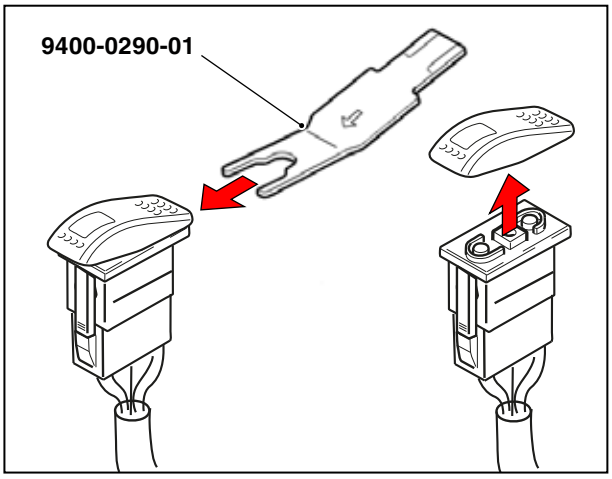
8.3.4 Replacing the control switches



The switches are press-fitted into their respective housings. To replace a switch:

1. Remove the switch guard to access the switch.
2. Press the connection clamp and pull the switch out. Some fittings have 2 locking latches.
3. Press the locking tabs on both sides of the switch against the switch itself.
4. Use a screwdriver or similar tool to remove the switch.

8.3.5 Replacing switch buttons



The button is separated from the body of the switch by a special tool.

1. Insert the tool fork under the button.
2. Press the end of the tool until the button is released.

To reassemble the button, press the button until it snaps into the hole in the switch.

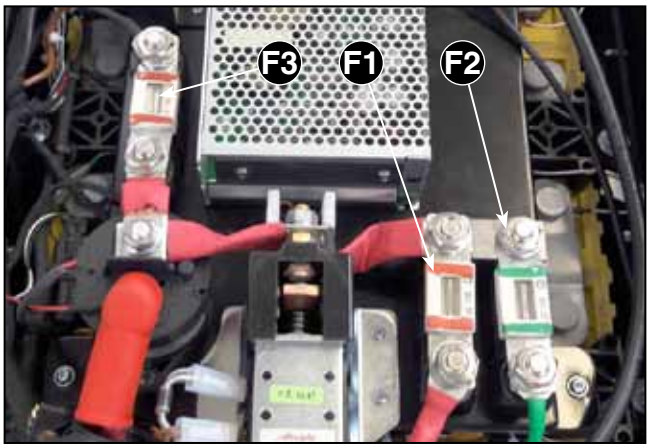
8.4 FUSES & RELAYS

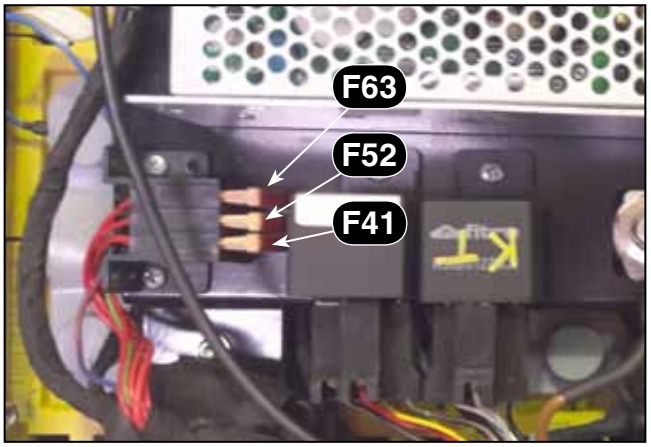
8.4.1 Fuse location and function

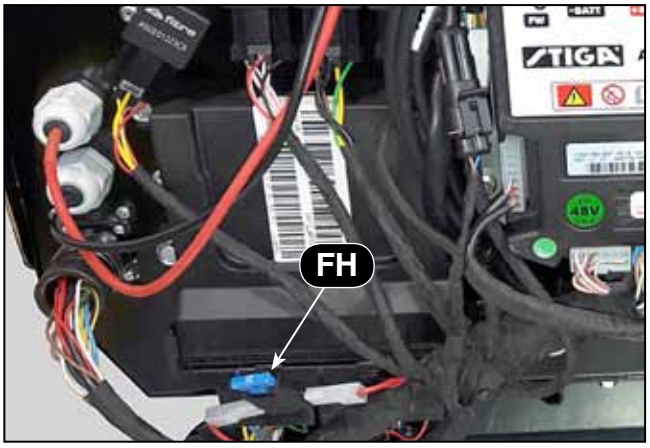
The fuses are distributed in various positions inside the battery compartment, located under the back cover.
Their function and scope are indicated in the table below.

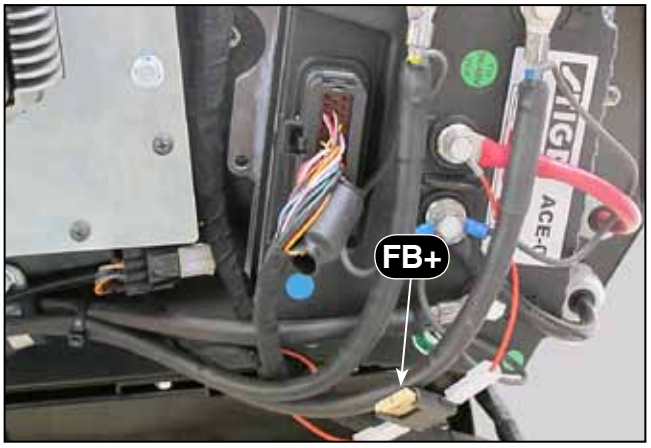
IMPORTANT *Before replacing a blown fuse, try to identify what caused the problem to prevent it from happening again.*

WARNING! ***Never replace a fuse with one of a different rating; it could cause damage to the electrical system and cause dangerous situations.***







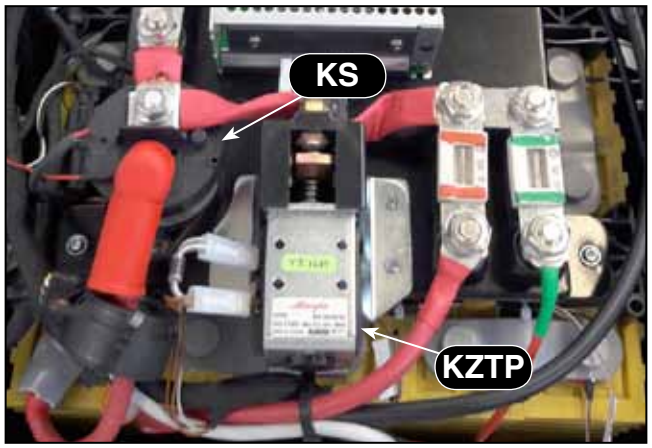


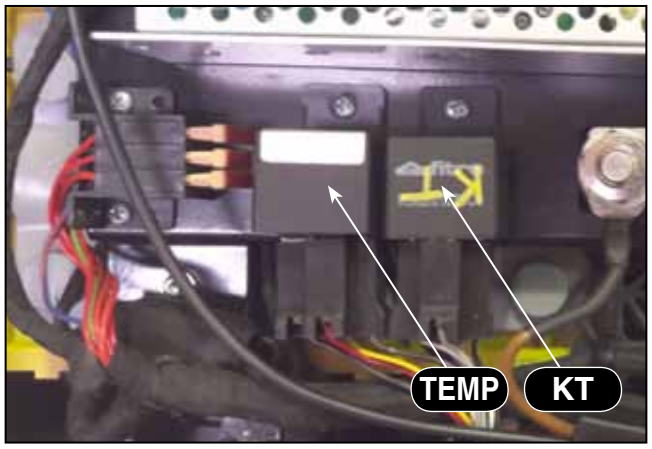
Reference	Flow rate	Colour	Protected element
F1	125 Amp	Red	Power circuit - ACE-0 control unit (blades)
F2	50 Amp	Green	Power circuit - ACE-0 control unit (traction)
F3	35 Amp	Brown	Power circuit - Battery charger
F41	5 Amp	Red	48 Volt key
F52	5 Amp	Red	12 Volt battery charger power supply
F63	5 Amp	Red	Display and Black box
FB+	5 Amp	Red	Button of the circuit/controller ACE-0 (blades)
FH	15 Amp	Blue	12 Volt Services

8.4.2 Relay location and function

The Relays are distributed in various positions inside the battery compartment, located under the back cover. The table below shows the functions of each relay.

IMPORTANTE *Before replacing a relay, investigate the causes of the failure in order to prevent the fault to recur again.*





Designation	Function
KS	General contactor to protect the battery cells on the 48 Volt circuit, managed by the BMS to stop the 48 Volt output.
KZTP	Self-protection of the 48 Volt power circuit of the AC-0 control unit.
KM	Managed by BMS, it gives the consent to the AC-0 control unit to start.
KT	Interrupts the power supply to the KZTP relay when the emergency switch is activated or in the absence of the operator.
OPC	It receives the operating consent from the emergency switch and from the micro switch (black) of the seat, manages the clutch safety control circuit and gives the consent to the delayed relay of the ACE-0 control unit.
BLADE	It receives the signal from the clutch and sends the clutch engaged signal to the ACE-0 control unit.
CLUTCH	It is activated with the clutch switch and powers the self-holding contacts of the BLADE relay.
TEMP	Relay delayed by 0.5" that interrupts the power supply to the control units AC-0 and ACE-0 when the operator leaves the seat.

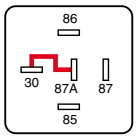
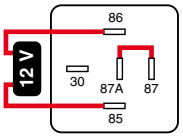
8.4.3 Checking the function of the relays

A basic relay consists of a coil of wire wound around a soft iron (magnetic) core. When current is passed through the coil, the core is magnetized and pulls down on a magnetic lever.

The lever in turn is attached to several switch contacts which open or close other electrical circuits. In this fashion, a small current can control one or more larger electrical currents and actuate several other devices.
In most cases a relay contact moves only a fraction of an inch and the magnetic pull is low.

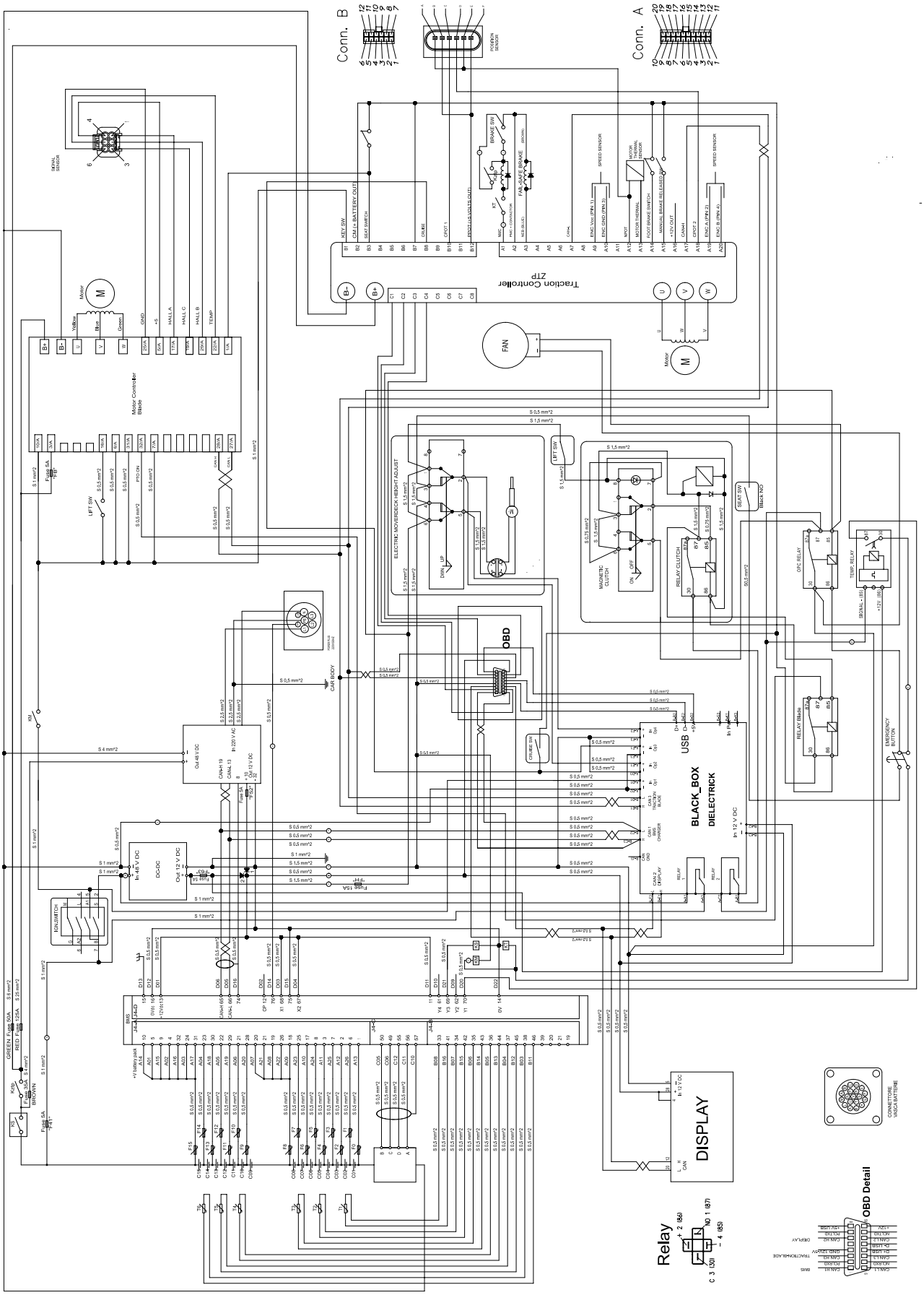
To check the operation of a relay you must have an Ohmmeter-dependent tester.
Disconnect the relay and connect the tester tips to the various contacts of the component concerned, an initial check with the relay disconnected and another with the power supply contacts connected to an external 12 Volt battery.

