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Use and maintenance manual

Spritzbeton mobile spraying machine

Translation of the original instructions

Model	TSR 7
Serial no.	_____
Year of manufacture	2018
Manual code	561318
Revision / of	0.0 / 05.11.2018





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ATTENTION!: CAREFULLY AND FULLY READ THIS USE AND MAINTENANCE MANUAL BEFORE INSTALLING, USING OR ANY OTHER OPERATION TO BE CARRIED OUT ON THE MACHINE!



2 Using the manual

2.1 Using the manual

This manual has been drawn up by the Manufacturer and is an integral part of the machine's equipment.

The information contained in the Spritzbeton mobile spraying machine manual is directed to the personnel responsible for driving and maintaining the machine itself.

The manual provides a series of information that must be known by qualified personnel, and which allows the machine to be operated safely.

This manual must be used by:

- Transport operators;
- Authorised installers;
- Installers, operators in charge of connections to the power supply mains (electric, etc.);
- Qualified personnel responsible for driving and moving the machine;
- Qualified personnel in charge of maintenance;
- Qualified personnel in charge of machine demolition and disposal.

2.1.1 Definitions

- **Danger:** a potential source of injury or damage to health;
- **Danger zone:** any area inside and/or near a machine in which the presence of a person constitutes a risk to the safety and health of that person;
- **Exposed person:** any person who is completely or partially inside a danger zone;
- **Operator:** the person or persons responsible for installing, operating, adjusting, cleaning, repairing and moving a machine or performing its maintenance;
- **Driver:** person in charge of moving the machine;
- **Risk:** combination of the probability and severity of an injury or damage to health that may arise in a dangerous situation;
- **Guard:** element of the machine used specifically to ensure protection by means of a material barrier;
- **Protection device:** device (other than a guard) which reduces the risk, alone or associated with a guard;
- **Intended use:** use of the machine compliant with the information provided in the instructions for use;
- **Reasonably foreseeable misuse:** use of the machine in a manner different from that indicated in the instructions for use, but which may derive from easily foreseeable human behaviour;
- **Concrete:** homogeneous mixture composed of cement, classified aggregate and water with additives;
- **Additive:** material added to the concrete to modify the properties of the mixture.



2.2 Structure of the manual

2.2.1 Subdivision of the manual

This manual is divided into chapters. Each chapter can in turn be divided into paragraphs. The page number, and the total number of pages of which the manual is composed are shown on the outer edge of each page (at the bottom).

A general summary to be used for quick reference is provided at the end of the manual.

2.2.2 Illustrations and tables

The illustrations and tables are usually shown near the text. If this is not possible, they are linked to the page and recalled as a connected illustration or connected table. All tables and illustrations are numbered and include a caption (Tab. 2.2-1, Fig. 2.2-1, etc.).

2.2.3 Annexes

Annexes are intended as the technical documents that are an integral part of the use and maintenance manual, such as wiring and pneumatic diagrams, component declarations of conformity, technical data sheets, etc. They are shown at the end of the manual (after the summary and figure index).

2.3 Unit of measurement

In this manual, the following units of measurement have been used, as defined by the International System of Units (S.I.), according to ISO 80000-1. The units of measurement normally used are:

- **Linear dimensions** - For length, the meter, symbol [**m**], or its submultiples (centimetres and millimetres, i.e. [**cm**] and [**mm**]) was used as the unit of measurement. In some cases, the inch may be used;
- **Time** - The unit of measurement of time is the second [**s**]. Where deemed convenient, minutes [**min**] and/or hours have been used;
- **Mass** - For mass, the unit used is the kilogram [**Kg**];
- **Electric current** - The electric current is measured in Ampere [**A**];
- **Thermodynamic temperature** - The crucial unit of thermodynamic temperature, in the SI system, is the degree Kelvin [**°K**]. The temperature unit used in this manual is generally the degree Celsius [**°C**]. Only when particular treatments concern parts for which the manufacturer provides the technical specifications, the temperature has been kept in degrees Fahrenheit [**°F**];
- **Illuminance** - Illuminance is expressed in [**lux**];
- **Plane angle** - Plane angles, according to the standard, must be expressed in radians [**rad**]. Within this manual, they have been expressed in sexagesimal degrees, according to the relation: $360^\circ = 2\pi$ [**rad**].

2.4 Derived units

The derived units of measurement are all based on the fundamental units expressed up to this point. In addition to units derived from basic metric units, some basic Anglo-Saxon units, and their derived units, are used in certain cases. The following table (Tab. 2.4-1) shows the derived units most commonly used as well as the conversion factors to the S.I.



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UNIT OF MEASUREMENT CONVERSION TABLE			
Quantity	Name	Symbol	Relation with other S.I. units
Length	foot	ft	0.3048 m
	inch	in	0.0254 m
Mass	pound	lb	0.453 Kg
Frequency	hertz	Hz	s ⁻¹
Speed	metres per second	m/s	
	feet per second	ft/s	0.3048 m/s
Acceleration	metres per second squared	m/s ²	
Temperature	Celsius degree	°C ¹	1 K
	degree rankine	°R ²	0.556 K
	degree fahrenheit	°F ³	0.556 K
Voltage, electromotive force	volt	V	
Force	newton	N	Kg*m/s ²
	kilogram force	Kgf	9.807 N
	pounds of force	lbf	4.44 N
Pressure	pascal	Pa	N/m ²
	bar	bar	105 Pa
	atmosphere	atm	101325 Pa
	ata	at	98066.5 Pa
	psi	psi	lbf/in ² = 6894,8 Pa
Energy, work, heat	joule	J	N*m ► Kg*m ² /s ²
	erg	erg	10 ⁻⁷ J
	kilowatt hour	kWh	3.6*10 ⁶ J
	horsepower hours	CVh	2.65*10 ⁶ J
	horse power hours	HPH	2.68*10 ⁶ J
	kilocalories	kcal	4186.8 J
Power	watt	W	J/s ► Kg*m ² /s ³
	erg per second	erg/s	10 ⁻⁷ W
	horsepower	CV	735.5 W
	horse power	HP	745.7 W
	kilocalories per hour	kcal/h	1.163 W

Tab. 2.4-1

¹ T_{oC} = T_k - 273.15

² T_{oR} = 1.8 * T_k

³ T_{oF} = 1.8 * (T_k - 255.38)

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2.5 Storing the manual

2.5.1 How do you store the manual?

This manual must be carefully stored for the entire lifespan of the machine, including the dismantling stage.

2.5.2 Where do you store the manual?

The manual must be kept in a dry place near the machine and must always be available to qualified personnel in charge of driving and monitoring.

2.5.3 How to copy the manual

This manual can only be photocopied from the original, since reproduction from copies reduces clarity of the images and therefore of the information.



PROHIBITION! The reproduction of this manual is allowed only for the purpose of making a safety copy.

The company *Turbosol Produzione S.r.l.* reserves, according to the law, ownership of this manual, prohibiting transfer to third parties and/or unauthorised reproduction.

2.5.4 What to do in case of loss or damage?

Should this manual be damaged or lost, a certified copy can be requested. When making the request, indicate the manual code and its revision index, or directly indicate **the serial number of the machine indicated on the marking plate**. This data can be found at the top (inside) of each page (Fig. 2.5-1).

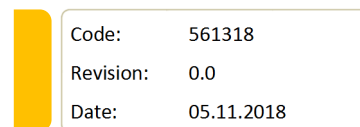


Fig. 2.5-1 - Manual identification data

2.5.5 What to do if the machine is sold?

In the event that the machine is sold to third parties, the manual must be handed over to the new owner.

2.5.6 What to do if the machine is modified?

Before making any changes to the machine, contact the manufacturer or the dealer to receive the necessary explanations on the feasibility of the operations without altering the characteristics or safety conditions.

If substantial modifications are made on the machine or on the control elements, the machine certification and consequently this manual **cannot be considered valid**.



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3 Main warnings

3.1 Working in complete safety

The safety instructions in the use and maintenance manual refer to the operations that can be performed on the machine.

Safety symbols are inserted into the text in points that require specific attention. It is crucial for these safety instructions to be always complied with. Failure to do so may result in personal injury and/or damage to the machine or other equipment.

With this in mind, some basic safety instructions are provided below:

- **Read, and familiarise yourselves with, this section of the safety instructions before installation, use, maintenance or repair of the machine;**
- **Read and follow the safety warnings contained in the text referring to specific operations;**
- **Wear the personal protective equipment (P.P.E.), such as safety goggles, gloves and work footwear, where required;**
- **Know and follow the safety instructions required by Turbosol Produzione S.r.l., the general accident prevention regulations and the safety regulations.**

3.2 Safety signs

The symbols shown below are used (if relevant) in the use and maintenance manual. These symbols have been inserted to warn the personnel about dangers or potential sources of danger. **Familiarise yourselves with them.**

Failure to pay attention to the symbols may result in personal injury, death and/or damage to the machine or equipment.

Generally speaking the signs can be of three types (Tab. 3.2-1):

	Triangular framed shape	Danger signs	They indicate requirements related to present or potential dangers
	Circular, barred frame	Prohibition signs	They indicate requirements related to actions that must be avoided
	Full circle	Compulsory signs	They indicate information that must be read and complied with

Tab. 3.2-1

Depending on the information to be transmitted, symbols may be contained within the signs which, by means of mental association, help to understand the type of danger, prohibition or obligation.



3.2.1 Danger signs



Generic danger

This sign is used to highlight dangerous situations that may cause damage to people, animals and property. Failure to comply with the requirements associated with the sign may cause hazards.



Danger of death

This sign is used to highlight situations of serious danger that may cause serious damage or death. Failure to comply with the requirements associated with the sign may cause serious damage or death.



Danger due to the presence of voltage

This signal is used to highlight the danger direct or indirect contact, electrocution - electrocution due to the presence of live parts of the machine. Failure to comply with the requirements associated with the sign may cause serious damage or death.



Crushing hazard

This sign is used to highlight the body crushing hazard. Failure to comply with the requirements associated with the sign may cause serious damage or death.



Crushing hazard

This sign is used to highlight the hand or upper limb crushing hazard by parts or moving parts of the machine. Failure to comply with the requirements associated with the sign may cause the risk of crushing hands or upper limbs.



Cutting-shearing hazard

This sign is used to highlight the hand cutting-shearing hazard by tools or moving parts of the machine. Failure to comply with the requirements associated with the sign may cause the risk of hand cutting-shearing.



Entrapment and crushing hazard

This sign is used to highlight the hand or upper limb entrapment-crushing hazard on moving transmission parts. Failure to comply with the requirements associated with the sign may cause the risk of crushing hands or upper limbs.



Explosion and/or fire hazard

This sign is used to highlight the explosion and/or fire hazard. Failure to comply with the requirements associated with the sign may cause explosions and/or fires.



Burning hazard

This signal is used to highlight the danger of burns due to contact with hot surfaces (> 60 °C). Failure to comply with the requirements associated with the sign may cause the risk of hand or upper limb burns.



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Fall from height hazard

This sign is used to highlight the fall from height hazard. Failure to comply with the requirements associated with the sign may cause serious trauma or death due to the fall.



Danger of obstacle at the top

This sign is used to highlight the danger arising from the presence of an obstacle at the top. Failure to comply with the requirements associated with the sign may cause serious trauma or death due to the fall.



Danger of obstacle at the bottom

This sign is used to highlight the danger arising from the presence of an obstacle at the bottom. Failure to comply with the requirements associated with the sign may cause serious trauma or death due to the fall.



Automatic start-up hazard

This sign is used to highlight the danger deriving from the automatic execution of operations by the machine. Failure to comply with the requirements associated with the sign may cause serious damage or death.



Forklifts and other industrial vehicles hazard

This signal is used to highlight the danger deriving from the presence of forklifts and other industrial vehicles. Failure to comply with the requirements associated with the sign may cause serious damage or death.



Suspended loads hazard

This sign is used to highlight the danger arising from the presence of suspended loads. Failure to comply with the requirements associated with the sign may cause serious trauma or death, due to the fall of the load and/or impact with the load itself.



3.2.2 Prohibition signs



Generic prohibition

This sign is used to highlight the prohibition to perform certain manoeuvres, operations or the prohibition against specific behaviour. Failure to comply with the prohibitions associated with the sign may cause damage to property, animals and people.



No photography

This sign is used to highlight the prohibition to record the subject of the requirement by means of cameras, video cameras or in any other way. This symbol is also used to highlight the prohibition of taking photos of the documentation.



Access denied

This sign is used to highlight the prohibition for the operator to access a specific area. Failure to comply with the prohibitions associated with the sign may cause damage to property, animals and people.



No climbing

This sign is used to highlight the prohibition for the operator to access a specific raised area. Failure to comply with the prohibitions associated with the sign may cause damage to people.



Do not stand or walk on the area

This sign is used to highlight the prohibition for the operator to stand or walk on a specific area. Failure to comply with the prohibitions associated with the sign may cause damage to property or people.



No touching

This sign is used to highlight the prohibition for the operator to touch a specific part of the machine. Failure to comply with the prohibitions associated with the sign may cause damage to hands.



Do not enter hands

This sign is used to highlight the prohibition for the operator to enter their hands into a specific area. Failure to comply with the prohibitions associated with the sign may cause damage to hands and/or upper limbs.



No manoeuvres

This sign is used to highlight the prohibition to perform manoeuvres or drive. Failure to comply with the prohibitions associated with the sign may cause damage to property, animals and people.



Do not change switch state

This sign is used to highlight the prohibition to alter the state of the switch and/or of the control device. Failure to comply with the prohibitions associated with the sign may cause damage to property, animals and people.



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Do not operate on moving parts

This signal is used to highlight the prohibition for the operator to perform any operation on moving parts. Failure to comply with the prohibitions associated with the sign may cause damage to property, animals and people.



Do not remove the protections or safety devices

This sign is used to highlight the prohibition for the operator to remove or tamper with any casing, protection or safety device. Failure to comply with the prohibitions associated with the sign may cause damage to property, animals and people.