The readings shall be as indicated in the table below, where the red continuous line indicates the electrical continuity occurring inside.

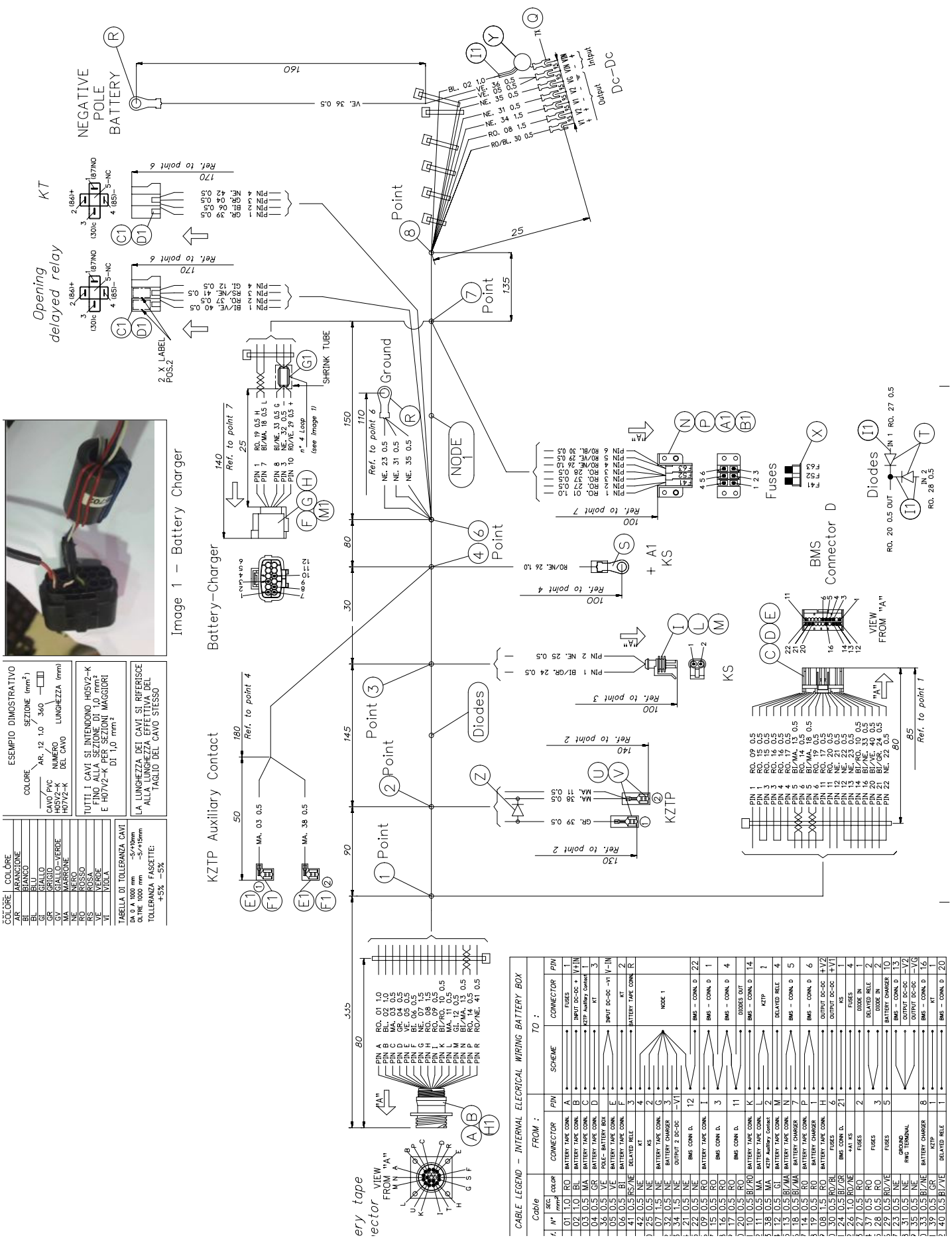
Definitions	Condition	Diagram	Readings
KS **KZTP** **KM** **KT** **OPC** **BLADE** **CLUTCH** **TEMP**	Not powered		87A-30 = 0 87-30 = ∞
	Powered		87A-30 = ∞ 87-30 = 0

8.5 ELECTRICAL WIRING DIAGRAMS

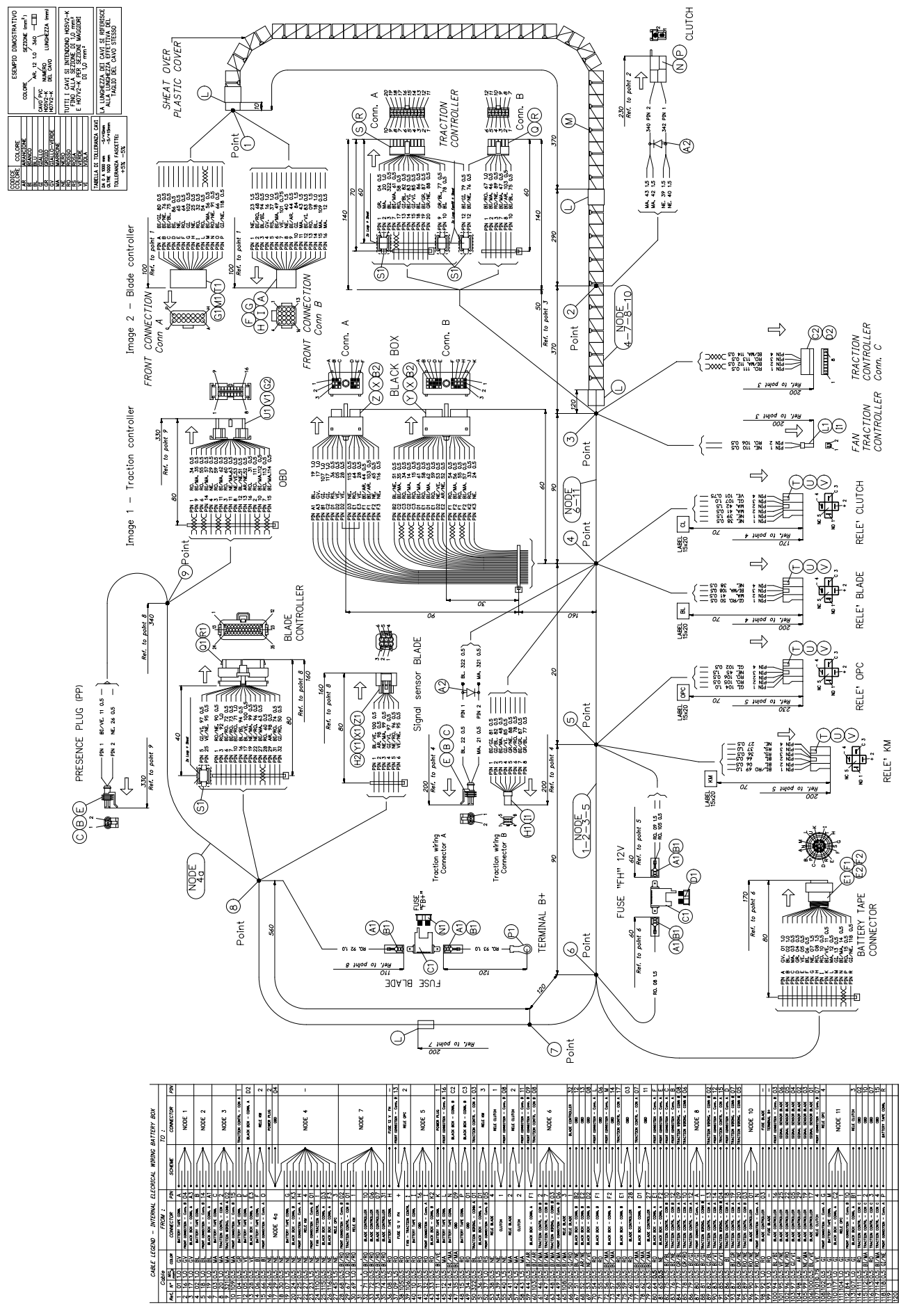
8.5.1 General electrical wiring diagram



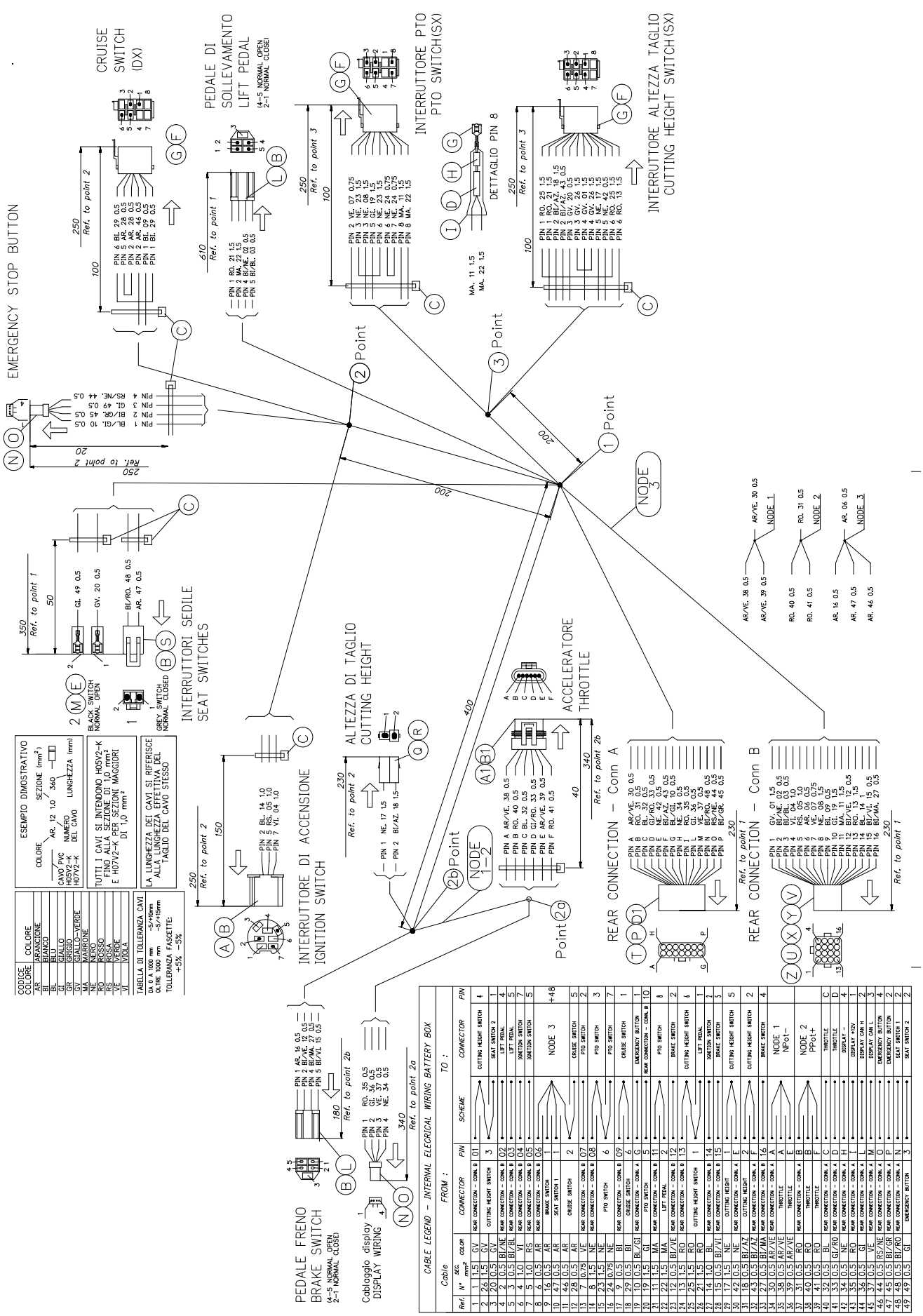
8.5.2 Internal cable harness diagram of the battery pack