No smoking or open flames

This sign is used to highlight the prohibition to smoke and/or using open flames. Failure to comply with the prohibitions associated with the sign may cause explosions and/or fires.



Do not put out with water

This sign is used to highlight the prohibition of extinguishing flames and/or fire outbreaks by using water. Failure to comply with the prohibitions associated with the sign may cause damage to property, animals and people.



No access to forklifts and other industrial vehicles

This sign is used to highlight the prohibition of accessing a specific area by forklifts and other industrial vehicles. Failure to comply with the prohibitions associated with the sign may cause damage to property, animals and people.



No cellphones

This sign is used to highlight the prohibition to keep cellphones on. Failure to comply with the prohibitions associated with the sign may cause explosions and/or fires.



No access to persons with pacemakers

This sign is used to highlight the prohibition to access a specific area by persons with pacemakers. Failure to comply with the prohibitions associated with the sign may cause serious traumas or death.



No access while wearing watches and other metal objects

This sign is used to highlight the prohibition to access a specific area while wearing watches and other metal objects. Failure to comply with the prohibitions associated with the sign may cause contamination of food products.



Do not place heavy loads

This sign is used to highlight the prohibition to place heavy loads. Failure to comply with the prohibitions associated with the sign may cause damage to property, animals and people.



3.2.3 Compulsory signs



Generic obligation

This sign is used to highlight the obligation by the operator to comply with the requirements. Failure to comply with the requirements associated with the sign may cause damage to property, animals and people.



Obligation to follow the sequence

This sign is used to highlight the obligation by the operator to perform the operations described by following the sequence. Failure to comply with the requirements associated with the sign may cause damage to property, animals and people.



Obligation to keep hair restrained

This sign is used to highlight the obligation to keep hair restrained during the operations. Failure to comply with the requirements associated with the sign may cause serious damage or the death of the operator.



Obligation to wear earmuffs

This sign is used to highlight the obligation to wear earmuffs or hearing protections during the operations. Failure to comply with the requirements associated with the sign may cause loss of hearing, even permanent.



Obligation related to clothing

This sign is used to highlight the obligation to wear suitable clothing during the operations. Failure to comply with the requirements associated with the sign may cause serious damage or the death of the operator.



Obligation to use specific P.P.E.

These signs are used to highlight the obligation to wear specific personal protective equipment during the operations. Failure to comply with the requirements associated with the sign may cause serious damage or the death of the operator.



Activation obligation

This sign is used to highlight the obligation to activate a control device. Failure to comply with the requirements associated with the sign may cause damage to property, animals and people. In any case, it is used to distinguish all the requirements concerning the activation of the control elements.



Obligation regarding pressure

This sign is used to highlight the obligation to comply with the requirements relating to fluids at a pressure higher than the atmospheric one. Failure to comply with the requirements associated with the sign may cause damage to property, animals and people.



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Obligation regarding personnel

This sign is used to highlight the obligation to comply with all requirements concerning the personnel (operators). Failure to comply with the requirements associated with the sign may cause damage to property, animals and people.



Obligation regarding voltage

This sign is used to highlight the obligation to connect the machine to an efficient earthing system. Failure to comply with the requirements associated with the sign may cause damage to property, animals and people.



Obligation to disconnect the plug

This sign is used to highlight the obligation to disconnect the electrical power supply plug before performing any other operation. Failure to comply with the requirements associated with the sign may cause damage to property, animals and people.



Obligation to disconnect the equipment before maintenance

This sign is used to highlight the obligation to disconnect the equipment before carrying out any maintenance operation. Failure to comply with the requirements associated with the sign may cause damage to property, animals and people.



Obligation to restore the protections removed

This sign is used to highlight the obligation to restore the protections removed during maintenance, repair, cleaning and lubrication operations. Failure to comply with the requirements associated with the sign may cause damage to property, animals and people.



Hooking obligation

This sign is used to highlight the obligation to hook the machine only in the specific points set up. Failure to comply with the requirements associated with the sign may cause damage to property, animals and people.



Obligation to read the instructions

This sign is used to highlight the obligation to read the instructions (use and maintenance manual, data sheets, etc.), before installation, use or any other operation to be performed on the machine!



3.3 Graphical signs and written warnings

The graphical signs and written warnings present on the machine are provided below. The signs were inserted in order to warn the operator against the dangers or residual potential sources of danger. A written comment explaining the meaning of the sign is present next to each exclusively graphic sign. **Familiarise yourselves with them.**



ATTENTION!: Lack of knowledge or failure to pay attention to the signs and warnings may result in personal injury, death and/or damage to the machine or equipment.

3.3.1 Danger graphical signs and written warnings



Fig. 3.3-1 - Danger pictograph

This signal highlights the **danger** (residual risk) deriving from the presence of voltage.

The sign is placed on the electric control board door.

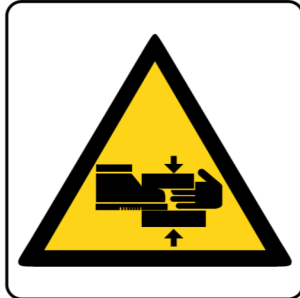


Fig. 3.3-2 - Danger pictograph

This signal highlights the **danger** (residual risk) of crushing hands and feet.

The sign is placed at the outriggers.



Fig. 3.3-3 - Danger pictograph

This signal highlights the **danger** (residual risk) of burn due to contact with materials and/or surfaces at high temperatures.

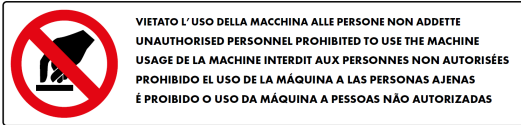
The sign is placed at the endothermic engine silencer.



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3.3.2 Prohibition graphical signs and written warnings



This sign highlights the **prohibition** against unauthorised persons to use the machine.

The sign is placed on the general electric control board.

Fig. 3.3-4 - Prohibition pictograph

3.3.3 Obligation graphical signs and written warnings



This sign highlights the **obligation** to read and understand the operator's manual before using the machine (failure to follow the instructions may result in death or serious injury).

The sign is placed near the main control devices, on the machine control desk.

Fig. 3.3-5 - Obligation pictograph



This sign highlights the **obligation** to lift the machine by means of the hooks provided on it.

The sign is placed near the machine lifting hooks.

Fig. 3.3-6 - Obligation pictograph



This sign highlights the points of the machine that must be periodically lubricated.

The sign is placed near the grease nipples through which manual lubrication of the machine parts is carried out.

Fig. 3.3-7 - Warning pictograph



3.3.4 Location of graphical signs and written warnings

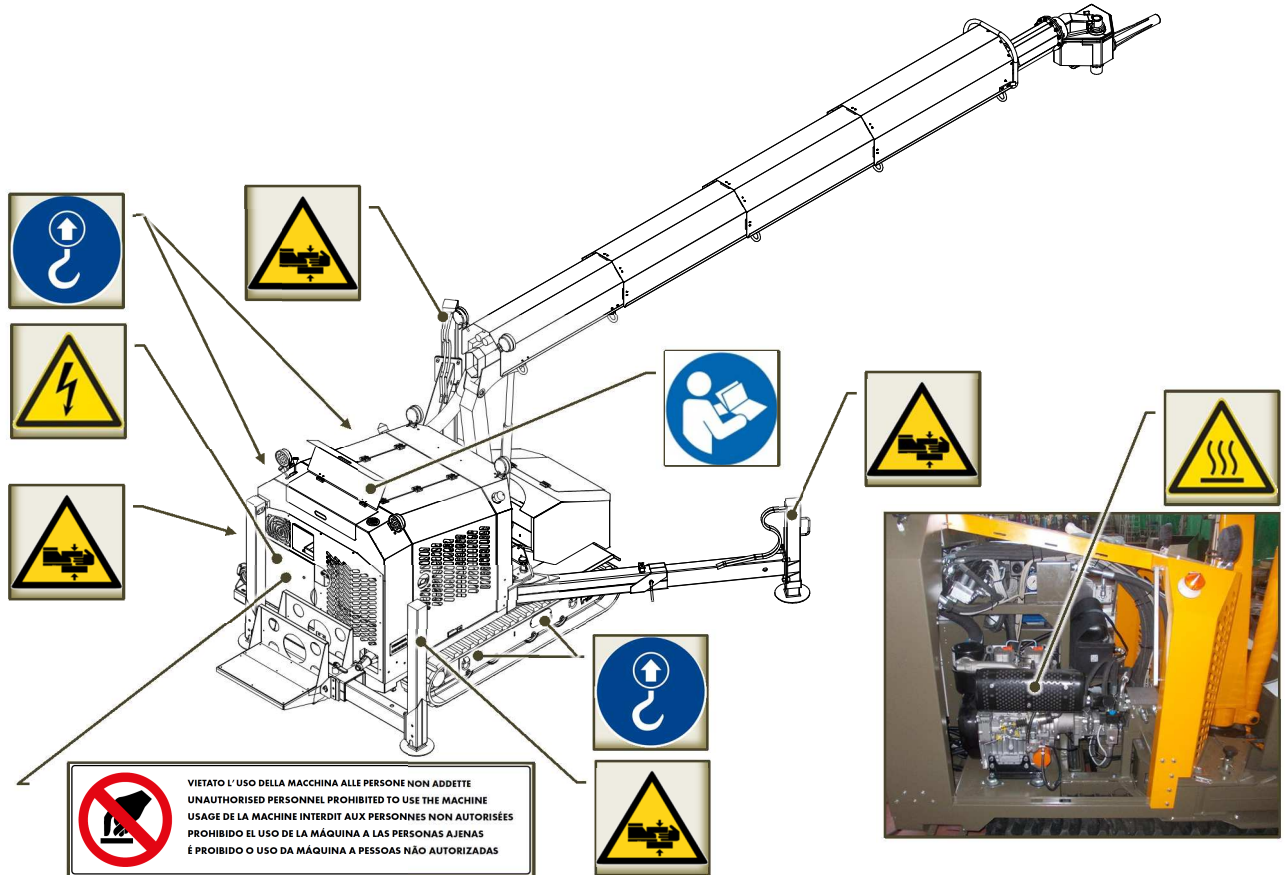


Fig. 3.3-8 - Location of graphical signs and written warnings



3.4 Physical and intellectual requirements of qualified personnel

Qualified personnel must be able to perform the necessary operations, even physically, and to familiarise themselves with the safety instructions and regulations. This personnel has been trained to be able to use and maintain the machine in safe conditions.



ATTENTION! *It is the responsibility of the PRODUCTION MANAGER to ensure that their personnel fits this professional framework.*



ATTENTION! *Qualified personnel cannot operate on the machine if they have taken substances that reduce their reaction times.*

The operator must be in perfect physical and psychological condition to perform his work.

Qualified personnel must be divided in:

- Personnel in charge of transport, installation, dismantling and commissioning;
- Personnel in charge of tooling;
- Personnel in charge of maintenance and repair;
- Personnel in charge of driving.

Each profile is characterised by specific skills described below.

3.5 Personnel in charge of transport, installation, dismantling and commissioning

A working group consisting of all persons, internal or external to the company, must be established and coordinated to perform all tasks required for carrying out the necessary steps described in the relative chapters of this manual. All personnel must be coordinated by a person in charge of operations, so as to act in perfect cooperation and synergy in the pursuit of the result.

3.6 Personnel in charge of tooling

The personnel in charge of tooling must be able, in addition to tool and drive the machine:

- To carry out tests with the latter in order to verify the correctness of the operation carried out;
- To identify any malfunctions, which may be the responsibility of operators who perform maintenance and repair;
- To train the operators in charge of driving, in regards to the details concerning tooling;
- To replace the tools and any other part subject to wear related to the processing, such as the equipment, which is not part of the routine maintenance of the machine.

The personnel in charge of tooling must intervene whenever a factor related to usage has changed.

If adaptation to the new usage factors requires a different machine tooling, this must be done in cooperation with the manufacturer.



3.7 Personnel in charge of routine maintenance and repairs

The personnel performing this task must be able to:

- Diagnose the efficiency condition of the machine;
- Identify any faults;
- Directly resolve the conditions that led to the error condition, provided that this is not a problem related to programming or tooling, in which case the relative personnel in charge will intervene;
- Keep the machine efficient by carrying out regular maintenance;
- Lubricate the machine, when required;
- Clean the machine, when required.

They must store all tools that allow the adjustment or assembly of all the guards installed on the machine.



ATTENTION! *Maintenance technicians or repairers, given the particular conditions in which the machine can be in when their intervention is required, must have a greater knowledge of the machine and of all the necessary safety prescriptions. They must safeguard not only themselves, but all operators who are located within the work environment in which the machine is located.*

These operators can be divided by specific assignment, in the context of maintenance operations, according to their role, knowledge, competence or experience.



PROHIBITION! *Operators in charge of maintenance must never receive help from personnel with different duties or qualifications, as the latter may not have the adequate knowledge to deal with the situation without compromising the safety of themselves and others.*



OBLIGATION! *If the type of operation involves specific risks, for example in case of operations on the electrical system, the maintenance personnel must be specialised in the operation under these specific situations.*

3.8 Personnel in charge of driving

The machine must be driven by a single operator at a time. The latter is responsible for the movement of the machine, its positioning and stabilisation, the movement of the boom and the nozzle during the concrete spraying operations, and supervise the spraying operations carried out by the machine; they must also check and use all the control and warning devices.

Depending on the usage stage, their working position is on the control desk, from where they can access the main control devices, or on the sides of the machine by using the remote control pushbutton panel.

The operator must always coordinate with the drivers of the pumps that feed the machine with the materials to be sprayed, as well as know the operation of these equipments which the machine must be connected to in order to operate (refer to the equipment instructions).

The driver must never operate to perform operations on the machine other than driving as described below; all maintenance, repair, tooling



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or operations other than driving are to be considered reserved for the specific personnel in charge.