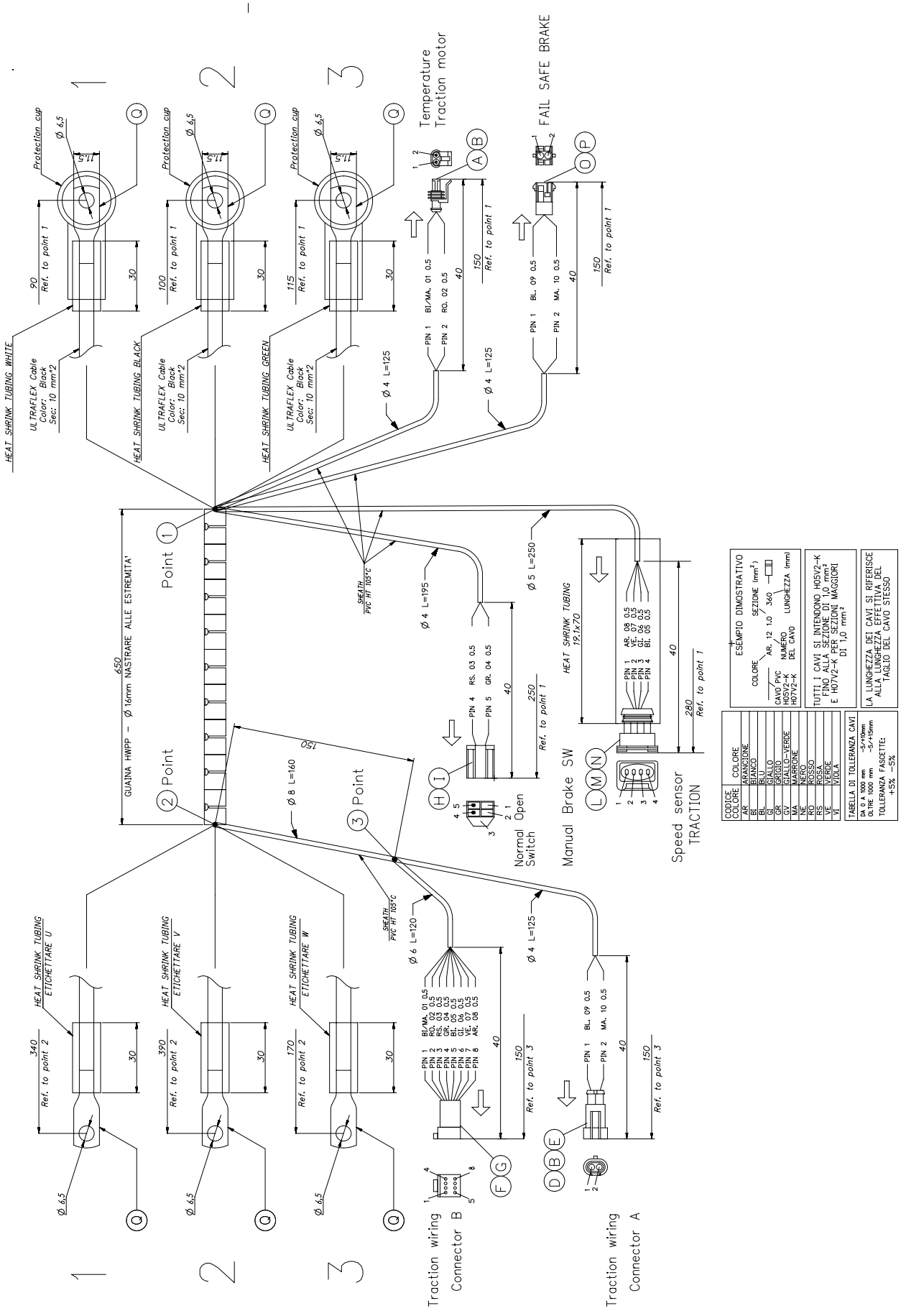
8.5.3 External rear cable harness diagram



8.5.4 Front cable harness diagram



8.5.5 Cable harness diagram of the transmission control unit



9 - ELECTRONIC MANAGEMENT - BATTERY

Summary

9.1 GENERAL INFORMATION

9.1.1 Introductory note

This chapter covers the electronic traction and blade management system, control units and batteries.
All the checks and interventions on the electrical system regarding safety systems, micro switches, fuses, relays and wiring in general are dealt with in a specific chapter of this manual **[☛ 8 - ELECTRICAL SYSTEM]**.

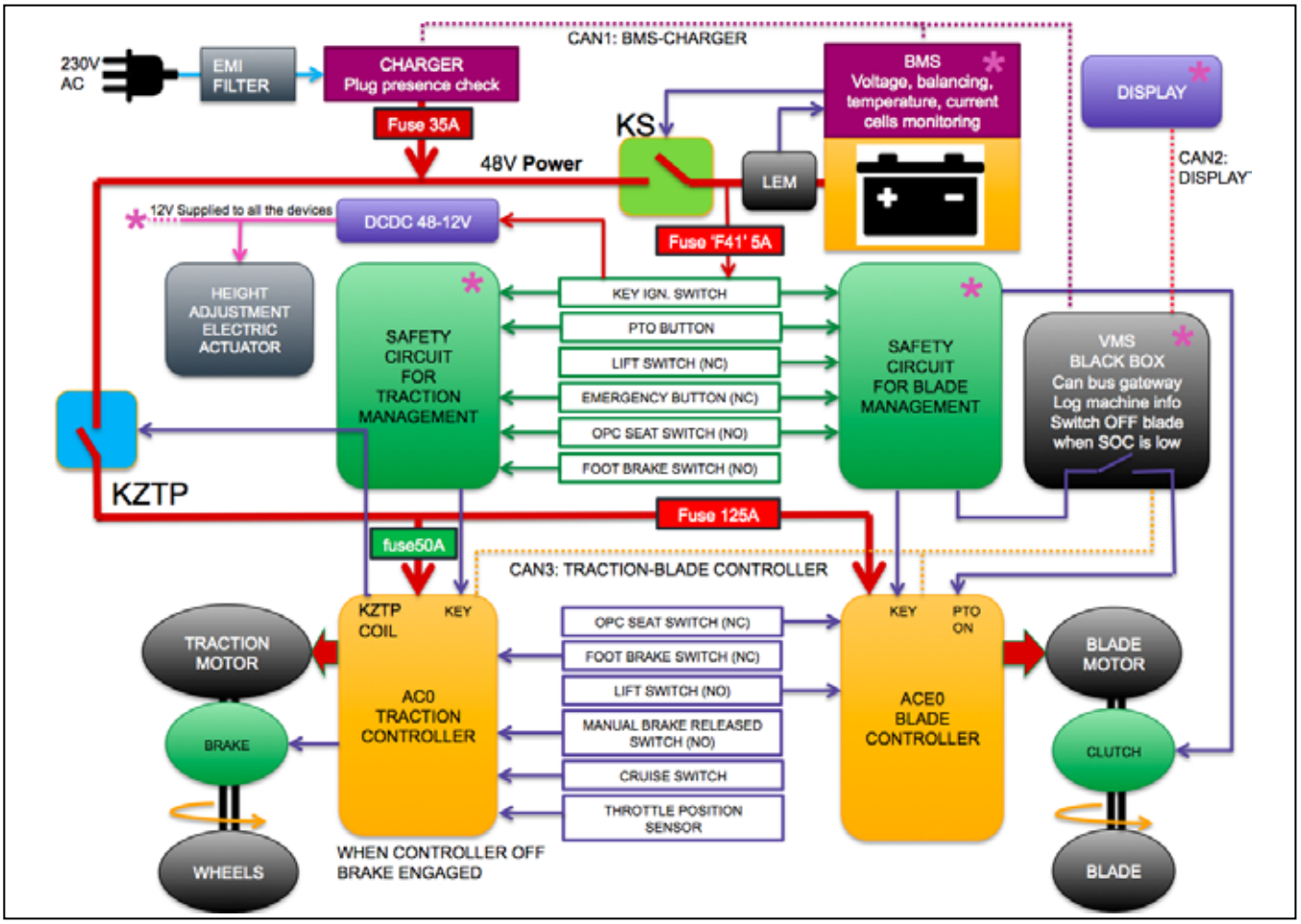
9.1.2 Safety regulations

WARNING! ***The presence of live elements requires particular attention when working on electrical components, in order not to create situations of danger while working and to restore the operating safety conditions for the user.***

- Do not wear rings or similar metal objects as this may cause a short circuit or fire due to accidental contact with live parts.
- Do not leave metal tools in areas where accidental contact with live parts may occur, as this may cause a short circuit or fire.
- All electrical cables are fastened to the frame with cable clamps. When an operation involves removing a clamp, then install a new clamp in its original position.
- Do not leave any electrical wiring that is not properly secured. Loose electrical cables can cause unnecessary wear to the insulation and cause short circuits and fire.

9.2 SYSTEM DESCRIPTION

9.2.1 Components description and functions



The block diagram shows the interaction of the main devices that make up the machine control system, the management of the power circuit, the CAN BUS communication system and electrical circuits that ensure total safety in the control of the electric motors.

The management of the system is controlled by 5 control units that interact with each other with a continuous exchange of incoming and/or outgoing information.

- **BMS (Battery Management System)**. Control unit that monitors the temperature, current and voltage of the cells that make up the battery pack, during the charging and draining phases of the battery pack.
  In the event of anomalies, both during charging and draining, the BMS completely isolates the power line of the battery pack, opening the main contactor KS.