PROHIBITION! *Never take personal initiative in order to resolve machine downtimes that are not strictly related to the driving task. Never attempt to help the personnel in charge maintenance or tooling.*



OBLIGATION! *When abnormal operating conditions or malfunctions occur on the machine, only the personnel in charge of maintenance can perform the reset.*

3.9 Personnel training

The machine may only be used by qualified personnel who pass the training period established during the sales contract and as such authorised for use. In any case, personnel who have not been adequately instructed on the correct functioning of the machine and of the safety devices are forbidden to use the machine.



ATTENTION! *The company Turbosol Produzione S.r.l. declines any responsibility deriving from incorrect operations performed by personnel not trained on using the machine, and from failure to comply with the general work protection safety regulations.*

3.10 Personal protective equipment

All operators in charge of the machine must use the following personal protective equipment:



- **Suitable protective clothing**, with long sleeves fastened with buttons or velcro, without loose flaps, taking care to avoid:
 - Using clothes that can get hooked to parts of the machine;
 - Using ties, scarves or other loose clothing parts;
 - Wearing rings, watches, cumbersome jewellery that may get hooked on the machine's part.



- Sturdy **gloves** able to protect the operator from any cuts or abrasions, and/or from contact with materials and hot parts.
- **Safety footwear** with anti-friction/slipping sole.



- **Earmuffs or ear protections**, during machine operation (spraying operations).



- Safety **goggles** when performing spraying, maintenance, tooling and adjustment operations.



- Safety **helmet**, specifically when using the machine inside tunnels.



OBLIGATION! *The machine Manager must always make sure that the personal protective equipment is in excellent condition, clean and efficient.*

3.11 Improper use

The machine is designed to be used only for the purposes described in the appropriate section of the manual (paragraph 4.3). Uses other than those described in this manual are to be considered improper and therefore not compliant with the safety regulations.



ATTENTION! *A non compliant use of the machine may result in personal injury, death and/or damage to the machine or equipment.*

A series of potential improper uses that may result in personal injury or damage to the machine or equipment, for which the company Turbosol Produzione S.r.l. disclaims any liability, are provided below:

- **Unauthorised modifications or replacements of machine parts;**
- **Failure to comply with the safety instructions;**
- **Failure to comply with the instructions for installation, use, operation, maintenance, repair or when these operations are carried out by unqualified personnel;**
- **Use of improper and incompatible materials or auxiliary equipment not required;**
- **Failure to comply with workplace safety regulations or applicable laws in force;**
- **Use of the boom (as a crane) for lifting and moving loads and/or people;**
- **Using the machine as a drive;**
- **Using the machine to transport/transfer loads;**
- **Using the boom with strong wind (beyond 20 km/h).**



4 Characteristics and technical specifications

4.1 Machine description

The Spritzbeton mobile spraying machine - TSR 7 (Fig. 4.1-1) is an articulated and extensible mobile boom with an adjustable nozzle at the end, designed for the infrastructure sector, suitable for use in both open and closed environments difficult to access such as tunnels, for spritzbeton (shotcrete) spraying.

The machine consists of the following parts:

- Crawler undercarriage with driving footboard;
- Motor compartment and hydraulic system;
- Mobile boom with nozzle;
- Outriggers;
- Tool compartment;
- Lighting headlights;
- Control and warning devices.

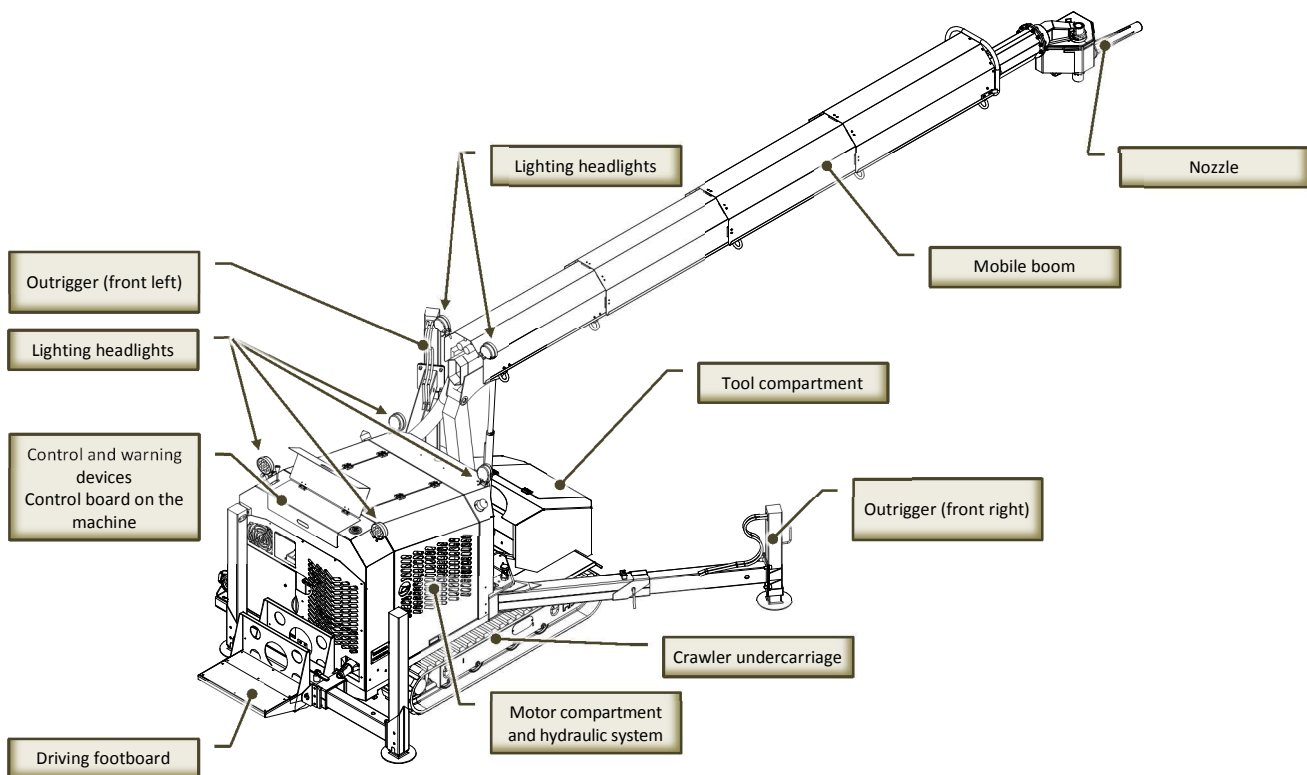


Fig. 4.1-1 - Spritzbeton mobile spraying machine (in the version with 4 outriggers)



From now on we will talk about the machine defining its front, rear, right and left movement directions.

The forward movement of the machine is towards its front part, where the mobile spraying arm is located.

The backward (reverse gear) movement of the machine is towards its rear part, where the on-board control desk is located, from which there is an overall view of the operations carried out and driving can be easily performed thanks to access to the main control and warning devices.

Movement to the right or left is defined with respect to an operator who located on the machine facing its front side; i.e. the right and left of the operator thus positioned.

For the position of the machine, see Fig. 4.1-2.

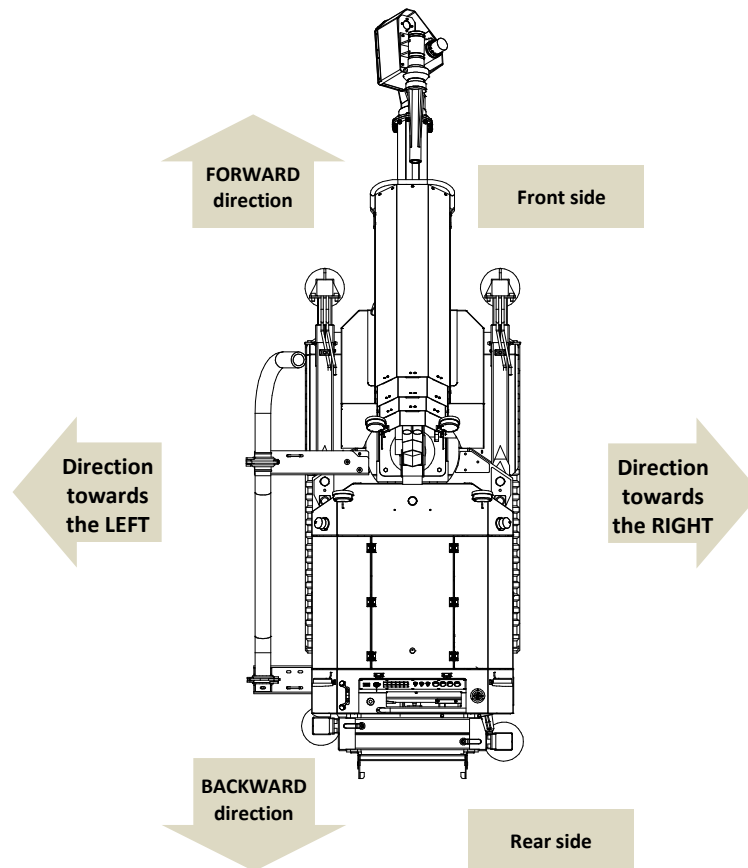


Fig. 4.1-2 - Machine position (plan view)



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4.2 Technical standards applied and directives

The machine has been designed in compliance with the Community regulations concerning machine safety:

- EN 12001:2012 Conveying, spraying and placing machines for concrete and mortar - Safety requirements;
- EN 13309:2010 Construction machinery - Electromagnetic compatibility of machines with internal power supply.

All relevant directives have been complied with, in particular:

- Directive 2006/42/EC of the European Parliament and Council of 17 May 2006 on machinery and amending Directive 95/16/EC;
- Directive 2014/30/EU of the European Parliament and Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility;
- Directive 2000/14/CE of the European Parliament and of the Council of 8 May 2000 on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors (and its amendments).

4.3 Intended use conditions

The Spritzbeton mobile spraying machine has been exclusively designed to carry out the functions described in the paragraph 4.1 of the manual.

The use of the machine is limited to the workplace where the spraying occurs.

The machine must operate in compliant environmental conditions as described in the relative paragraph 4.5.8. When using the machine in open environments, the machine can be powered by means of the endothermic engine. When the machine is used in closed environments (such as tunnels), the machine **must** operate by means of an electric motor and must therefore be connected to an external power supply by means of a power cable.

The materials that can be processed by the machine must comply, both in terms of type and characteristics, with the requirements listed in the paragraph concerning product characteristics (par. 4.6).



4.4 Residue risks

The machine, *in normal working conditions*, may present some residual risks, mainly due to incorrect use or incorrect operation.

The qualified personnel in charge of the machine, during its movement stage, must always stand on the driving footboard, highlighted in green in Fig. 4.4-1, i.e. on board the machine, at a speed suitable for the ground that is being travelled on, following the crawler handling requirements indicated in the instructions, and only and exclusively with the parts of the machine positioned in the configuration required for movement (see Fig. 7.5-1).

The qualified personnel, in charge of driving the machine, during the boom movement and spraying stage, must always stand inside the operator area highlighted in green in Fig. 4.4-2, i.e. near the control station of the selected machine, by always monitoring machine operation and the area in which the concrete is sprayed.

Under normal working conditions, residual risks are always present only *inside* the *danger zones*, highlighted in red in Fig. 4.4-1 and Fig. 4.4-2 (depending on the use stage).

- **Residual risks related to pressurised parts:**
 - Before using the machine, check and ensure the structural integrity of the pipes, the correct tightening of all the quick couplings and pipe joints.
 - Do not disconnect the fittings when the hose is under pressure.
 - The machine must be used by qualified personnel.
 - Periodically check the hydraulic system of the machine.
 - Perform maintenance of the hydraulic system with the machine secured, cut off from the power supplies and discharged from the residual pressure.
 - Do not stand near the spraying area.
 - Use the personal protective equipment.
 - Constantly make sure that unauthorised persons do not approach the danger zone.
- **Residual risks related to hot parts:**
 - Do not touch the hot parts of the machine, such as the diesel engine silencer.
 - Avoid opening the body when the machine is operating.
 - Wait until the machine parts have cooled down before carrying out maintenance operations.
 - Follow the safety signs.
- **Residual risks related to moving parts:**
 - Blow against boom due to accidental movements of the boom controls:
 - Activate the boom via the remote control only when required and outside the danger zone.
 - Turn off the remote control when not used.
 - Constantly make sure that unauthorised persons do not approach the danger zone.
 - Crushing of the upper limbs between mobile and fixed parts of the machine and of the boom:
 - Keep a safe distance from the movement range of the machine parts.



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- Constantly make sure that unauthorised persons do not approach the danger zone.
- Lower limb crushing against crawlers during machine movement:
 - Activate the crawlers via remote control only when required and outside the danger zone.
 - Do not lean over the driving footboard when on board the machine.
- **Residual risks due to lack of stability (e.g. overturning of the machine due to collapse of the ground or overturning of the machine during movement):**
 - Check the condition of the ground before stabilising the machine.
 - The machine must only be used with outriggers perfectly positioned on solid ground, increasing the support base accordingly if required.
 - Follow the instruction requirements to stabilise the machine.
 - Avoid abrupt manoeuvres of the boom.
 - Constantly make sure that unauthorised persons do not approach the danger zone.
 - Move the machine by following the speed, steering and approachable slope requirements indicated in the instructions.
- **Residual risks related to noise:** wear suitable hearing protection devices.
- **Material projection risks:**
 - Do not enter material other than that required.
 - Never aim the spraying nozzle towards other people.
 - Do not remain in the spraying area.
 - Use the personal protective equipment (e.g. goggles).
 - Constantly make sure that unauthorised persons do not approach the danger zone.
 - Perform the cleaning operations according to the warnings and procedures indicated in the instructions.
 - Perform the obstacle removal operations according to the warnings and procedures indicated in the instructions.
- **Risks related to the substances used:**
 - Should the operator come into contact with dangerous substances (for example additives) without wearing suitable protective equipment.
 - Avoid causing sparks near the battery.
 - Prevent the electrolyte from coming into contact with skin or clothes.
- **Risks related to contact with live electrical parts or electric discharge:**
 - Operations on electrical parts must only be carried out by qualified and authorised personnel.
 - Regularly check the electrical system of the machine.
 - Check that the power supply system conforms with current laws.
- **Fire/explosion hazard:**



- No smoking and no open flames.
- **Risks related to connected machines:**
 - Use the connected machines only in accordance with their instructions for use.