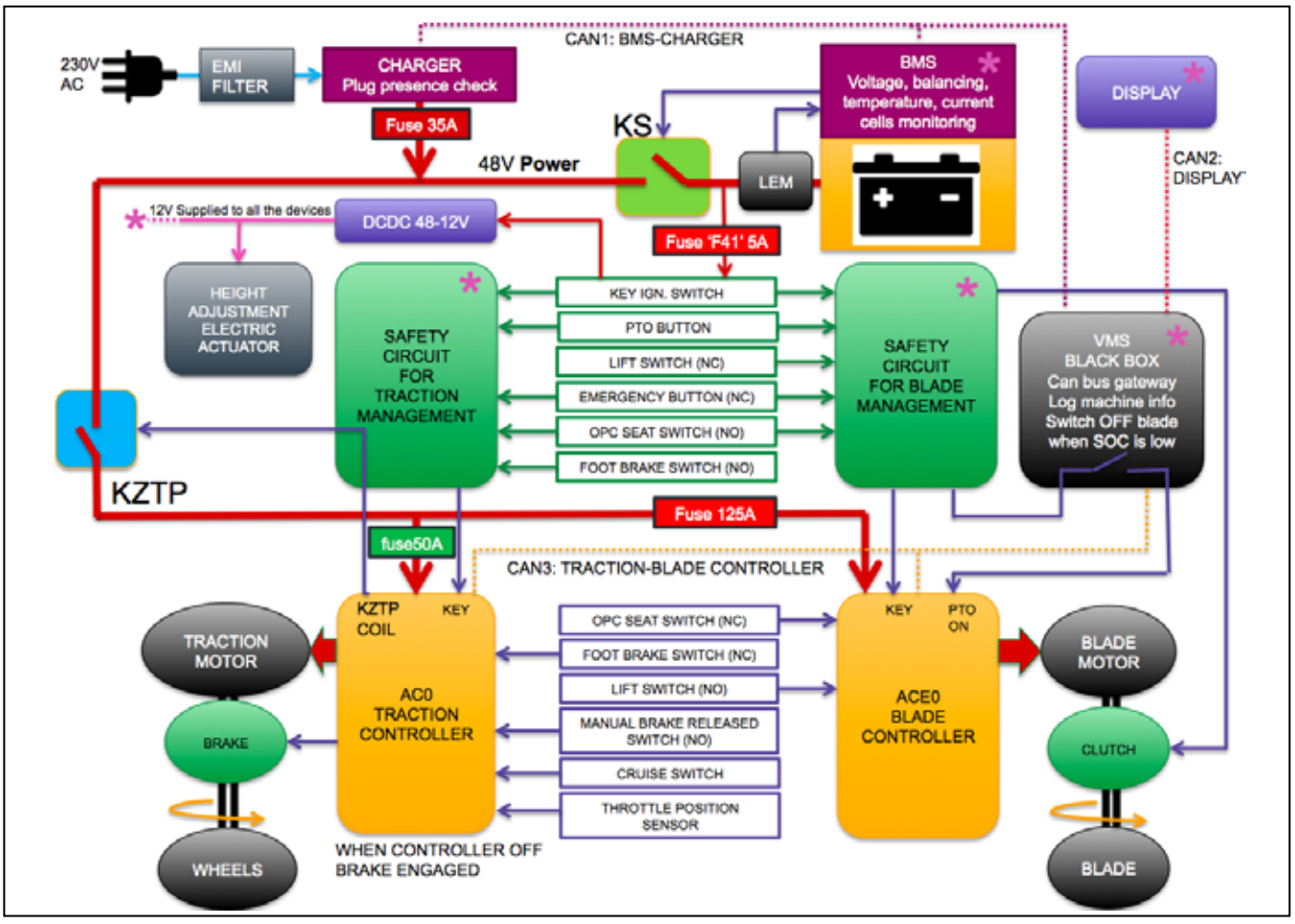
- **CHARGER** The battery charger commence working only when the machine is being charged. It is a device that transforms the voltage of the 230V AC home network into direct current, and supplies the battery pack with the current/voltage profile required by the BMS.
  If there is no communication with the BMS, or overheating, the charger interrupts the power supply.

- **AC-0 TRACTION CONTROLLER** The traction motor controller is a control unit that controls the motor and the traction brake, depending on the input signals it receives: status of the switches ,

accelerator pedal position, motor temperature and speed of the motor.
Once switched on, the control unit keeps in constant communication, by the CAN BUS 3 line, with the blade motor controller ACE-0. If both controllers do not show any anomalies, the AC-0 enables the closure of the KZTP contactor, subject to the consent of the safety circuit as well.
To increase the safety level of the machine, an electrical circuit external to the controller switches off the controller and opens the KZTP contactor when the emergency mushroom is pressed or the operator leaves the seat.
The traction controller also implements the Cruise Control function.

- **ACE-0 BLADE CONTROLLER** The blade motor controller is a control unit that controls the blade motor according to the input signals it receives: switches status, temperature and motor speed.
  Once switched on, the control unit keeps in constant communication, by the CAN BUS 3 line, with the blade motor controller AC-0.
  To increase the safety level of the machine, an electrical circuit external to the controller disconnects the clutch when the PTO button is pressed, the emergency mushroom is pressed or the operator leaves the seat.

- **VMS-BLACK BOX** The VMS controller reads the information of the CAN 1 and 3 signals and transmits it via the CAN 2 line to the display. It also deactivates the blade motor when the battery power reserve is less than 5%, reads the status of the Cruise Control button and adjusts the height of the cutting deck.
  The VMS control unit is equipped with an internal memory for logging the "Black box" information.



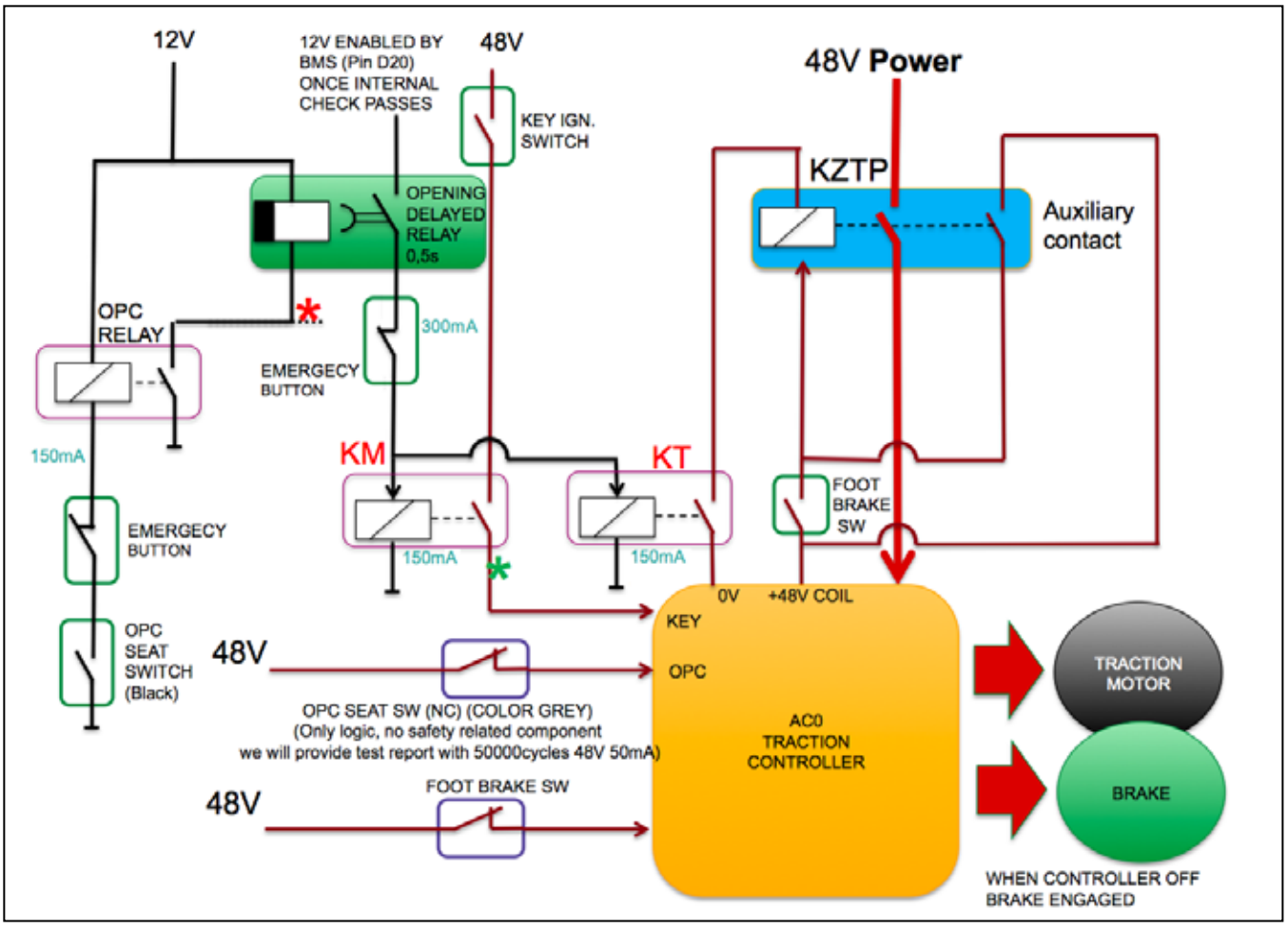
9.2.2 Power management

When drained, by turning the ignition key of the machine, the 48-12V DCDC converter starts to supply all the devices with 12V power supply:
- BMS
- VMS
- Display
- Electric height adjustment control
- Safety circuit

The self-holding of the key contact is then carried out by the VMS through Relay1. Once this contact is closed, it is possible to release the key keeping the machine in the on mode.
If the charging cable is not plugged into the socket and no anomalies are detected on the pack, the BMS closes the KS contactor to supply the power line. In addition, the BMS enables the operation of the motor controllers via a 12V signal (Pin D20).

If the startup procedure is correct:
- emergency switch released,
- operator present,
- brake pedal pressed,
- accelerator pedal in neutral,

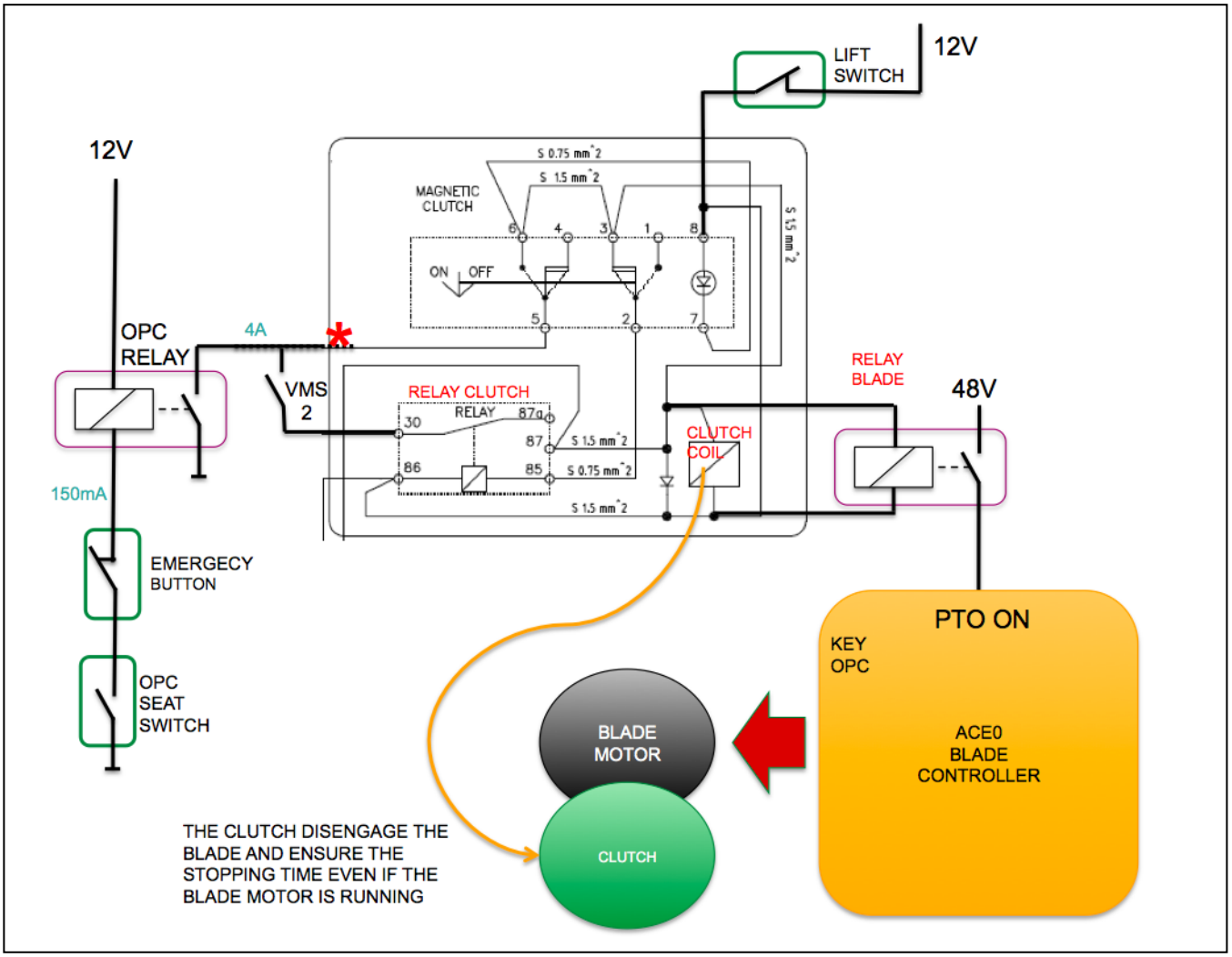
and the controllers are fault-free, the AC-0 controller closes the KZTP contactor to provide access to the power line: the AC-0 traction controller is powered via the 50 A fuse while the ACE-0 blade controller is powered via the 125 A fuse.



9.2.3 ACE-0 Safety Systems (Blades) Operational Description

To increase the safety level of the machine, an electrical circuit external to the blades controller removes the consent to the operation of "KEY". and opens the KZTP contactor when the emergency button is pressed or the operator leaves the seat.

In this case, the safety circuit also disconnects the coil of the coaxial electromagnetic clutch to the "CLUTCH COIL" blade motor, which allows the blades to be stopped within the times established by the regulations, even in the event of controller malfunction.



9.3 MANAGEMENT SOFTWARE

9.3.1 General information

The machine's electronic management system includes five software packages, each of which is dedicated to a specific command or control device:

- **BMS (Battery Management System)**. Presides over the general functions concerning the energy system and the rational use of energy availability by the AC-0 and ACE-0 control units.
- **VMS (Vehicle Management System)**. Collects data from the control units and communicates with the BMS. Contains the machine operating history (Black Box)
- **AC-0.** Manages the traction control unit and interacts with ACE-0 and BMS.
- **ACE-0.** Manages the control unit of the blade control and interacts with AC-0 and BMS.
- **Display.** Displays the operating functions and is the communication interface with the operator or the Service Centre.

The software is physically resident in the single devices; in the event of replacement of one of the above components, the corresponding software is already pre-loaded in the replacement component,

The availability or necessity of any updates is communicated through the usual channels of information in use with the Assistance Centres, indicating how to download from the Internet and the relative instructions on how to load them on the relative equipment.

9.4 MENU “SERVICE MODE” AND DIAGNOSTICS

9.4.1 Accessing and exiting the "Service Mode" menu

In the "Service Mode" menu, you will find all the useful information on the status of the machine and any malfunctions.

NOTE *Access to the various functions of the menu always requires the presence of the operator, seated at the driver's seat.*

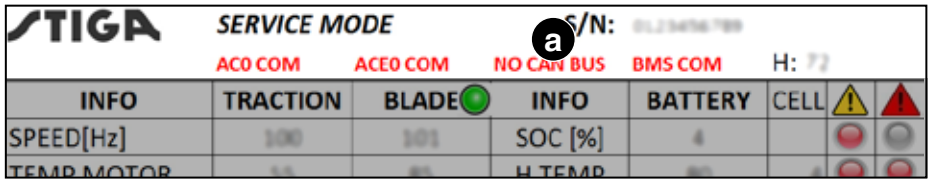
•To access the menu it is necessary:
– To release the emergency stop button (3).
– To operate the brake pedal and hold it down.
– To turn key (1) to position «I» and hold it in this position for 2", then release it so that it moves into position «C» activating the machine.
– To press the Cruise Control for 5 seconds.
– To release the brake pedal.

• To exit the menu it is necessary:
– To turn key (1) to position«O» and switch off the machine, or:
– Press the brake pedal and hold down the Cruise Control for 5 seconds.

9.4.2 Elements description of the graphic interface

The upper part of the window (a) displays the messages concerning the state of the computer connections that control the exchange of information between the various management software

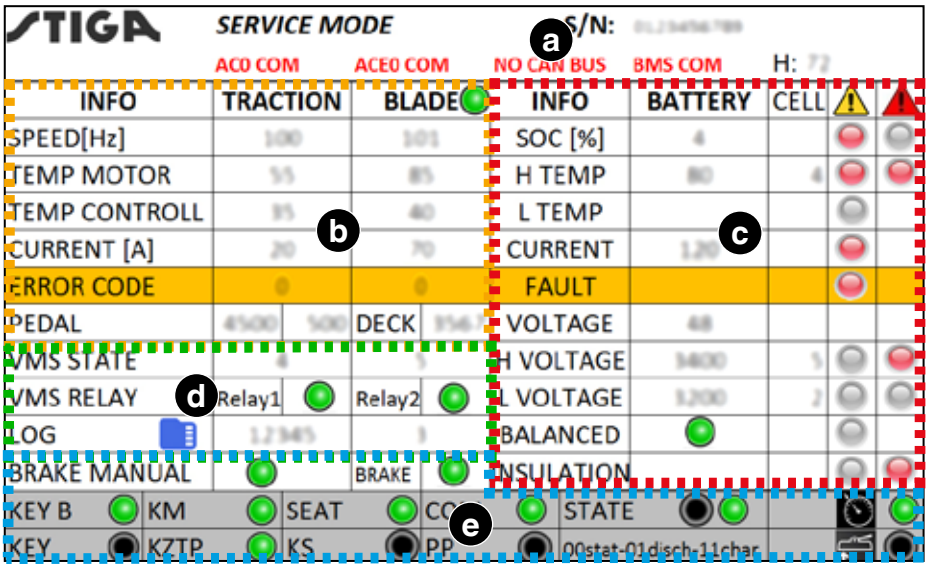
The meaning of the messages is shown in the table below.



MESSAGE	Meaning
NO CAN BUS	Physical connection interrupted between VMS and display
NO CAN BUS BMS COM	Physical connection interrupted between VMS and BMS
AC-0 COM NO CAN BUS	Connection interrupted between VMS and AC-0 AC-0 control unit fault
ACE-0 COM NO CAN BUS	Connection interrupted between VMS and ACE-0 ACE-0 control unit fault

The chart below includes 4 areas, with information relating to:

b) traction motors and blades;
c) battery;
d) VMS status;
e) machine and interconnections status



These areas also contain indicator lights and symbols to indicate:

Off

Regular operation

Operating fault

Warning

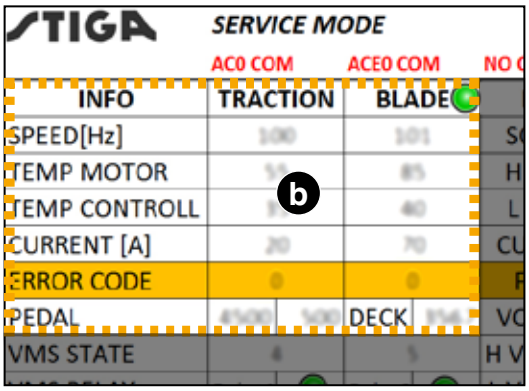
Alarm

The description of the contents is given in the following charts for each single area.

b) Traction motors and blades

The values within the normal operating limits are displayed in the table fields.

Exceedances of the normal values are indicated by an error code [☛ 9.4.3] - [☛ 9.4.4].

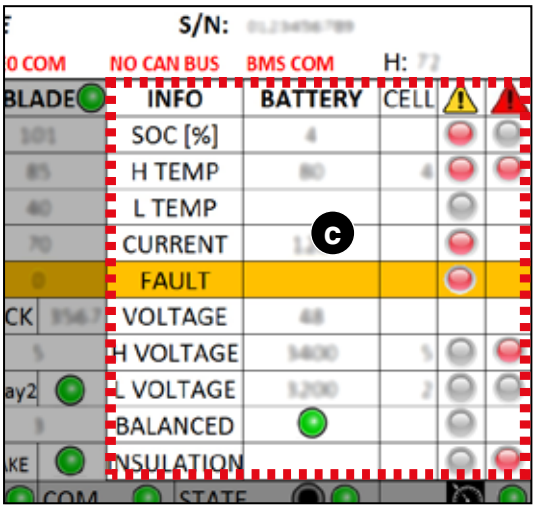


INFO	SCALE VALUES AND MEANING	
	TRACTION	BLADE
SPEED [Hz]	Indicates the motor frequency: 0 = Stationary 200 = Maximum – xx = Reverse	Indicates the motor frequency: 0 = Stationary 200-210 = Motor speed
MOTOR TEMP	Motor temperature in °C	Motor temperature in °C
CONTROL TEMP	Temperature AC-0 in °C	Temperature ACE-0 in °C
CURRENT [A]	Phase current consumption	Phase current consumption
ERROR CODE	Error code [☛ 9.4.3]	Error code [☛ 9.4.4]
PEDAL	Value transmitted by the potentiometer in mV - Correct values: 0-5000 / 5000-0 No value = No consent	DECK = Field not active

c) Battery

The values within the normal operating limits are displayed in the table fields.

Exceedances of the normal values is indicated first by the warning light and then by the warning light with an identification code of the fault [☛ 9.4.3] - [☛ 9.4.4].

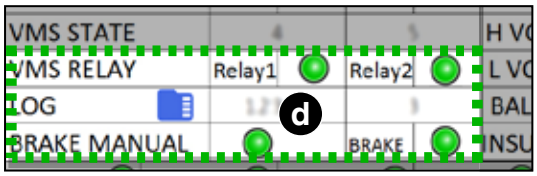


INFO	SCALE VALUES AND MEANING		
	BATTERY	CELL	⚠ - ⚠
SOC [%]	Battery power reserve status in %	Field not active	⚠+● = Power reserve 0%
H TEMP	Actual maximum temperature between sensors in °C	Number of the cell pack area where it occurs	
L TEMP	Actual minimal temperature between sensors in °C	Number of the cell pack area where it occurs	⚠+● = Temperature < -25°C
CURRENT [A]	Current value in the cell pack in amperes from +500 to -50 *	Field not active	⚠+● = Excessive value
FAULT	Not active	Field not active	● = General alarm for any cause
VOLTAGE	Voltage of the entire cell pack (normal from 37.5 to 59 V)	Field not active	Not active
H VOLTAGE	Maximum voltage of a single cell in mV	Cell number where it occurs	⚠+● = Abnormal voltage value but the machine is running ⚠+● = Voltage >3950 mV and machine shutdown
L VOLTAGE	Minimum voltage of a single cell in mV	Cell number where it occurs	⚠+● = Abnormal voltage value but the machine is running ⚠+● = Voltage <2500 mV and machine shutdown
BALANCED	● = Charging completed and start of voltage balancing between all cells	Cell number where it occurs	⚠+● = Unadjustable unbalance in one cell
INSULATION	Field not active	Field not active	⚠+● = Battery negative not connected to the chassis or leakage in the ground cables

* A negative value is displayed during charging.

d) VMS status

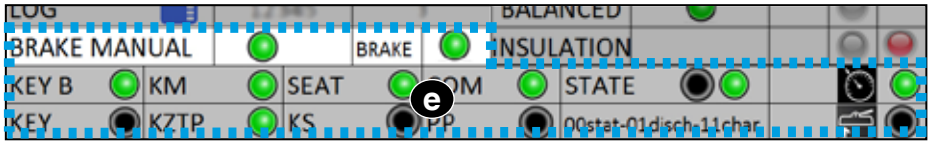
The operating statuses are displayed in the table's fields.



INFO	SCALE VALUES AND MEANING			
	TRACTION		BLADE	
VSM STATE	Management phases sequence of the AC-0 traction control unit: 0 = key in "OFF" position 1 = key in activation position 2 = key in "ON" position 3 ÷ 4 = Inactive 5 = Software Lock* 6 = Shut-down phase 7 = all off (not visible in the display)		Management phases sequence of the blade movement control unit ACE-0: 0 ÷ 3 = starting and starting phases 4 = fully operational 5 ÷ 6 = Stop stages 7 = error message from ACE-0 9 = alarm	
VSM RELAY	Relay 1 = Contact in parallel to the ignition key	= Contacts closed, machine on	Relay 2 = Blades control unit ACE-0	= Controller active Off = Battery charger < 5%
LOG **	Numbering of the data log file in the "Black Box		Recording steps sequence: 0 ÷ 3 = Writing startup steps 4 = writing 5 = Standby 6 ÷ 7 = closing steps of the recording session 8 = Error due to memory card absence or failure 9 = Not active 10 = Error due to inability to save data.	
* Try restarting. ** The crossed out logo indicates that the system is not saving data. Turn off and restart the machine.				

e) Machine and interconnections status

The lighting of the light indicates the correct functioning of the component.