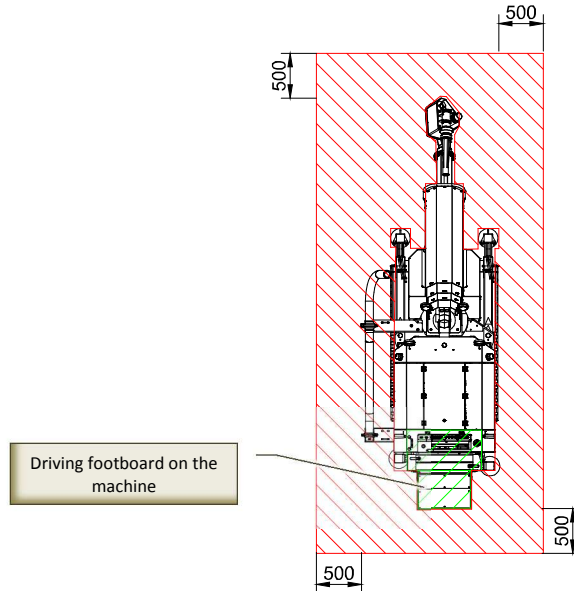


Fig. 4.4-1 - Operator zones and danger zones during machine movement (plan view)

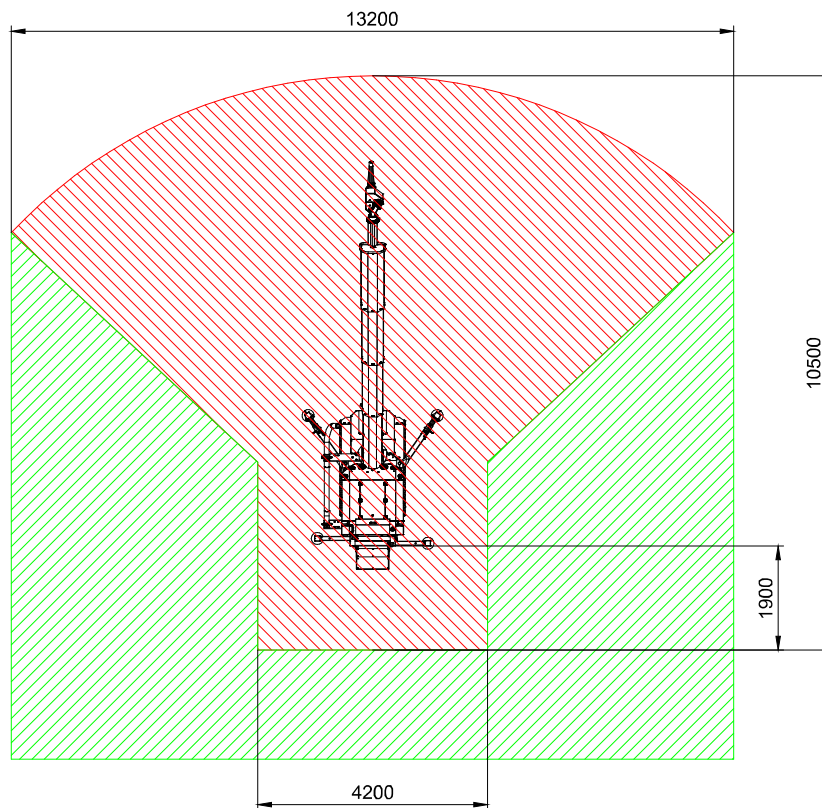


Fig. 4.4-2 - Operator zones and danger zones during spraying (plan view)



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4.5 Machine technical specifications

4.5.1 Technical specifications

				KUBOTA	LOMBARDINI	
Endothermic engine		Power	kW / Hp	18.5 / 24.8	15.7/21	
		Speed	min ⁻¹	3000	3000	
		Cooling		Liquid	Air	
		Accelerator		Manual	Manual	
Battery				70 Ah 12 Vdc		
Fuel tank capacity			Litres	40		
Electric motor		Power	kW / Hp	7.5 / 10.2		
		Rated voltage	V	400		
		Rated frequency	Hz	50		
		Poles	No.	4		
Warning				Flashing light		
				Alarm backup		
Lighting	Front		2 LED Taillights 12W (1A/12Vdc) – 700 lumen			
	Rear		2 LED Taillights 12W (1A/12Vdc) – 700 lumen			
Speed	With endothermic engine	1st speed	Km/h	0 + 1.44		
		2nd speed	Km/h	0 + 2.88		
	With electric motor	1st speed	Km/h	0 + 0.93		
		2nd speed	Km/h	0 + 1.86		
Gradeability (boom in transport position)		Ascent	Degrees/%	25/46		
		Descent	Degrees/%	15/26		
		Lateral	Degrees/%	10/17		
Maximum working slope (without outriggers extended and lowered)		Front/Rear	Degrees/%	5/9		
		Lateral	Degrees/%	0/0		
Coupling angle		Front	Degrees	42		
		Rear	Degrees	22		
Outriggers with built-in locking valve	<i>Frontal</i>		no.	2		
	Manual extension	Length	mm	2720		
	Hydraulically controlled descent	Stroke	mm	400		
	<i>Rear (only for version with 4 outriggers)</i>			no.	2	
	Manual extension	Length	mm	—		
	Hydraulically controlled descent	Stroke	mm	—		
Dimensions	Length (undercarriage)		mm	2780		
	Length (boom in transport position)		mm	3850		
	Width		mm	1231		
	Height		mm	2250		

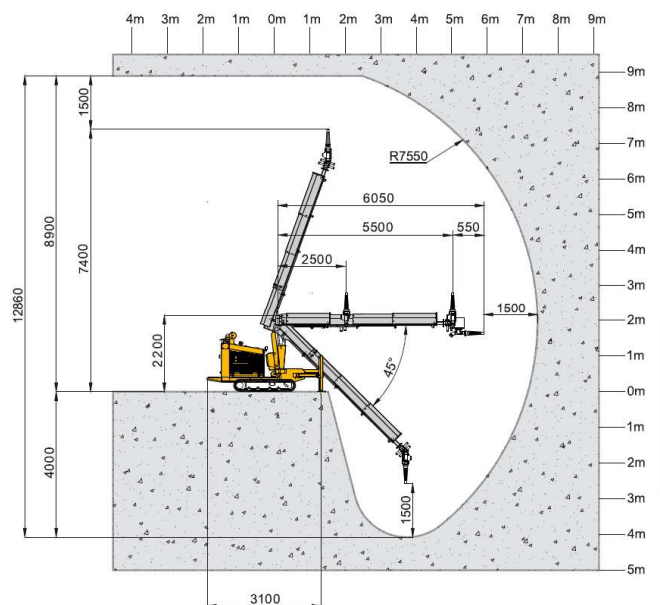
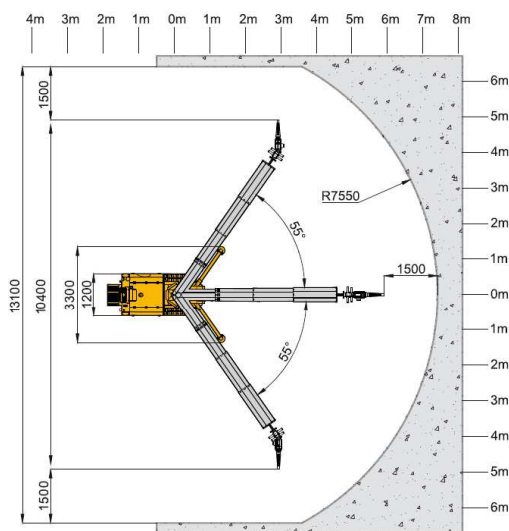
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Distributors	External levers	Forward/Reverse		
	Middle levers	Outriggers		
	Inner levers (joined)	High/Low speed		
Oil tank capacity		Litres	100	
Heat exchanger			12 Vdc / 7.1 A	
Maximum spraying height		m	8.5	
Spraying range		m	7.3	
Maximum granulometry		mm	15	
Extensions (with protective casing)		no.	3	
Stroke		m	2.9	
Rotating angle (right/left)	End of stroke with sensors	Degrees	± 55	
	Mechanical end of strokes	Degrees	± 58	
BOOM	Lifting (up/down)	Degrees	70/45	
	Head rotation	Degrees	360	
	Head inclination	Degrees	240	
	Brushing	Degrees	6	
	Outlet diameter		mm	40
	Recommended concrete pipe	W.P. / Øi	bar / mm	80 / 65
	Recommended air pipe	W.P. / Øi	bar / mm	27 / 38
	Recommended additive pipe	W.P. / Øi / rubber	bar / mm / -	20 / 19 / EPDM
	Work lights		2 LED lights 24W (2A/12Vdc) - 2000 lumen	

4.5.2 Output





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4.5.3 Dimensions

	Description	Code	Measurement
During transport	Machine length	Transp. le	3932 mm
	Machine width	Transp. wi	1553 mm
	Machine height	Transp. h	2055 mm
During movement	Minimum machine length (footboard lowered)	Min. le	4600 mm
	Minimum machine width	Min. wi	1553 mm
	Minimum machine height	Min. h	2098 mm
	Driving footboard height	Driv. h	416 mm
For the maximum overall dimensions during the spraying stages, see par. 4.5.2.			

Tab. 4.5-1

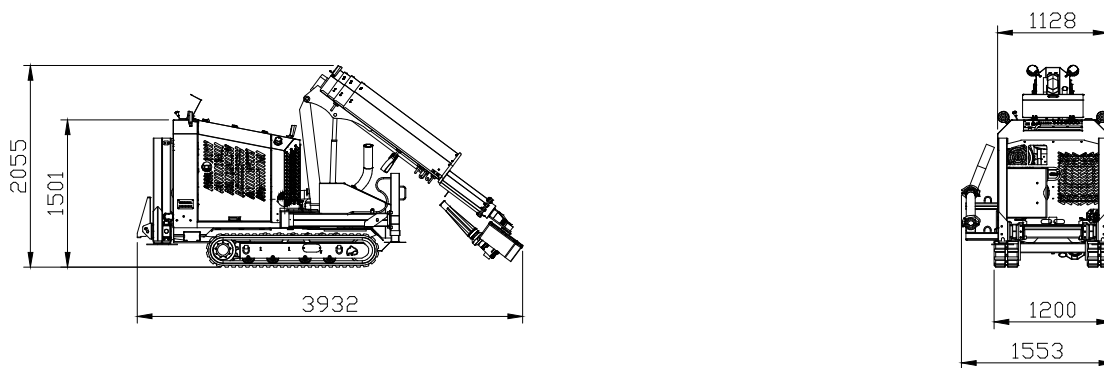


Fig. 4.5-1 - Machine dimensions during transport

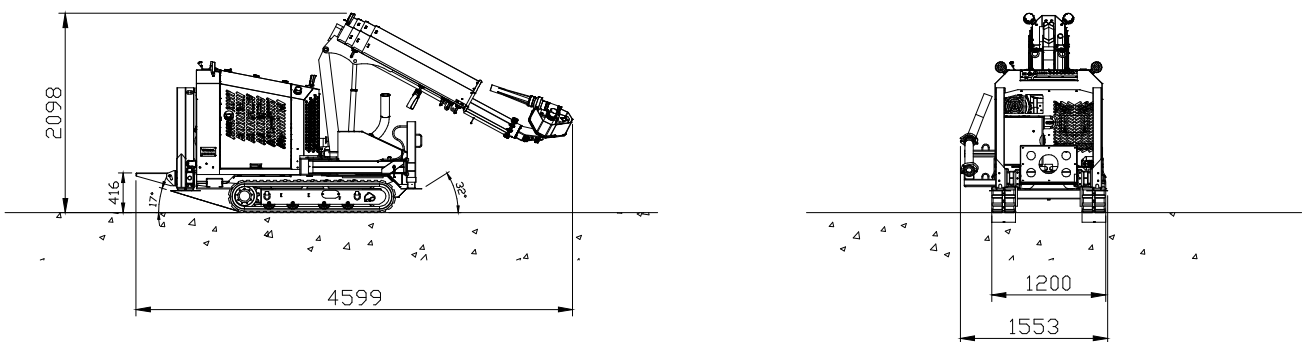


Fig. 4.5-2 - Machine dimensions during movement

4.5.4 Mass

Masses	With 2 outriggers	With 4 outriggers
Machine net weight	___ kg	___ kg

Tab. 4.5-2

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4.5.5 Machine power supply

Engine type	Characteristic	Value	
Endothermic engine	Brand	KUBOTA	LOMBARDINI
	Power	18.5 kW	15.7 kW
	Displacement	___ cm³	1123 cm³
	Speed	3000 rpm	3000 rpm
	Cooling	Liquid	Air
	Battery	70 Ah 12 Vdc	70 Ah 12 Vdc
Electric motor (powered by electric control board on the machine)	Voltage	3/PE/400 Vac +/- 10%	
	Frequency	50 Hz	
	Auxiliary circuits	12 Vdc	
	Power	7.5 kW / 10.2 Hp	
PLEASE NOTE: Diesel engine and electric motor cannot run simultaneously.			

Tab. 4.5-3

4.5.6 Noise

The machine has been designed and built so as to reduce the noise emission level at the source. Under normal conditions of use the sound power level of the machine is:

Sound pressure		
A-weighted sound power level L_w	With endothermic engine	107 dB
	With electric motor	80 dB
A-weighted emission sound pressure level L_p	With endothermic engine, driver station	89 dB
	With endothermic engine, workstation	86 dB
	With endothermic engine, at a distance greater than 3 m	< 85 dB
	With electric motor	< 70 dB

Tab. 4.5-4

The noise values indicated are emission levels measured under normal conditions of use according to standards EN ISO 3744, EN ISO 4871, EN ISO 11201, EN ISO 11204. If changes are made to the machine, the aforementioned values may vary, and must therefore be determined on the same.

The indicated noise values are emission levels and do not necessarily represent safe operating levels.

Although there is a relation between emission levels and exposure levels, this cannot be reliably used to determine whether further precautions are required or not. The factors that determine the level of exposure to which workers are exposed, include the duration of exposure, the characteristics of the work area and other sources of noise (number of machines, adjacent processes, etc.). Furthermore, permitted exposure levels may also vary from country to country. In any case, the information mentioned above will allow the user of the machine to better assess the danger and the risk to which they are subjected.



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ATTENTION! The acoustic impact on the surrounding environment produced by the machine in question under test conditions can be considered irrelevant.

However please note that noise exposure of the operator assigned to such machines will have to be assessed under the actual working conditions in which the machines will operate.

4.5.7 Vibrations

The vibration levels have been determined according to EN standard 12096 both for the vibrations transmitted to the hand/boom system and those transmitted to the entire body.

Vibrations emitted	Value	Measurement uncertainty
Total vibration value to which the hand-boom system is exposed (AW,sum)	2.7 m/s²	0.5
Maximum root-mean-square value of weighted acceleration to which the whole body is exposed (AW,max)	0.96 m/s²	0.1

Tab. 4.5-5



OBLIGATION! No specific arrangements are required in order to protect the operator from the effects of the vibrations produced.

In case of abnormal vibrations, the operator must immediately stop the machine and report the phenomenon to the maintenance personnel.

4.5.8 Permissible environmental values

Permissible environmental values	
Operating temperatures	+5 °C ÷ +40 °C⁴
Room temperature variations	max. 1.1°C / Min
Average temperature	not exceeding +35°C during 24 h
Relative humidity range (RH)	75 % or less
Vibrations	≤ 0.5 G
Altitude	Up to 1000 m a.s.l.

Tab. 4.5-6

4.5.9 Degrees of protection

Electrical equipment degree of protection (IP ⁵)	
Degree of protection against foreign solid bodies (protected against dust)	5
Degree of protection against water (protected against splashes of water)	5
Degree of protection against access to dangerous parts	B

Tab. 4.5-7

⁴ The electrical equipment is able to operate correctly when the relative humidity does not exceed 50% at a maximum temperature of +40 °C. Higher relative humidity can be allowed at lower temperatures (e.g. 90% at +20 °C).

⁵ According to CEI EN standard 60529.

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4.6 Characteristics of the product to be processed

4.6.1 Technical specifications of the product to be sprayed

The machine can process concrete whose composition is suitable to be sprayed.

Air and additive, necessary for the shotcrete, must be mixed to the concrete in the nozzle.

<i>Technical specifications of the product to be sprayed</i>	
Specific concrete weight	Max 2400 kg/m³
Granulometry spritzbeton (shotcrete)	Max 15 mm

Tab. 4.6-1



ATTENTION! Do not feed the machine with materials with characteristics other than those permitted.

This may cause the pipes to clog, causing damage to the machine itself and/or hazards for the operators.

4.6.2 Supply of product to be sprayed

<i>Equipment to be connected to the machine</i>	<i>Coupling</i>	<i>Maximum pressure</i>	<i>Recommended flow rate</i>
Concrete pump	Victaulic 3"	80 bar	5 + 20 m³/h
Pump for additive	Camlock ¾"	15 bar	Appropriate to concrete flow rate
Compressed air compressor	BSP (ogive 60°) 1 ½"	7 + 8 bar	Appropriate to concrete flow rate

Tab. 4.6-2



OBLIGATION! Observe the safety requirements of the manufacturers of the concrete additive products.



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5 Transport and commissioning

5.1 Transport

The machine is delivered assembled in a single part and must be transported exclusively by the manufacturer or by specialised personnel. The machine is supplied without packaging.



ATTENTION! *The machine is supplied without packaging and therefore must be transported exclusively on closed vehicles.*

5.2 Handling



ATTENTION! *Follow the requirements provided below.*

The machine can only be transported by personnel of the company Turbosol Produzione S.r.l. or by personnel authorised by it.

The Spritzbeton mobile spraying machine must be lifted and moved by using a suitable lifting device with a suitable capacity. The capacity of the lifting device must be at least 20% more than the mass to be lifted (see Tab. 4.5-2).

Follow the operating instructions provided below:

- Make sure that the parts of the machine are in the transport position (Fig. 5.2-2), and with the driving footboard raised;
- Secure any moving parts (e.g. cables, control devices, any accessories, etc.) to the machine structure in a stable and safe manner, so as to prevent them from falling during handling operations or, if possible, remove and move them separately;
- Make sure that the machine is switched off and disconnected from the power supply (power cable) and from the equipment supplying the product to be sprayed (pipes);
- Make sure that the remote control pushbutton panel is disconnected and stored in the specific machine compartment;
- Make sure that the machine is firmly secured to the lifting device;
- Lift the machine a few centimetres from the ground and check its stability;
- Once the stability of the assembly has been checked, move it with caution.

Some safety instructions regarding transport operations are provided below:



- **The lifting and handling operations required to carry out installation must be performed by using adequate means and by specialised personnel trained in this type of operation;**
- **The presence of a helper is important for communication while moving the machine components;**
- **The machine must be lifted by using equipment suitable to these operations, adopting all the precautions required and recommended in order to prevent damage to people or things;**
- **No person must be near the suspended load, in the range of**



operation of the forklift or crane.

In any case please note that improper use of the lifting device subjects the operators to the following risks:

- **Contacts with moving parts of the forklift or of the crane;**
- **Fall of the load, in particular at the corners or on slopes;**
- **Overturning;**
- **Impact between the forklift or crane and other objects;**
- **Operator crushing between the forklift or crane and other objects;**
- **Foot crushing by the forklift wheels.**

5.2.1 Lifting hooking points

The gripping points (hooks) are set up on the machine to perform the lifting operations.

The lifting points on the machine are indicated with an image (Fig. 5.2-1).



Fig. 5.2-1 - Lifting hooking point

5.2.2 Machine lifting configuration

The machine can only be lifted if its parts are positioned as intended in the transport configuration (Fig. 5.2-2):

- Boom fully lowered and aligned with the machine;
- Nozzle facing upward to occupy as little space as possible;
- Hydraulic boom pipes collected so as not to be in the way;
- Outriggers in resting position: outriggers fully raised and extensions retracted and locked;
- Driving footboard raised.

For lifting, the machine must be disconnected from the product supply pipes, disconnected from the power supply (power cable disconnected, diesel engine off).

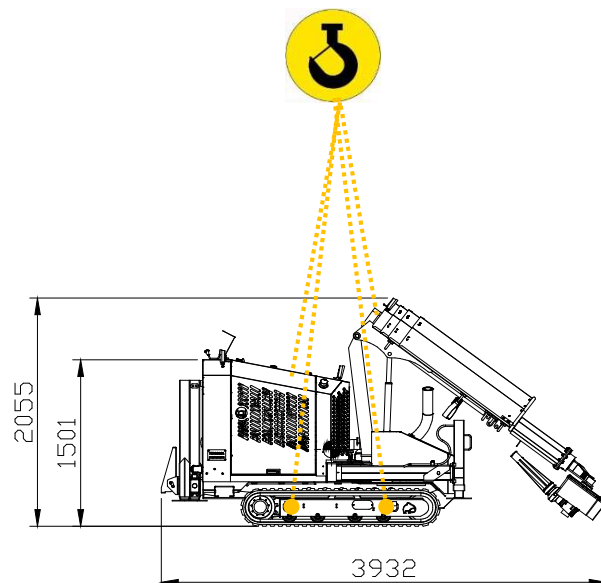


Fig. 5.2-2 - Machine lifting configuration



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5.3 Lifting by using ropes or slings

5.3.1 General recommendations

- The lifting and handling operations required to carry out installation must be performed by using adequate means and by specialised personnel trained in this type of operation;
- The loads must be distributed evenly, to avoid unbalancing. Basket slings with the ropes passing underneath the load are preferable. In the case of particularly long loads it is advisable to use a lifting beam, especially if the centre of gravity cannot be immediately identified;
- Check that the load is properly balanced, by lifting it of a few centimetres;
- Before lifting the load, check that the hook closing device is closed;
- Leave the crane operating range as soon as possible.



ATTENTION! Failure to comply with the following instructions may cause the component to be transported to overturn, with the risk of injury to the operator and damage to the line.



ATTENTION! All slings consisting of steel ropes must comply with ISO standard 2408.

5.3.2 Load harness

Some preliminary instructions related to the harnessing operations by using appropriate devices are provided below:

- **Before carrying out any operation, check the integrity of all the accessories (chains, ropes, hooks, rings, clamps, wire terminals, etc.), paying attention to cuts, elongations, crushing, deformation and play of the pins. Replace any equipment that appears damaged;**
- **Evaluate the weight of the load to be transported;**
- **Carry out the harnessing according to the instructions provided in paragraph 5.3.2.3.**

5.3.2.1 Checking the safety device of the hook of the lifting device

- Check that the release safety device works correctly;
- Check that the safety device fully closes the hook inlet opening.



Fig. 5.3-1 - Hook



ATTENTION!: Notify the crane operator/superior in case of faults.

5.3.2.2 Harness integrity check

- Check that the harness is not damaged (without cracks, cuts, crushing, knots);
- Check the register of periodic checks of lifting devices, check the expiration dates;
- Check that the chosen harness is suitable for the material to be transported.

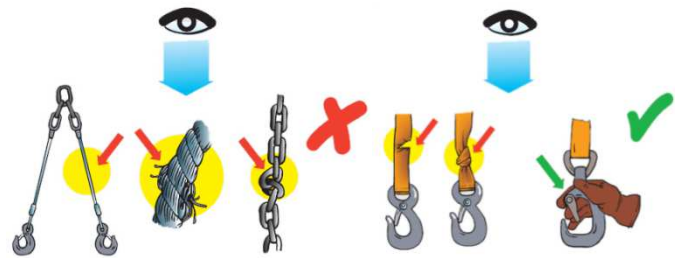


Fig. 5.3-2 - Harnesses



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5.3.2.3 Check of the material to be transported and of the harness

- Check that the materials, in their current state, can be transported by means of the lifting device (check that the packaging is intact, no element is unstable);
- In the event that separate modules must be lifted, suitably and securely harness the individual packages;
- Evaluate the point where the harness must be fixed to the load to be transported. Use the hooking points provided on the equipment and use protections at the corners of the load if the load has rough or sharp edges (paragraph 5.3.2.4);
- The material must be transported in a well-balanced position (take into account the load centre of gravity);



Fig. 5.3-3 - Harness

- Hook the loads with a vertex angle (inclination angle) as acute as possible (paragraph 5.3.3);
- Apply chains, straps or ropes around the material to be transported in such a way as to make it impossible for the load to move during the lifting and transport operation.

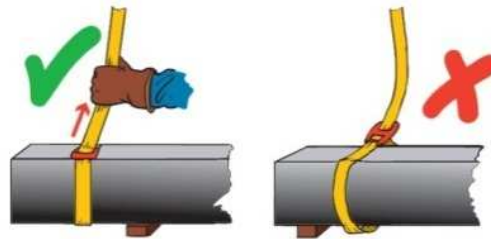


Fig. 5.3-4 - Harness fixing

5.3.2.4 Lifting accessory protections

Use protections for chains and lifting ropes at load angles if the load has roughness or edges or other peculiarities for which it is recommended to insert wooden or rubber shims.

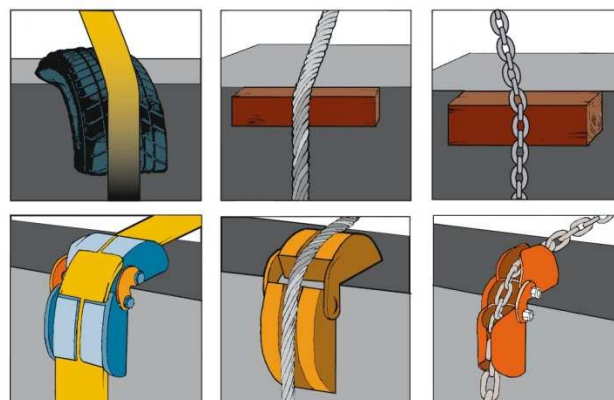


Fig. 5.3-5 - Lifting accessory protection types



5.3.3 Determining the capacity

The following figure (Fig. 5.3-6) indicates the load percentages that the harness accessories can actually support depending on the vertex angle. In the example on the right (vertex angle $60^\circ \times 2 = 120^\circ$) the lifting accessory can support only 50% of the load that it can support if used instead as indicated in the example on the left (vertex angle 0°).

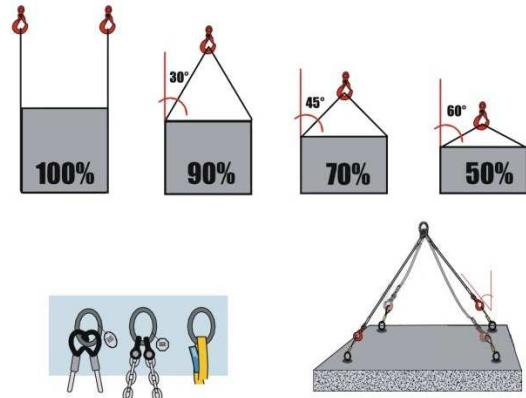


Fig. 5.3-6 - Vertex angle - indicative percentages

To know the actual capacity of a sling having a specific vertex angle, it is required to divide its vertical capacity by a specific coefficient "C" (Tab. 5.3-1 and Fig. 5.3-7).