INFO	SCALE VALUES AND MEANING			
	TRACTION		BLADE	
BRAKE MANUAL	= Transmission unlocked and wheels free for push movement		BRAKE = Parking brake pedal pressed	
INTERCONNECTIONS STATUS				
KEY B = BMS active	KM = Driving permission from the BMS	SEAT = NC status of the seat micro switch	COM = Correct communication between charger and BMS	STATE Battery status = waiting for charging socket to be inserted = drained = charged
KEY = VMS active	KZTP = Active contactor	KS - Contactor BMS = Active contactor	PP - Presence Plug = Charging socket plugged in*	
* The machine cannot be switched on with the socket inserted.				

9.4.3 Decoding of AC-0 operating faults

The table includes the decoding of all the messages indicating the operating faults of the ACE-0 control unit, with an indication of the actions to be taken for their solution.

Code	Definitions	Probable Cause and Consequent Action
8	WATCH DOG	The test takes place both in standby mode and during operation. It is an internal self-diagnosis test of the mechanism. • **Solution**: Check the motor connection and the continuity of its three phases If the alarm persists, the controller must be replaced.
13	EEPROM KO	Malfunction in the memory section where the control parameters are saved; this alarm prevents the machine from operating. If the fault persists even after turning the machine off and on again, replace the mechanism. If the alarm disappears, remember that the previously saved parameters are deleted and are replaced by the default values.
17	LOGIC FAILURE #3	• **Cause:** occurs when the circuit is turned ON to limit the peak current in the controller via the HW. • **Solution**: This is probably an electrical or mechanical fault. If the fault persists, the controller must be replaced. A fault has occurred in the hardware section of the motherboard that manages the electrical protection of the hardware. Replace the motherboard.
18	LOGIC FAILURE #2	A fault has occurred in the hardware section of the motherboard that handles phase voltage feedback. Replace the motherboard.
19	LOGIC FAILURE #1	This alarm signals the activation of an under-voltage/over-voltage protection mode. There are two possible reasons for this: a. An actual under-voltage/over-voltage situation has occurred. B. A fault has occurred in the hardware section of the motherboard that handles over-voltage protection. Replace the motherboard.
30 - 31	VMN LOW VMN HIGH	The test takes place during initial diagnosis and in standby mode. Possible causes: a. there is a problem with the motor connections or with the motor electrical circuit; check if the 3 phases are correctly connected; check for any dispersion of the motor to earth; b. inverter faulty; replace it.
37	CONTACTOR CLOSED	The controller checks whether the KZTP contactor contact is closed when the coil is not operative There are two possible reasons for this: • **Solution**: It is recommended to check whether the contactor contact is mechanically blocked or stuck.
38	CONTACTOR OPEN	The KZTP contactor coil has been operated from the motherboard, but the contactor does not close. There are two possible reasons for this: a) The cables connected to the coil are interrupted or poorly connected; b) The contactor contact does not function properly.
49	I=0 EVER – NO CURRENT MEASURMENT DURING TRACTION	• **Cause**: This test is performed when the motor is running and verifies that the current feedback sensor does not always lock at 0. • **Solution**: If there are no faults in the motor, the problem may be in the current sensor or in the current circuit.
53	STBY I HIGH	Test performed in standby mode. Check if the current is 0. If the test is not performed, an alarm appears that prevents the machine from operating. Possible causes: a. current sensor fault; b. mechanism failure; if alarm persists, controller must be replaced.
60	CAPACITOR CHARGE	• **Cause**: During operation, a resistance connected between the key and the track capacitors keeps these last loads before the main capacitor closes. This alarm occurs when the track capacitor voltage (measured at phase V) is low and does not increase when the main capacitor is opened. When the key is activated, the inverter tries to charge the capacitor via an electrical resistance and checks whether the capacitor is charged within a definite time. If this does not happen, an alarm appears and the main capacitor does not close. Possible causes: - Another device, connected in parallel to the capacitor line, is faulty - At least one motor phase is not connected to the controller or is broken. - An electrical or mechanism fault has occurred in the controller.

Code	Definitions	Probable Cause and Consequent Action
61	HIGH TEMPERATURE	The temperature of the isolating switch is above 78 °C. The maximum current is reduced proportionally to the temperature increase. The cutter stops at 103 °C. If the alarm appears when the isolating switch is cold: a. check the wiring of the thermal sensor; b. thermal sensor failure; c. mechanism failure.
65	MOTOR STOP TEMPERATURE	The motor temperature is higher than the set value of 160 °C ("MOTOR STOP TEMP"). This is only a warning: No correction actions are taken. If the traction motor is cold and the sensor is disconnected, check the wiring / traction connector.
66	BATTERY LOW	If the "Battery Check" option is active (NOT ON), a battery draining algorithm is performed. When the charge level is 10%, this alarm appears and the current is reduced to half the programmed level.
69 - 220	WRONG ACQUISITION	The VACC procedure was not performed correctly. Repeat the procedure. Is the cable of the accelerator pedal sensor damaged?
74	DRIVER SHORTED	This alarm occurs when the KZTP contactor voltage is higher than expected: it means that the KZTP contactor coil has a high voltage even in the absence of power supply. Check for an external short circuit and whether the ohmic value of the KZTP contactor is correct.
75	CONTACTOR DRIVER	• **Cause**: This alarm occurs when the KZTP contactor voltage is lower than expected: it means that the KZTP contactor coil has no voltage when it receives current. • **Solution**: Check that the KZTP contactor coil (CNA#1) has not suffered a short circuit. Otherwise, you will probably need to replace the controller because the KZTP contactor drive is broken.
76	COIL SHORTED	When the key is turned on, the µP system checks the contactor drive KZTP - FF SR. If the drive does not react correctly to the µP stimulus, this alarm is sent. Replace the motherboard. The FF SR system performs a hardware check of the current in the coil of the KZTP contactor. If the current is too high, the system opens the KZTP contactor and sends the alarm. Check for an external short circuit and if the ohmic value of the KZTP contactor is correct; if not, replace the mechanism.
78	VACC NOT OK	The test is performed in standby mode. This alarm indicates that the throttle voltage is 1V above the minimum value programmed by the VACC PROGRAM function. Possible causes: a. the potentiometer is not calibrated correctly; b. potentiometer is defective.
79	INCORRECT START	This alarm signals an incorrect start sequence. Possible causes: a. microswitch failure during operation; b. operator error during sequence; c. incorrect wiring; d. if the fault persists, replace the mechanism.
80	FORW + BACK	• **Cause**: This alarm occurs when both motion questions (forward and reverse) are active at the same time. Possible causes: a. incorrect wiring; b. failure of the micro switch during operation; c. incorrect operation; d. if the fault persists, replace the mechanism.
86	PEDAL WIRE KO	This alarm appears if a fault is detected in the wiring of the Accelerator Unit (brake in the NPOT or PPOT cable). Check the wiring to the accelerator pedal sensor.
219	CRUISE SW STUCK	Cruise switch locked with key in position ON. Do not press the switch during start-up Check whether the switch is short-circuited.
221	MOTOR WARNING TEMPERATURE	The motor temperature is higher than the set value of 130 °C ("ATT TEMP"). MOTOR"). This is just a warning: the current is limited to 30%.
228	ALL ENC LOCK	Encoder cable problem.
232	VACC MISMATCH	The VACC procedure was not performed correctly. Repeat the procedure. Is the cable of the accelerator pedal sensor damaged?
240	WRONG CONFIG	Configuration error. Replace the controller.

Code	Definitions	Probable Cause and Consequent Action
248	CAN BUS KO	The CAN-BUS line diagnosis is present. The alarm appears if the inverter does not receive any message from the CAN-BUS line. First, check the wiring. If this is correct, the problem is with the motherboard, which needs to be replaced.
250	THERMIC SENSOR KO	The temperature sensor range of the AC-0 inverter is always checked and a warning message appears in the event of a fault. If this alarm occurs, wait and check the connection of the sensors.
252	WAITING NODE	The AC-0 controller signals the start. Usually appears when the key is ON.
254	AUX OUTPUT KO	The µP system controls the application of the electromechanical brake. The alarm appears if the output status of the drive does not match the signal from the µP system. Possible cause: a. The electromechanical brake of the traction unit is not connected. Check the wiring connection. Check the integrity of the cables. b. Electromagnetic brake damaged. Check the ohmic coil of the electromagnetic brake. c. defective mechanism.

9.4.4 Decoding of ACE-0 operating faults

The fault diagnosis system of the ACE-0/ KOMBI AC-0 controller is divided into 2 main fault groups:

a) ALARMS: these anomalies open the electrical section, i.e. they determine the opening of the energy bridge and, if applicable, of the KZTP system and the application of EB. These are anomalies linked to:
- motor /controller failures preventing the electrical system from operating the trolley
- safety-related faults

b) WARNINGS: These are faults which do not stop the machine or which stop it by means of a regenerative braking system. In other words, the controller works correctly, but detects conditions that reduce performance or stop the machine without opening the electrical devices. These warnings are linked to
- incorrect operator sequences
- conditions requiring a reduction in performance (e.g. high temperature, etc.).

The following tables include the decoding of all messages, divided between "ALARM" and "WARNING", with an indication of the actions to be taken for their solution.

a) ALARM Messages

Code	Definitions	Probable Cause and Consequent Action
8	WATCHDOG	• **Cause**: This is a safety test. It is an internal self-diagnosis test of the mechanism. The watchdog circuit consists of two single-stable multivibrators that guarantee double verification of software execution. • **Solution:** This alarm may be caused by a hardware fault in either (or both) of the multivibrators, or by a software execution problem. In both cases, the fault is internal to the controller and must be replaced.
17	LOGIC FAILURE #3	• **Cause**: Hardware problem in the circuit board of the mechanism for high current protection (overload). • **Solution:** This type of failure is independent from external components, so when it occurs, the control unit must be replaced.
18	LOGIC FAILURE #2	• **Cause**: A fault has occurred in the hardware section of the mechanism board that handles phase voltage feedback. • **Solution:** This type of failure is independent from external components, so when it occurs, the control unit must be replaced.
19	LOGIC FAILURE #1	This fault appears when the controller detects an overvoltage or undervoltage condition. For the 24V controller, the overvoltage threshold is 35V and the undervoltage threshold is 9.5V. For the 48V controller, the overvoltage threshold is 65V and the undervoltage threshold is 9.5V. • The troubleshooting message appears when the power is turned on or in standby mode; in these cases, it is very likely that the fault is due to undervoltage and therefore it is advisable to check: A) Pulse lowering in the key input signal (above undervoltage threshold) due to external loads, such as starting DC/DC converters, switching relays or contactors, powering solenoids on/off. B) If no transient voltages are detected on the power supply and the alarm appears each time the key is activated, the fault is probably in the controller hardware, which must be replaced. • The troubleshooting message appears on the motor drive; in this case, it may be an undervoltage or overvoltage problem. A) If the alarm appears during traction acceleration or hydraulic operation, undervoltage is most likely to occur; check the battery charge and electrical cable connection. B) If the alarm appears when you release the brake, it is most likely due to an overvoltage; check the line contactor contact and the battery power cable connection.