Vertex angle (°)	Load increase factor ©	Vertex angle (°)	Load increase factor ©
0	1.000	90	1.414
10	1.004	100	1.556
20	1.015	110	1.743
30	1.035	120	2.000
40	1.064	130	2.366
50	1.103	140	2.924
60	1.155	150	3.864
70	1.221	160	5.759
80	1.305	170	11.474

Tab. 5.3-1



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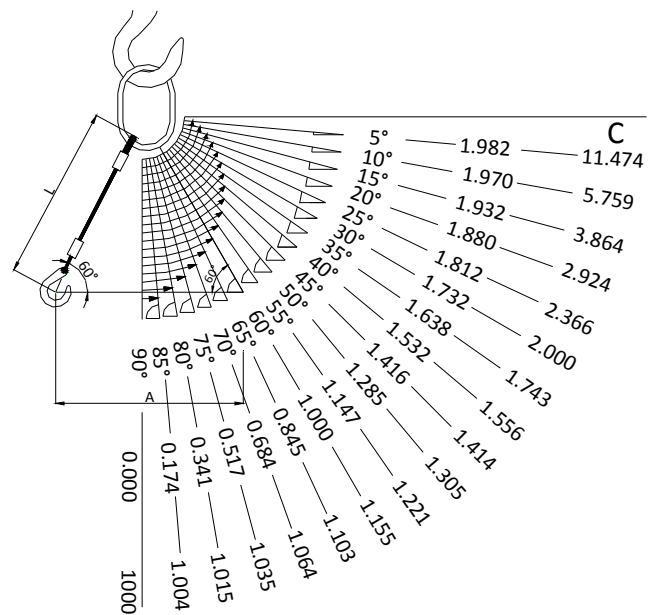


Fig. 5.3-7 - Vertex angle diagram - load increase factor

In any case, please note that:

- For vertex angles higher than 120°, the capacity varies greatly due to small variations in the angle and it is advisable to avoid such excessive configurations by implementing, for example, rocker arms or lifting beams;
- When the mass is supported by a four-boom sling, only two of these actually support the load.



5.3.4 Load lifting and traversing

Some safety instructions regarding load lifting operations are provided below:

- *Check that the harness corresponds to what is required (both when all the required active sections come into action, and as a general seal) and the proper balancing of the load, by slowly and slightly raising the load (Fig. 5.3-11);*
- *Once the harness has been checked, load lifting (Fig. 5.3-12) can be started, taking care that it occurs vertically avoiding dangerous inclinations, since cause changes in the load balance which may cause the load to be released and which may increase the stress in the harnessing equipment. Immediately give the “stop” signal in case of danger (Fig. 5.3-13);*
- *If the slingers (operators in charge of harnessing the component) are more than one, only one of them can give signals to the operator. The start, the successive movements and the stops must be gradual and not abrupt;*
- *The suspended load must not be guided with hands but with ropes or hooks; it must not be pushed but only pulled, avoiding standing under it;*



Fig. 5.3-8 - Suspended load guided with a hook

- *It is important to avoid dangerous oscillations of the load during traversing;*
- *Once the load has been placed on suitable supports, loosen the pull to check that there are no falls or movements of parts of the load before and after removal of the harnessing equipment;*
- *If these return to the starting point hanging from the transport hook, they must be arranged in such a way that they do not give rise to problems or accidents during the stroke;*
- *After use, the lifting equipment must not be left on the ground where (in addition to causing accidents to people stumbling on them) they can be damaged by being stepped on by vehicles and people or by contact with caustic acids, greases, sand or dust; they must instead be brought back to their assigned positions;*
- *For slings with multiple booms and for loads whose surface causes them to be placed at a sharp angle (as in the present case), please note that this capacity varies considerably with the variation of the vertex angle.*



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5.3.4.1 Slinger work position

- Choose a safe working position, with the option of dodging the load in case of unexpected movements, with no falls and crushing;
- Visual contact with the crane operator is required;

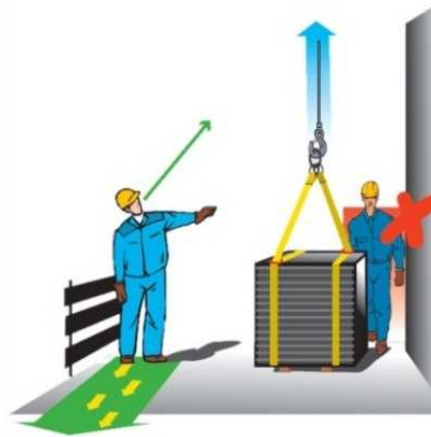


Fig. 5.3-9 - Slinger position

- Never stand underneath the suspended load.

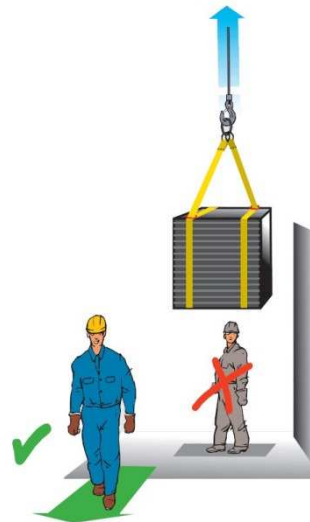


Fig. 5.3-10 - Do not stand underneath the suspended load.



5.3.4.2 Hand signs during load movement

Hand signal: «Slowly upward»

- Give the «Slowly upward» order to the crane operator via a hand signal;
- Supervise the load lifting operation from a close distance and without being exposed to risks.

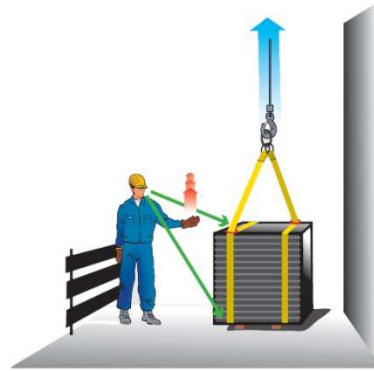


Fig. 5.3-11 - "Slowly downward" sign

Check of the suspended load and lifting

When the load is slightly above the ground, check:

- If the load is balanced and the harness points are properly stable;
- If YES: «Load up» hand signal.

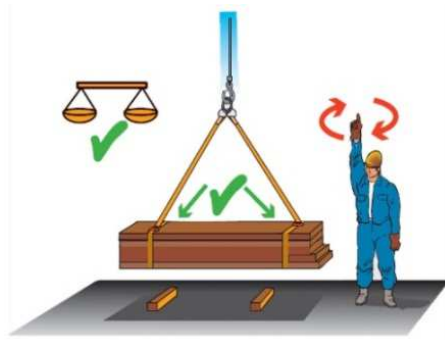


Fig. 5.3-12 - "Load up" signal

Danger!

If the load is overturned or the harness points move:

- Immediately signal for «Stop»;
- Never correct the suspended position of the load by using your hands.

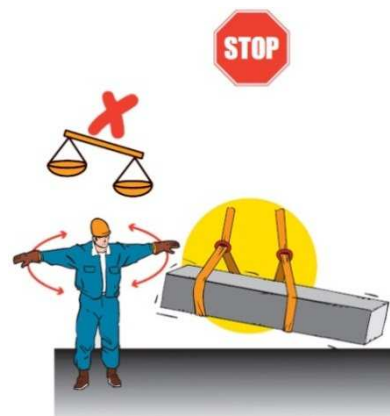


Fig. 5.3-13 - "Stop" signal



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5.4 Manual handling of loads

Manual handling of loads (MHL) must be carried out in safe conditions to avoid overloading the dorso-lumbar section of the vertebral column.

Some safety instructions regarding manual load handling operations are provided below:



ATTENTION! The lifting and handling operations must be carried out in compliance with the maximum weight that can be lifted by a person ⁶; use appropriate lifting devices to avoid the risk of dorso-lumbar injuries.



PROHIBITION! Do not manually lift products weighing more than the permitted limit!

In any case please note that during manual handling operators are subject to the following risks:

- Fall of the load;
- Foot crushing.

To prevent risks deriving from incorrect handling of loads, comply with the following general indications:

- Make sure the floor is stable and without roughness;
- Use, if possible, suitable transport devices (e.g. hand trucks, forklifts or cranes);

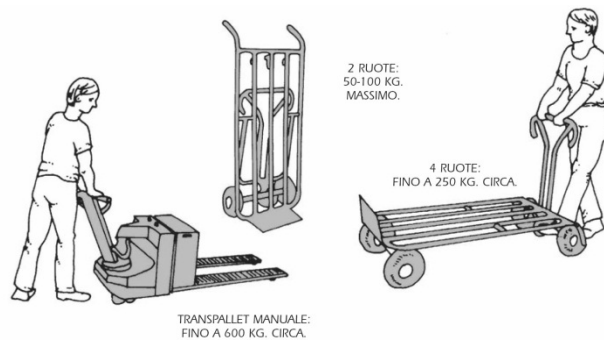


Fig. 5.4-1 - Transport devices

- Be in a stable position;
- Flex the knees (at an angle of 90°) and use your leg muscles to lift the load. Slowly lift the load by keeping your back straight;

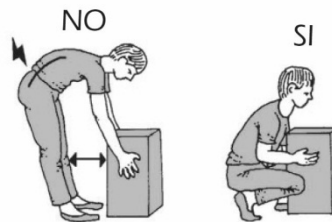


Fig. 5.4-2 - Lifting technique

⁶ 25 kg for men and 15 kg for women, according to Annex XXXIII of Legislative Decree 81/2008 and ISO standard 11228.



- Avoid twisting the chest;

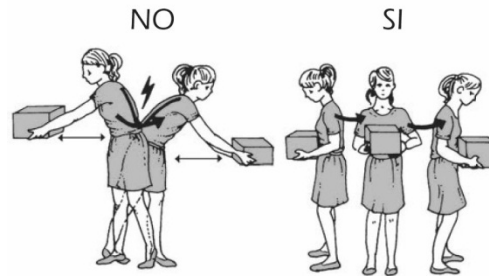


Fig. 5.4-3 - Lifting technique

- Keep the load as close to the body as possible;
- Distribute the load on both sides;
- Keep the view free;
- At least two operators must be present to lift bulky loads;
- Follow the maximum weight limitations that can be lifted by a person;
- If the load is too heavy or requires considerable physical effort to lift it, one of the following solutions must be chosen:
 - Use auxiliary devices,
 - Divide the load into multiple parts that can be transported individually,
 - Transport the load with two operators.

Should it be required to move components by pushing or pulling, observe the following general indications:

- Always operate in a stable position;
- If possible, position the load on devices with wheels;
- Push, preferably by resting the back on the load and keeping the arms parallel to the body, if pushing the load in front of you, take care to keep your back straight;
- Please note that pushing is preferable to pulling;
- If pulling is required, always use safe gripping points (which cannot be broken due to the pulling action).



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5.5 Commissioning



ATTENTION! Before proceeding with commissioning, carefully read the following warnings.

Failure to comply with the following warnings may result in injury, death or damage to the equipment.

The company Turbosol Produzione S.r.l. declines any responsibility for damage to persons and property caused by an installation carried out in an environment with one of the following situations.



OBLIGATION! The use of the machine is limited to the workplace where the spraying occurs.



PROHIBITION! The machine cannot be used in environments with an explosive atmosphere (even mines) due to the presence of dust or explosive gases.



PROHIBITION! The machine cannot be commissioned in environments where an IP protection rating above 55 is required.



ATTENTION! In the site of use, sufficient lighting must be assured for usage and maintenance operations, according to the provisions of the Legislative Decree of 9 April 2008 no. 81.

The recommended average lighting values are those required by standards UNI EN 12464-1 and UNI EN 12464-2.

The machine is delivered fully assembled. The only operations to be carried out before starting the machine are limited to the electrical connection if the machine is to be used in a tunnel.



5.6 Connection to the electrical mains

PLEASE NOTE: The machine must be connected to electrical mains only when used with an electric motor, rather than an endothermic one.
In general, the machine must work with the electric motor when it must be used in a tunnel.

5.6.1 Requirements



ATTENTION! Only connect the machine to a power supply system (e.g. construction site electric control board) with adequate power and that meets the current safety regulations.

The machine must be protected by a circuit breaker of adequate capacity (30mA), proportional to the absorption of the machine. The circuit breaker, commonly known as a cut-out switch, is an electrical device capable of interrupting a circuit in the event of a ground fault (electrical leakage) or phase-ground electrocution thus also providing protection towards direct or indirect electric macroshock. It offers no protection against overcurrent or short-circuit between phase and phase or between phase and neutral, for which a magneto-thermic switch is required.

PROHIBITION! It is forbidden to connect the machine to a power line that is not protected by a circuit breaker.



ATTENTION! Failure to comply with the following safety instructions may result in injury, death or damage to the equipment.

- All electrical connections of the machine must be carried out by authorised personnel (for Italy authorisation pursuant to the Decree of 22 January 2008 no.37);
- Mains connection operations must be performed in the absence of voltage;
- The conductors of the cables that connect the system to the electrical control board of the machine must have a section suitable for use with the power supply current;
- It is required, in compliance with the current safety regulations, for the machine to be connected to an efficient earthing system (marked by the symbol \perp);
- The machine must be equipped with compatible protection fuses, with nominal current consumption values corresponding to those required (see wiring diagram attached);
- Any cables that may be outside of the machine must be regularly checked for wear, tear or damage;
- The cables must never be compressed or crushed. Position them in such a way as to prevent an operator from tripping or walking over them.



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5.6.2 Connection modes

The electrical control board of the machine is powered by inserting the power cable socket into the 5-pin plug (3P+N+T) for machine connection (Fig. 5.6-1), after removing the cap.

Before making the connection, check that the mains voltage and frequency are compatible with the values required by the electric motor of the machine (see paragraph 4.5.5).

The supply line to which the machine will be connected must be protected by a circuit breaker of adequate capacity.



Fig. 5.6-1 - Machine electric control board supply plug

PLEASE NOTE: When not in use, the machine connection plug must always be closed with the supplied cap.



6 Operation

6.1 Machine operation

The Spritzbeton mobile spraying machine - TSR 7 (Fig. 6.1-1) is an articulated and extensible mobile boom with an adjustable nozzle at the end, designed for the infrastructure sector, suitable for use in both open and closed environments difficult to access such as tunnels.

The machine consists of the following parts:

- Crawler undercarriage with driving footboard;
- Motor compartment and hydraulic system;
- Mobile boom with nozzle (or nozzle-holding wrist);
- Outriggers;
- Tool compartment;
- Lighting headlights;
- Control and warning devices.

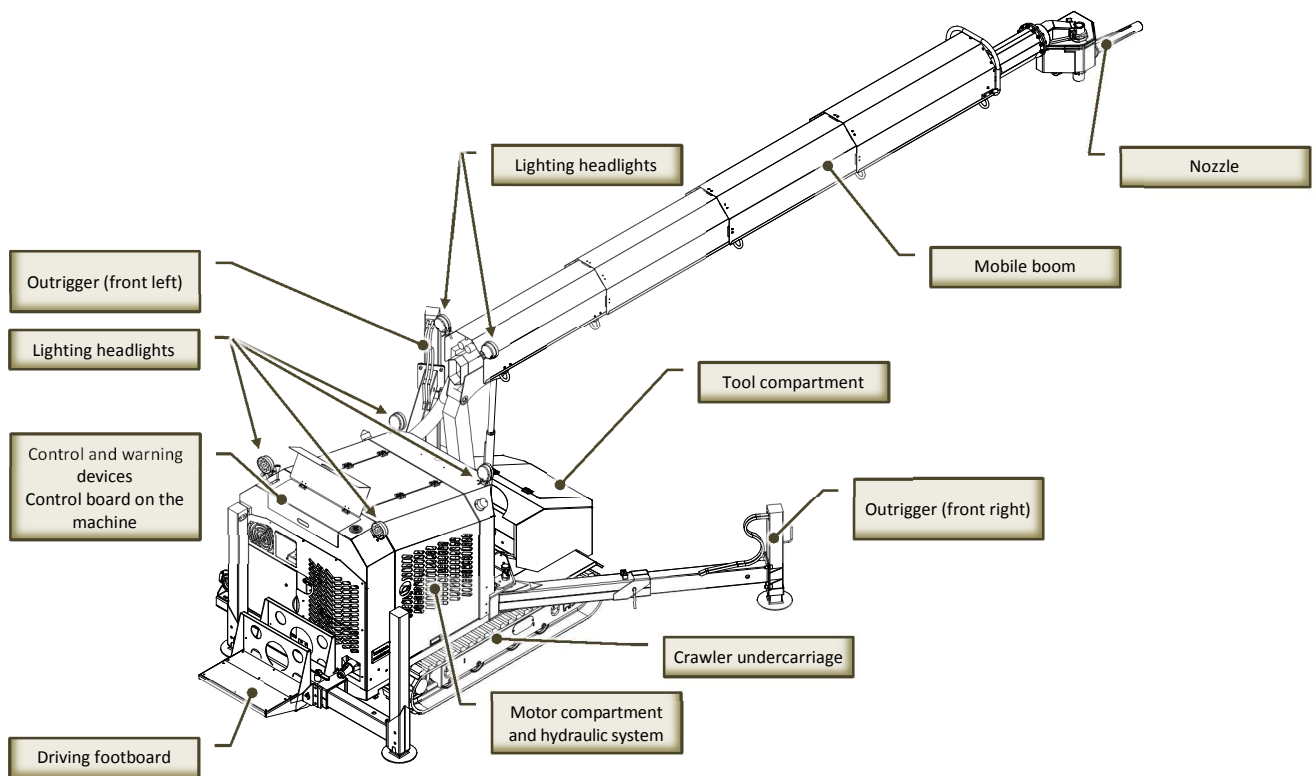


Fig. 6.1-1 - Spritzbeton mobile spraying machine (in the version with 4 outriggers)

6.1.1 Crawler undercarriage with driving footboard

The machine is mobile, with driver on board, as mounted on a crawler undercarriage (Fig. 6.1-1).

The two crawlers are made of rubber, each driven by a hydraulic orbital gear motor with a negative brake.

The driver of the truck, when on board, is stationed on the specific driving footboard (Fig. 6.1-1). The footboard can be tipped so that, when not in use, it can be lifted so as not to represent an obstruction. The footboard lowered position is controlled by a sensor.

The machine is not approved for road circulation.



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6.1.2 Motor compartment and hydraulic system

All machine movements (crawler, boom, outriggers) are hydraulically operated. The machine's hydraulic system consists of hydraulic motors, hydraulic pumps, valves/solenoid valves, cylinders (of various types), oil tank and so on (see attachment A4 Hydraulic diagram of the machine).

To operate the various circuits, the machine is set up with two different engines that activate the pump of the hydraulic system.

The first engine is endothermic, while the second is electric (powered by an electrical control board on the machine). The two engines are mutually exclusive, i.e. the machine works with only one engine at a time. In general, the machine has been supplied with an electric motor to allow it to be used in closed environments (tunnels), thus avoiding the formation of exhaust gases.

For additional information on the endothermic engine, see its original documentation in annex A5 Endothermic engine instructions.

The two engines, the fuel tank, most of the components of the hydraulic system are housed inside the engine compartment, enclosed by two bonnets, one on the right side and one on the left side, with key lock for locking and with specific grid openings for ventilation. Each bonnet is hinged at the top and can be opened by lifting it once the lock has been opened. The open/raised position of the bonnet is secured by a support rod which must be positioned by the operator.

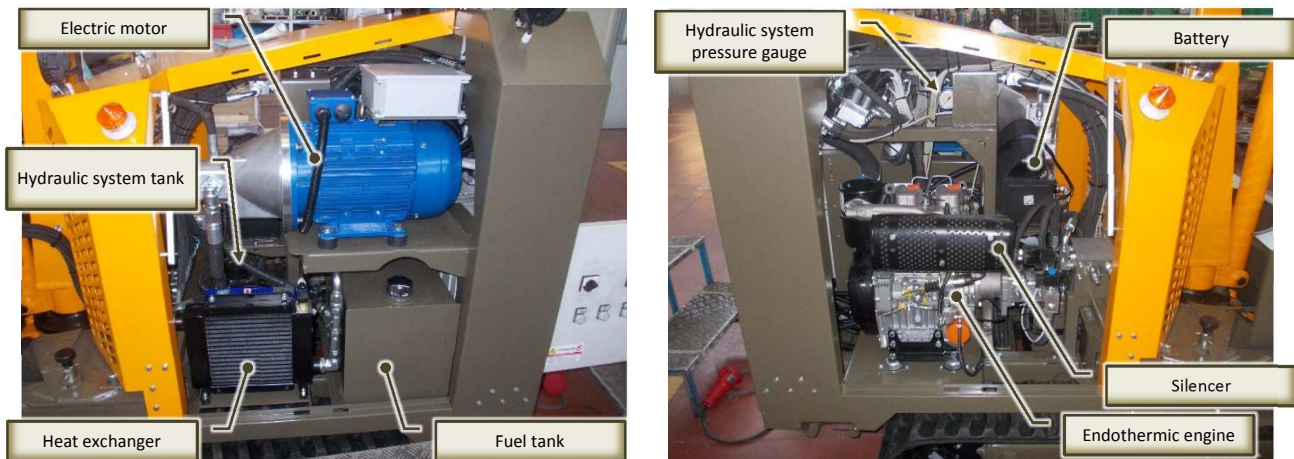


Fig. 6.1-2 - Motor compartment: left and right side view



6.1.3 Mobile boom with nozzle

The mobile boom is the part of the machine that allows the spraying nozzle to be brought to the specific position for laying the concrete. This device, mounted on the crawler undercarriage on the opposite side to that of the driver, is composed of:

- A fifth wheel, driven by a hydraulic motor, to rotate the boom (at the resting point);
- A first folding sector (Fig. 6.1-3), hydraulically operated, for raising/lowering the boom;
- Three removable sectors (Fig. 6.1-3), hydraulically operated, to extend the boom;
- A hydraulically operated system for inclination up to 240° of the wrist supporting the nozzle;
- A hydraulically operated system for rotation up to 360° of the wrist supporting the nozzle;
- An hydraulic pump oscillate the nozzle.

To protect the boom from any concrete splashes/projections, the removable sectors are surmounted by protection casings (Fig. 6.1-3) which, when the boom is fully retracted, are stacked one on top of one another.

In the lower part of the removable sectors there are rings (Fig. 6.1-3) on which to hook the support straps of the hydraulic pipes and of the pipes supplying the product to be sprayed.

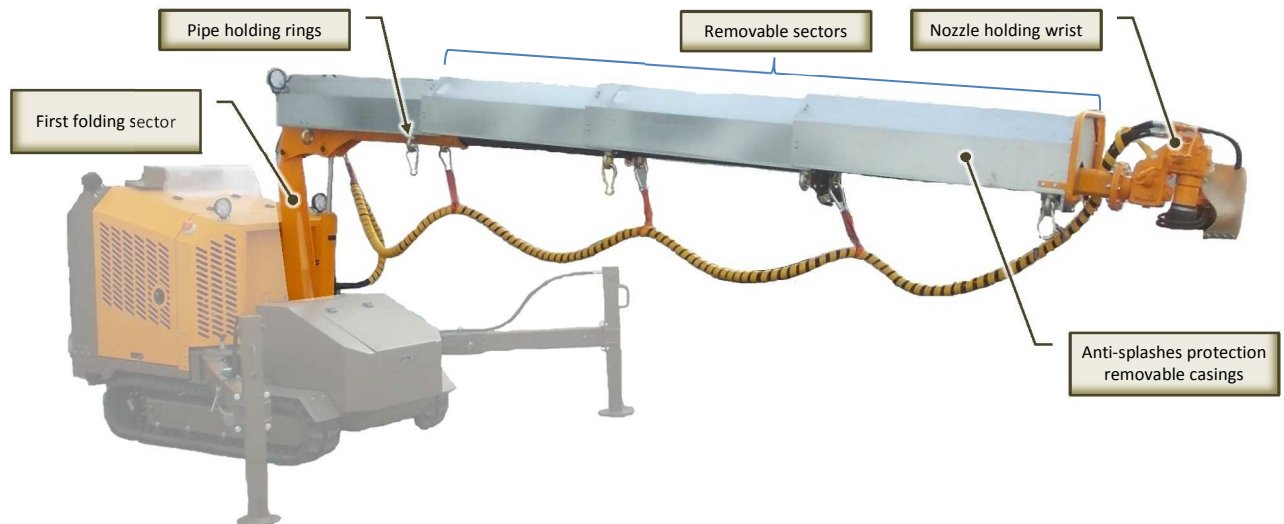


Fig. 6.1-3 - Mobile boom



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6.1.4 Outriggers

The outriggers, hydraulically operated, are the elements of the machine that allow it to be protected against potential displacement/overturning during the boom handling and spraying stages. Once brought to the place of use, before spraying, the machine must be stabilised by activating the outriggers, so that it is stable and levelled in its position.

The outriggers are not devices for lifting or supporting the entire machine, but only to ensure stability during boom movement and spraying operations.

Depending on the configuration, the machine can be equipped with two or four outriggers, in the first case on the front side of the machine (boom side), in the second case also on the rear side (driver footboard side).

The outriggers are mounted on a hinged and/or removable structure so that, when not being used, they can be reduced to the minimum size and be less bulky when moving the machine.



Fig. 6.1-4 - Outriggers (rear side view)

6.1.5 Tool compartment

An additional compartment has been made underneath the spraying boom (Fig. 6.1-1), closed by a hinged door, to bring all the tools and instruments supplied and useful to the machine, such as the remote control, cables, the machine instructions booklet and so on.

6.1.6 Lighting headlights

The machine is equipped with six lighting headlights (Fig. 6.1-1), four at the upper corners of the engine compartment and two at the boom raising/lowering joint. Turn on the headlights for better lighting than the room one. For headlight technical specifications, see par. 4.5.1



6.2 Control and warning devices

The tables that describe the control and warning devices associated with each illustration are provided below.

The code column shows the references to the control and warning devices as shown in the wiring diagram attached to the manual.



ATTENTION! The bold acronyms, shown in the tables, will be used in the following description of operation (chapter 7, "Operator instructions").

6.2.1 Electric control board

The following figure (Fig. 6.2-1) highlights the electrical control board of the Spritzbeton mobile spraying machine, on which the main switch and some warning devices are installed.

PLEASE NOTE! The control devices of the electrical control board must only be used when the machine operates by means of an electric motor.