Code	Definitions	Probable Cause and Consequent Action
28	PUMP VMN LOW	• **Cause**: The output of the pump motor is lower than expected, considering the pwm value applied. • **Solution:** A) If a power-on problem occurs (KZTP does not close properly), check: - internal motor connections (ohmic continuity); - motor electrical cable connections; - If the motor connection is OK, the problem is inside the controller. B) If the problem occurs when you close the KZTP system (KZTP closes and reopens), check: - motor connections - if the motor windings/cables leak to the machine chassis; - if no motor problems are found, the problem is inside the controller. C) If the alarm occurs during motor operation, check: - motor connections - If the motor windings/cables leak to the machine chassis; - that the electrical contact of the KZTP system is correctly closed, with a good contact; - if no motor problems are found, the problem is inside the controller.
29	PUMP VMN HIGH	• **Cause**: This test is performed when the pump motor is running (wpm applied). The output of the pump motor is higher than expected, considering the wpm value applied. • **Solution:** It is advisable to check: - motor connections - If the motor windings/cables leak to the machine chassis; - if no motor problems are found, the problem is inside the controller.
30	VMN LOW	• **Cause 1:** startup test. Before turning on the KZTP system, the software checks the energy bridge: it alternately turns on the Mosfet transistors at the top and waits for the phase voltage to increase towards the capacitor line value. If the phase voltage does not increase, the alarm appears. • **Cause 2**: motor operation test When the motor is running and the power bridge is active, the test verifies the motor voltage feedback; if it is lower than the value ordered, the fault status appears. • **Solution:** A) If a power-on problem occurs (KZTP does not close properly), check: - internal motor connections (ohmic continuity); - motor electrical cable connections; - leaks between the motor and the machine chassis - if the motor connections are OK, the problem is inside the controller. B) If the alarm occurs during motor operation, check: - motor connections - If the motor windings/phase cables leak to the machine frame; - that the electrical contact of the KZTP system is correctly closed, with a good contact; - if no motor problems are found, the problem is inside the controller.
31	VMN HIGH	• **Cause 1**: Before turning on the KZTP system, the software checks the power bridge: it turns on the Mosfet transistors alternately at the bottom and waits for the phase voltage to drop to -BATT. If the phase voltage does not decrease, the alarm appears. • **Cause 2**: This alarm may appear even after the ignition diagnosis has been passed and therefore with the KZTP system closed. In this case, the phase voltages should be less than 1/2 Vbatt. If the value is higher, the fault status appears. • **Solution:** A) If a power-on problem occurs (KZTP does not close properly), check: - internal motor connections (ohmic continuity); - motor electrical cable connections; - if the motor connection is OK, the problem is inside the controller B) If the problem occurs when you close the KZTP system (KZTP closes and reopens), check: - motor connections - If the motor windings/phase cables leak to the machine frame; - if no motor problems are found, the problem is inside the controller.

Code	Definitions	Probable Cause and Consequent Action
38	CONTACTOR OPEN	• **Cause**: The main contactor coil has been driven by the controller, but the contactor does not close. • **Solution:** It could also be a contact problem not working in the KZTP system (pull-in resistance anomaly). Try replacing the KZTP system.
	TILLER ERROR	• **Cause**: Misalignment between H&S and bar inputs. • **Solution:** Check the CAN#1 and CAN#29 wiring with a voltmeter If the status of these inputs is correct, the problem may be internal to the controller, which must be replaced.
53	STBY I HIGH	• **Cause**: The current transducer or feedback circuit inside the controller is damaged. • **Solution:** This type of failure is independent from external components, so when it occurs, the control unit must be replaced.
60	CAPACITOR CHARGE	It follows the capacitor charging system: When the key is turned on, the inverter tries to charge the electrical capacitor via a resistance and checks whether the capacitor charges within a defined time. If the capacitor does not charge, an alarm appears; the main capacitor does not close. • **Solution:** - There is an external load parallel to the capacitor bank, which reduces the current from the controller's capacitor pre-load circuit, thereby preventing the caps from being loaded. Check whether there is a lamp or DC/DC converter or auxiliary load in the capacitor bank. - The charging resistance is open; insert an electrical resistance through the terminals of the line contactor; if the alarm disappears, it means that the controller's internal charging resistance is damaged. - The charging circuit has a fault inside the controller. - There is a problem with the electrical section of the controller.
74	DRIVER SHORTED	• **Cause**: The main contactor coil is shorted or the coil is disconnected. • **Solution:** - check for short-circuits or low impedance pull-downs between NMCC CNA#12 and -BATT. - the drive circuit is damaged inside the controller, and the controller must be replaced. - The wires to the KZTP coil are interrupted or not connected; check the coil wiring.
75	CONTACTOR DRIVER	• **Cause**: Drive of the KZTP coil is not able to drive the load. The damage is to the device or its drive circuit. • **Solution:** This type of failure is independent of external components; replace the controller
	CONTACTOR CLOSED	• **Cause**: Before operating the KZTP coil, the controller checks whether the contactor is locked. The controller operates the bridge for about ten milliseconds, trying to unload the capacitors bank. If the capacitors do not drain, the fault condition appears. • **Solution:** It is advisable to check the electrical contacts of the KZTP system; it is necessary to replace the KZTP system.
80	EMERGENCY	• **Cause**: The voltage on A3 is different from +Vbatt • **Solution:** - check if A3 is correctly connected to +V batt. - check that the fuse on A3 is not damaged.
82	ENCODER ERROR	• **Cause**: This anomaly appears in the following conditions: the frequency supplied to the motor is higher than 40 Hz and feedback from the encoder jumps above 40 Hz in a few tens of milliseconds. This condition is due to the malfunction of the encoder. • **Solution:** - check the function of the electrical and mechanical encoder and the crimping of the wires. - check the mechanical installation of the encoder; this alarm may appear even if the encoder slips inside its housing. - the alarm can also be caused by electromagnetic interference on the sensor bearing. In this case, try replacing the encoder. - if the problem persists even after replacing the encoder, the fault is in the controller.

Code	Definitions	Probable Cause and Consequent Action
86	POS EB SHORTED	• **Cause**: The output of the integrated Smart Driver that supplies the positive pole of the electromagnetic brake coil is high when the bar and the H&S switch are open. • **Solution:** - It is suggested to check the wiring to determine if the positive pole is connected to the CNA#2 output of the Smart Driver. - If the output remains high even when disconnecting the wire from the connector pin, the problem is inside the controller and the Smart Driver is likely to be shorted.
213	AUX BATT. SHORT	• **Cause**: A) The coil on the aux output is not connected correctly. B) The Smart Driver inside the controller is damaged. • **Solution:** - It is suggested to check that the coil is properly connected between A2 and A4. - If no problems are found in the coil, the problem is inside the controller.
214	EVP1 COIL OPEN	• **Cause**: This fault appears when the EVP1 LOWER output is used (the "TYPE EVP" parameter in the "SET OPTION" menu is set to ANALOG or DIGITAL) but no load is connected between the output and the PAUX positive pole. • **Solution:** - It is suggested to check the wiring to see if the EVP1 coil is connected to the pin of the right connector and that it is not interrupted. - If the alarm persists even if you connect the coil to the right pin or replacing it, the problem is inside the controller's motherboard, which needs to be changed.
215	EVP2 COIL OPEN	• **Cause**: This fault appears when the EVP2 output is used (the "EVP2 TYPE" parameter in the "SET OPTION" menu is set to ANALOG or DIGITAL) but no load is connected between the output and the PAUX positive pole. • **Solution:** - It is suggested to check the wiring to see if the EVP2 coil is connected to the pin of the right connector and that it is not interrupted. - If the alarm persists even if you connect the coil to the right pin or replacing it, the problem is inside the controller's motherboard, which needs to be changed.
220	KEYOFF SHORTED	• **Cause**: This fault appears when the controller detects a low level of the Key-Off signal during the start-up diagnosis. • **Solution:** The fault is most likely due to undervoltage and should be checked: A) Pulse lowering in the key input signal (above undervoltage threshold) due to external loads, such as starting DC/DC converters, switching relays or contactors, powering solenoids on/off. B) Check the connection of the electric cables to the battery terminal (positive and negative terminals), to MC and to the +Batt and -Batt controller, which must be tightened with a torque between 5.6Nm and 8.4Nm. C) If no voltage surges are detected on the supply line and the alarm appears each time the key is activated, the fault is probably in the controller hardware and the motherboard must therefore be replaced.
221	FLASH CHECKSUM	• **Cause**: The software was not written correctly to the flash memory or the flash memory is damaged. • **Solution:** This type of failure is independent of external components; replace the controller
222	SMART DRIVER KO	• **Cause**: The integrated Smart Driver is open, but cannot power the positive pole of the electromechanical brake. • **Solution:** - It is suggested to check the wiring to check if the CNA#2 output of the Smart Driver has a -Batt short circuit. - If the output remains low even when disconnecting the wire from the connector pin, the problem is inside the controller and the Smart Driver is probably damaged.
223	COIL SHORTED	• **Cause**: This alarm occurs when there is a short circuit in one of the coils connected to the outputs of the CombiAC-0 system (KZTP or EB coils). Once the overload condition is eliminated, the alarm automatically disappears authorising and enabling a transport request. • **Solution:** - The cause of this error code is usually the wiring or the loading coil. Therefore, first check the connections between the output and controller loads. - If there are no external faults/problems, it means that the problem is inside the controller, which needs to be replaced.

Code	Definitions	Probable Cause and Consequent Action
225	CURRENT SENS. KO	• **Cause**: One of the current sensors used to measure the current value on the motor phases is damaged. • **Solution:** This type of failure is independent of external components; replace the controller
233	POWER MOS SHORTED	• **Cause**: Before turning on the KZTP system, the software checks the energy bridge: it turns on the Mosfet transistors alternately at the top and bottom and waits for the phase voltage to drop to -BATT (increases to +Batt). If the phase voltage does not follow the commands, the alarm appears. • **Solution:** This type of failure is independent of external components; replace the controller
237	ANALOG INPUT	• **Cause**: This alarm appears when the A/D conversion of the analog inputs shows a "frozen" value in all the converted signals for more than 400 msec. The objective of this diagnosis is to detect an A/D converter error or a problem in the encoding flow that omits the update of the analog signal conversion. • **Solution:** If the alarm persists, the controller must be replaced.
239	EVP2 NOT OK	• **Cause**: A) EVP2 drive is short-circuited. B) The micro controller detects a misalignment between the valve setting and the drive voltage, measured at the EVP2 output. • **Solution:** Check for a short circuit or low impedance between the negative pole of the coil and -BATT. Otherwise, the drive circuit is damaged and the controller must be replaced.
240	EVP1 NOT OK	• **Cause**: A) EVP drive is short-circuited. B) The micro controller detects a misalignment between the valve setting and the drive voltage, measured at the LOWER EVP1 output. • **Solution:** Check for a short circuit or low impedance between the negative pole of the coil and -BATT. Otherwise, the drive circuit is damaged and the controller must be replaced.
246	AUX DRIVER OPEN	• **Cause**: The activation of the electromechanical brake coil is unable to activate the load. • **Solution:** Replace the controller.
251	WRONG SET BATTERY	• **Cause**: At startup, the controller checks the battery voltage, which must be within a range close to the rated value. • **Solution:** A) Check that the "SET BATTERY" parameter in the controller matches the rated battery voltage. B) Check that the "TESTER MENU / BATTERY VOLTAGE" parameter shows the same value as the battery voltage measured with a voltmeter. If the values do not match, activate the "ADJUST BATTERY" function. C) Replace the battery.
252	WRONG ZERO	• **Cause**: The outputs of the amplifiers (used to measure the traction motor voltage) should be checked to ensure that they are within a defined range. This alarm appears when the voltage signals are >3V or <2V at the time of initialization. • **Solution:** This type of failure is independent of external components; replace the controller
254	AUX DRIVER SHORTED	• **Cause**: The activation of the electromechanical brake coil is short-circuited. • **Solution:** A) Check for a short circuit or low impedance pull-down between NEB CNA#4 and -BATT. B) The drive circuit is damaged inside the controller, and the controller must be replaced.

b) WARNING Messages

Code	Definitions	Probable Cause and Consequent Action
13	EEPROM KO	• **Cause**: This is due to an HW or SW defect in the integrated non-volatile memory that supports the controller parameters. This alarm does not prevent the machine operations, but the machine will operate with default values. • **Solution:** Try executing the CLEAR EEPROM command (refer to the Console manual). Turn the key off and check the result. If the alarm persists, the controller must be replaced. If the alarm disappears, the previously saved parameters will be replaced by the default parameters.
52	PUMP I=0 EVER	• **Cause**: This test is performed when the pump motor is running and verifies that the current feedback sensor is not always locked at 0. • **Solution:** - Check for continuity in the motor connection. If the motor connection is open, current does not flow and the test fails, resulting in an error code. - If everything is in order with the motor, the problem may be with the current sensor or its circuit.
62	HIGH TEMPERATURE	• **Cause**: This alarm occurs when the temperature of the base plate is above 85 °C. As a result, the maximum current decreases proportionally as the temperature increases from 85° to 105°. At 105° the current is limited to 0 Amp. • **Solution:** Improve the air cooling of the controller. If the alarm appears when the controller is cold, the possible causes are a fault in the thermal sensor or in the motherboard. In this case, the controller must be replaced.
65	BATTERY LOW	• **Cause**: The alarm occurs when the battery charge has a caKZTPulated value less than or equal to 10% of the full charge and the BATTERY CHECK setting is different from 0 (refer to the "SET OPTION" menu). • **Solution:** Recharge the battery. If the problem persists, measure the battery voltage with a voltmeter and compare it to the value in the BATTERY VOLTAGE parameter. If the values are different, adjust the value of the ADJUST BATTERY function.
	MOTOR TEMPERATURE	• **Cause**: This warning appears when the temperature sensor is open (if digital) or has exceeded the 150°C threshold (if analog). • **Solution:** Check the thermal sensor inside the motor (use the MOTOR TEMPERATURE value in the TESTER menu); check the ohmic value and the sensor wiring. If the sensor is OK, improve the air cooling of the motor. If the warning persists when the motor is cold, the problem is inside the controller.
79	INCORRECT START	• **Cause**: This warning indicates an incorrect start sequence. • **Solution:** Possible causes of this alarm are (use values in the TESTER to facilitate troubleshooting): - A key-active transport demand on ON - Operator presence sensor active with key ON. Check the wiring. Check the micro switches. This may also be caused by an incorrect sequence on the part of the operator. The mechanism may also have failed; if all of the above conditions have been met without finding the cause, replace the controller.
80	FORW+BACK	• **Cause**: This alarm occurs when both motion commands (forward and reverse) or BACKING FOR and BACKING REV are active at the same time. • **Solution:** Check the wiring of the inputs of the Forward and Backward motion command and the inputs BACKING FOR and BACKING REV (use the values in the TESTER to facilitate troubleshooting). Check the micro switches for faults. A failure of the mechanism is also possible. Once you have determined that the transport request and contact switches are working properly and that the wiring is not a problem, you need to replace the controller.
86	PEDAL WIRE KO	• **Cause**: The SW continuously checks the connection of the two potentiometer power supply ends in the throttle. The test consists in reading the voltage drop on a diode connected between NPOT (CNA#30) and GND and cascaded to the potentiometer: if the potentiometer disconnects on PPOT (CNA#25) or NPOT, this diode does not receive current and the voltage on the NPOT connection collapses. The alarm appears when the voltage at the NPOT is less than 0.3V. This alarm also appears when the voltage at the NPOT is higher than 2Vdc (also check for diode breakage). • **Solution:** Check voltage at NPOT and potentiometer connections.

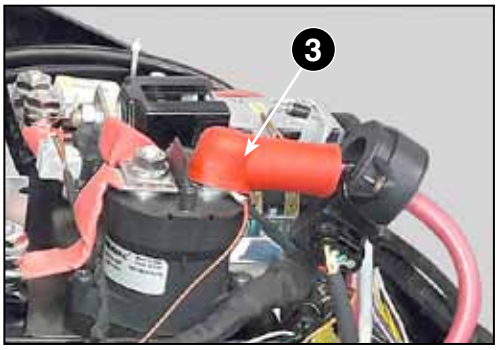
Code	Definitions	Probable Cause and Consequent Action
217	PUMP I NO ZERO	• **Cause**: In standby mode (pump motor not activated), feedback from the current sensor in the pump impeller provides a value outside the allowable range because the pump current is not zero. • **Solution:** This type of failure is independent of external components; replace the controller
218	TH. PROTEC-TION	• **Cause**: The controller detects a high temperature and the motor performance is limited. • **Solution:** It is suggested to check the cause of the high temperature. The controller is usually not installed properly or the fan does not work.
	SENS. MOT. TEMP.	• **Cause**: - The motor temperature sensor is not properly connected to A22. - The motor temperature sensor is damaged. • **Solution:** - Check the correct connection of the motor temperature sensor. - If the current sensor is connected correctly, replace it. - If the problem persists, it is the controller's fault.
219	DEAD MAN ABSENT	• **Cause**: This warning (only present in wagons with a "Dead Man" switch) appears when the "Dead Man" switch is open. • **Solution:** The warning disappears on the next transport application when the dead man switch is closed.
224	WAITING FOR NODE	• **Cause**: The controller receives from CAN the message that another controller in the network is faulty; as a result, the ACE-0/ COMBIAC-0 controller is unable to enter the operational status, but must WAIT for the other controller to exits the fault status.
226	VACC NOT OK	• **Cause**: The test is performed when the key is activated 20 seconds after both transport requests have been turned off. This alarm occurs if the ACCELERATOR value in the TESTER menu is 1.0V higher than the minimum VACC PROGRAM acquisition when the accelerator is released. • **Solution:** Check mechanical calibration and potentiometer operation.
228	TILLER OPEN	• **Cause**: Note: When the bar is released, the main contactor opens after a certain standby period(30 seconds). • **Solution:** The warning disappears at the next transport demand.
236	CURRENT GAIN	• **Cause**: The maximum current gain parameters are set to default values, which means that the maximum current setting procedure has not yet been performed. • **Solution:** Seek assistance from a Zapi technician to perform the proper current adjustment procedure for the current gain parameters.
247	DATA ACQUISITION	• **Cause**: Acquisition of current gains • **Solution:** The alarm ends when the acquisition is done.
249	CHECK UP NEEDED	• **Cause**: It is simply a warning to perform scheduled maintenance. • **Solution:** The alarm disappears when the acquisition is completed.
250	THERMIC SENSOR KO	• **Cause**: The controller's thermal sensor output is out of range. • **Solution:** This type of failure is independent of external components; replace the controller
253	SLIP PROFILE	• **Cause**: There is an error in the choice of glide profile parameters. • **Solution:** Check the value of these parameters in the software settings menu.

9.5 INTERVENTIONS ON ELECTRONIC COMPONENTS

9.5.1 Access to electronic equipment

- Remove the back cover to access the battery and electronic equipment compartment [☛ 3.1.1].

If necessary for access to the components below, remove the protection (1) secured by four screws (2).

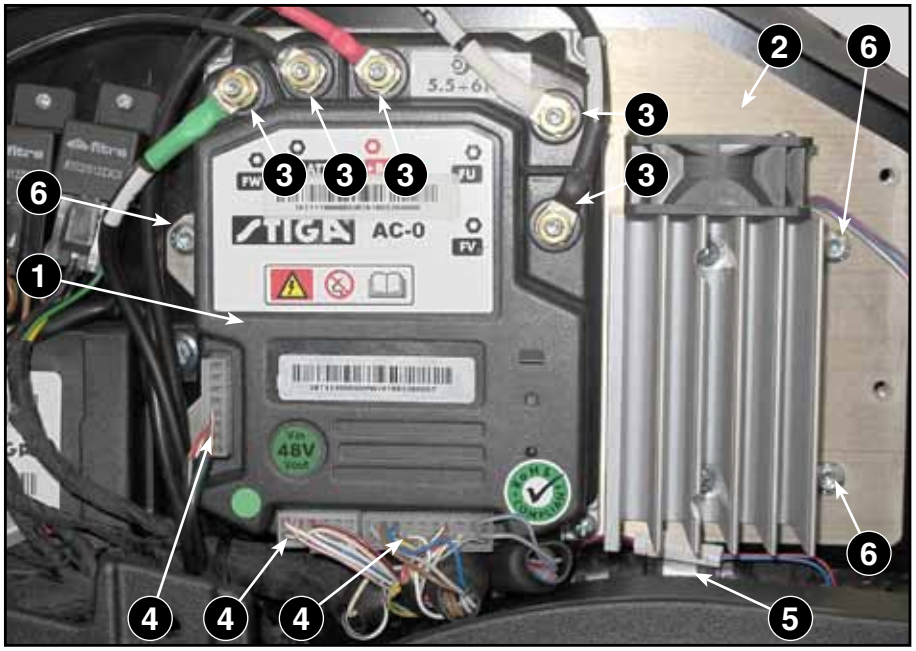


⚠ ⚠ **WARNING!** ***Always disconnect the red 48-volt battery cable (3) before starting any work that requires handling the cables and connectors.***

9.5.2 Replacing the AC-0 control unit

The AC-0 control unit (1) is mounted on a plate (2) and connected to the general electrical system by means of:

– 5 cables (3) with eyelet terminal corresponding to:
  FW = Traction motor phase
  –BATT = Black - Negative Battery
  +BATT = Red - Battery positive
  FU = Traction motor phase
  FV = Traction motor phase
– 3 connectors (4);
– 1 plug (5) of the cooling fan.



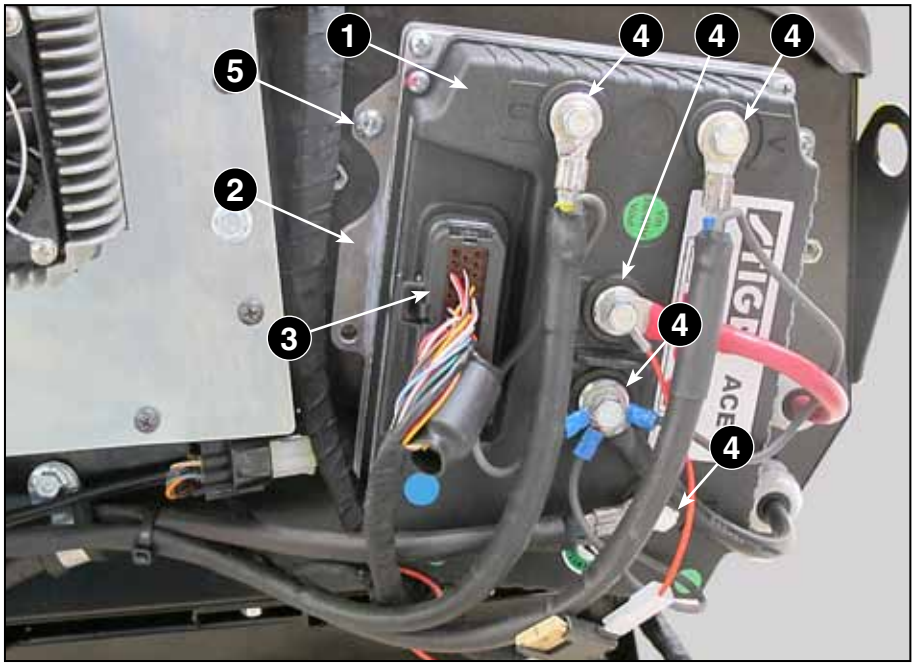
1. Disconnect all connectors mentioned above.

2. Remove the plate (2) fixed by four screws (6).

When mounting, pay attention to the correct repositioning of the connectors and cables and tighten the nuts of the cable eye terminals (3) to the value indicated on the control unit itself (5.5-6 Nm).

9.5.3 Replacing the ACE-0 control unit

The AC-0 control unit (1) is mounted on a plate (2) and connected to the general electrical system by means of:



– 1 connector (3);

– 5 screw contacts (4) marked with embossed letters on the plastic cover, to which the ring terminals corresponding to :

U = Yellow power cable + black shielding cable;
V = Blue power cable + black shielding cable;
W = Green power cable + black shielding cable;
+B = Red power cable + red cable to the fuse;
–B = Black power cable + 3 black shielding cables from U - V - W.

1. Disconnect all cables and connectors mentioned above.

2. Remove the plate (2) fixed by four screws (5).

When mounting, make sure the connectors and cables are repositioned and tighten the contact screws (4) to 5.5-6 Nm.

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