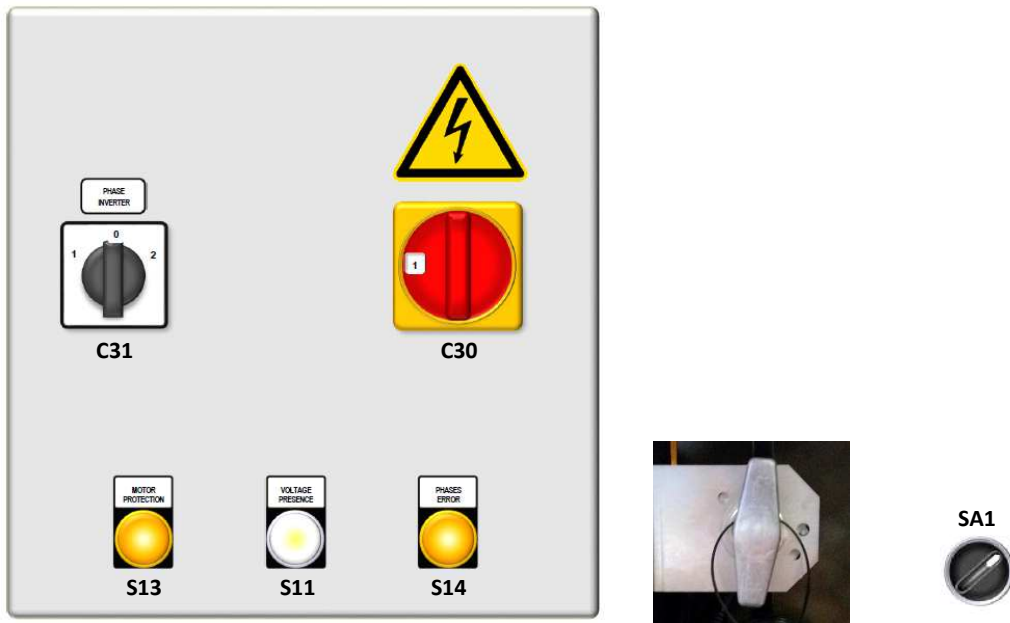


Fig. 6.2-1 - Electric control board

ELECTRIC CONTROL BOARD					
CONTROL DEVICES			WARNING DEVICES		
Symbol	Code	Description	Symbol	Code	Description
O / I	C30	Master switch on electric control board			
PHASE INVERTER	C31	Phase change control three-contact selector 1 Phase connection 0 Phase disconnection 2 Phase inversion			



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ELECTRIC CONTROL BOARD					
CONTROL DEVICES			WARNING DEVICES		
Symbol	Code	Description	Symbol	Code	Description
			ENGINE PROTECTION	S13	Motor thermal protection activation warning YELLOW indicator light
			VOLTAGE PRESENCE	S11	Board power supply engaged warning WHITE indicator light
			PHASE ERROR	S14	Phase inverted or phase at electrical connection to the board absent warning YELLOW indicator light. In this case check the power cable. If the phase is inverted, move the "Phase inverter" selector to position "2".
-	-	Battery disconnecter			
-	SA1	Two-position selector for enabling / disabling inductive end of strokes for spraying boom rotation <i>PLEASE NOTE: This selector is located inside the electric control board and must only be used during maintenance operations</i>			

Tab. 6.2-1



6.2.2 Control desk

The following figure (Fig. 6.2-2) highlights the control, warning and EMERGENCY devices installed on the control desk on the machine.

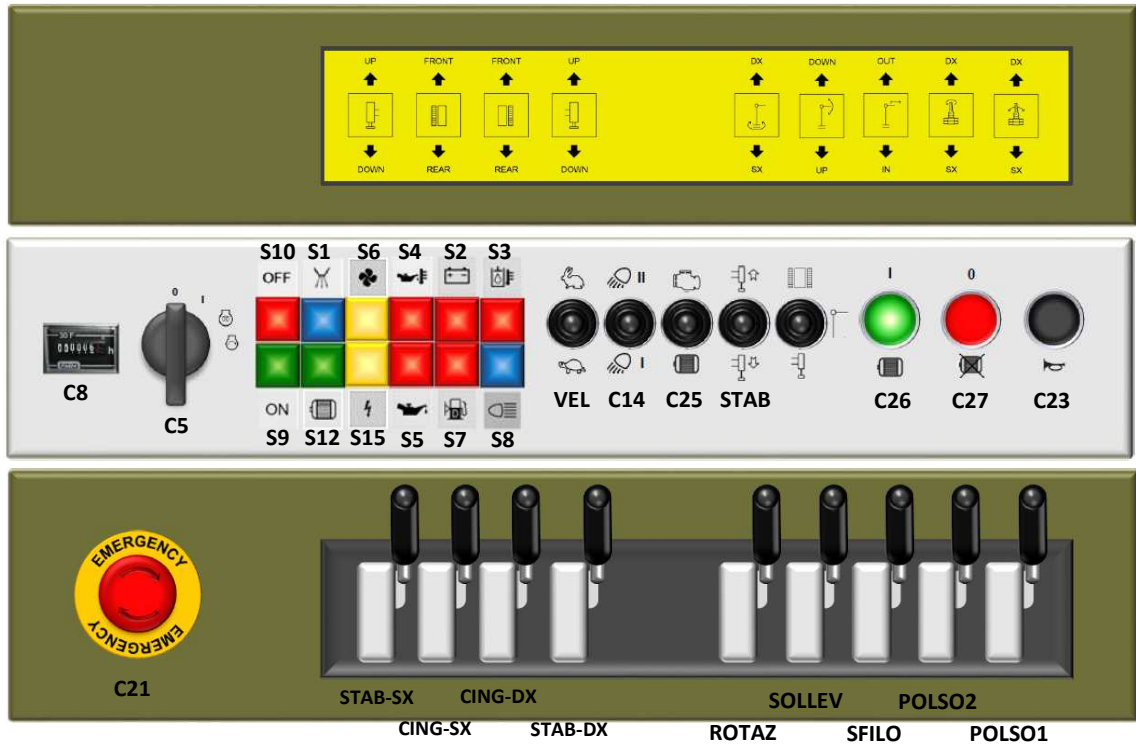


















Fig. 6.2-2 - Control panel (complete with levers supplied delivered separately)

CONTROL PANEL					
CONTROL DEVICES			WARNING DEVICES		
Symbol	Code	Description	Symbol	Code	Description
	ACC	Distributor that allows to rev up and down the endothermic engine Not shown in the figure			
	C8	Analogue counter: indicates the number of work hours of the machine			
	C5	Key selector for starting the machine. 0: machine off, stable position from which the key can be removed. I: machine on, stable position. II: plug heating, to be used only with endothermic engine. III: ignition pulse, to be used only with thermal engine, unstable position with return to position I.			



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CONTROL PANEL					
CONTROL DEVICES			WARNING DEVICES		
Symbol	Code	Description	Symbol	Code	Description
				S10	Circuit disengaged warning RED indicator light
				S9	Circuit engaged warning GREEN indicator light (system control enabled)
				S1	Spraying boom control enabled warning BLUE indicator light
				S12	Electric motor started warning GREEN indicator light
				S6	Hydraulic circuit fan active warning YELLOW indicator light
				S15	Electric control board socket powered warning YELLOW indicator light
				S4	Engine high temperature warning RED indicator light
				S5	Engine oil pressure low warning RED indicator light
				S2	Battery low warning RED indicator light
				S7	Fuel low warning RED indicator light
				S3	Hydraulic oil high temperature warning RED indicator light
				S8	Headlights on warning BLUE indicator light
 	VEL	Undercarriage speed selection 2-position selector: <ul style="list-style-type: none"> Upward: fast Downward: slow The speed can also be changed while moving.			
 	C14	Headlight ignition three-position selector: <ul style="list-style-type: none"> Upward (II): of the undercarriage (no.4) At the centre: headlights off Downward (I): all (no.6) 			

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CONTROL PANEL					
CONTROL DEVICES			WARNING DEVICES		
Symbol	Code	Description	Symbol	Code	Description
	C25	Engine to be used selection 2-position selector: <ul style="list-style-type: none"> Upward: endothermic engine Downward: electric motor 			
	STAB	Outriggers to be moved selection two-positions selector: <ul style="list-style-type: none"> Upward: front outriggers movement enabling Downward: rear outriggers movement enabling <i>PLEASE NOTE: The rear outriggers are optional and therefore this selector may not be present</i>			
	C22	Machine part to be moved selection three-position selector: <ul style="list-style-type: none"> Upward: undercarriage movement enabling At the centre: spraying boom movement enabling Downward, hold-to-run: outriggers movement enabling 			
	C26	Electric motor ignition control GREEN button			
	C27	Electric motor shutdown control RED button			
	C23	Horn activation hold-to-run control BLACK button			
	C21	Emergency stop button on control panel			
	STAB-SX	Left outrigger lifting or lowering control hydraulic distributor			
	CING-SX	Left crawler forward or backward start control hydraulic distributor			
	CING-DX	Right crawler forward or backward start control hydraulic distributor			
	STAB-DX	Right outrigger lifting or lowering control hydraulic distributor			



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CONTROL PANEL					
CONTROL DEVICES			WARNING DEVICES		
Symbol	Code	Description	Symbol	Code	Description
	ROTAZ	Spraying boom rightward or leftward oscillation control hydraulic distributor <i>PLEASE NOTE: This lever is delivered disconnected, supplied inside the tool compartment.</i>			
	SOLLEV	Spraying boom lifting or lowering control hydraulic distributor <i>PLEASE NOTE: This lever is delivered disconnected, supplied inside the tool compartment.</i>			
	SFILO	Spraying boom extension or retraction control hydraulic distributor <i>PLEASE NOTE: This lever is delivered disconnected, supplied inside the tool compartment.</i>			
	POLSO2	Nozzle wrist 360° rightward or leftward rotation control hydraulic distributor <i>PLEASE NOTE: This lever is delivered disconnected, supplied inside the tool compartment.</i>			
	POLSO1	Nozzle wrist 240° rightward or leftward handling control hydraulic distributor <i>PLEASE NOTE: This lever is delivered disconnected, supplied inside the tool compartment.</i>			
				SR	Horn with undercarriage backward movement
				C24	Horn

Tab. 6.2-2



6.2.3 Remote control pushbutton panel

The following figure (Fig. 6.2-3) highlights the control, warning and EMERGENCY devices installed on the remote control pushbutton panel.

It can operate both wirelessly and with a cable. To enable and disable the remote control pushbutton, see par. 7.4.2.1 and 7.4.2.2.

When not being used, the remote control pushbutton panel must be stored in the machine's tool compartment.



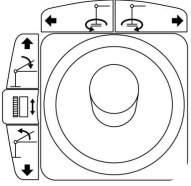
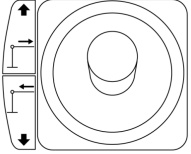
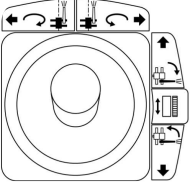
Fig. 6.2-3 - Remote control pushbutton panel

REMOTE CONTROL PUSHBUTTON PANEL					
CONTROL DEVICES			WARNING DEVICES		
Symbol	Code	Description	Symbol	Code	Description
	S3	Part to be moved selection two-positions selector: <ul style="list-style-type: none"> Upward: undercarriage Downward: spraying boom 			
	S1	Emergency stop button			
	S6	Forward speed selection 2-position selector: <ul style="list-style-type: none"> Upward: fast Downward: slow 			
	S7	360° spraying nozzle wrist rotation two-positions selector: <ul style="list-style-type: none"> Upward: nozzle wrist rotation enabling Downward: nozzle wrist rotation disabled 			
	S8	Unstable selector which, if pushed upward, activates the horn			
	S9	Remote control pushbutton panel enabling (upward) or disabling (downward) two-positions selector			



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REMOTE CONTROL PUSHBUTTON PANEL					
CONTROL DEVICES			WARNING DEVICES		
Symbol	Code	Description	Symbol	Code	Description
	JOYSX	<p>Four control positions joystick:</p> <ul style="list-style-type: none"> • Upward: boom lowering or undercarriage forward (depending on the part enabled) • Downward: boom lifting or undercarriage backward (depending on the part enabled) • Leftward: boom anticlockwise rotation (if the part is enabled) • Rightward: boom clockwise rotation (if the part is enabled) 			
	JOY2	<p>Control two-positions joystick (if enabled):</p> <ul style="list-style-type: none"> • Upward: boom extension • Downward: boom backward 			
	JOYDX	<p>Four control positions joystick:</p> <ul style="list-style-type: none"> • Upward: nozzle lowering or undercarriage forward (depending on the part enabled) • Downward: nozzle lifting or undercarriage backward (depending on the part enabled) • Leftward: nozzle clockwise rotation (if the part is enabled) • Rightward: nozzle anticlockwise rotation (if the part is enabled) 			

Tab. 6.2-3

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6.2.4 Other warning devices

The other warning devices present on the machine are highlighted below.



Fig. 6.2-4 - Levelling indicator



Fig. 6.2-5 - Indicator light

OTHER WARNING DEVICES					
CONTROL DEVICES			WARNING DEVICES		
<i>Symbol</i>	<i>Code</i>	<i>Description</i>	<i>Symbol</i>	<i>Code</i>	<i>Description</i>
				-	Machine levelling spirit level during the stabilisation stage
				-	Machine moving warning YELLOW indicator light Present on both the right and left side of the machine

Tab. 6.2-4



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6.3 Safety devices

The machine is equipped with some safety devices shown in the following paragraphs.



PROHIBITION! *Tampering with, excluding and/or removing any of the safety devices on the machine is strictly prohibited.*

Replacing any safety device or one of its components with a non-identical/original one is strictly prohibited.



OBLIGATION! *It is compulsory to constantly make sure that all safety devices installed on the machine operate properly.*

It is compulsory to immediately replace any malfunctioning and/or damaged safety devices. The machine can be used again only and exclusively when all the safety devices are efficient.

6.3.1 Emergency buttons

These devices (Fig. 6.3-1) are designed, when activated, to stop the machine in an emergency condition. Their protruding (mushroom-shaped) shape allows easy operation with the palm of the hand.

They are always red and have a yellow highlighting ring at the base. Once these buttons have been pressed, they require a manual release which can be performed by turning the button clockwise or pulling it towards you. Some emergency buttons highlight the stop status in progress through a red lamp inserted on the pushbutton itself.

In some cases, when the manoeuvre to reset the machine from the emergency condition may present specific dangers, the emergency button can be equipped with an unlocking key for reset.

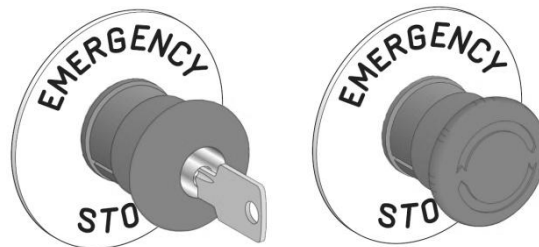


Fig. 6.3-1 - Example of emergency buttons with and without unlocking key



ATTENTION! *The action of an emergency stop device cannot eliminate the burning hazard due to the presence of hot surfaces.*

If it is required to operate on the hot parts, wait until their surface temperature reaches room temperature and always use heat-resistant gloves to protect against this hazard.



6.3.2 Guards

The guards are parts of a machine used specifically to provide protection through a physical barrier. Depending on their construction, guards can be called sleeve, cover, screen, door, full segregation guard, etc.

The types of guard used on the machine are described below:

- **Fixed guard** - guard kept in position (i.e. closed) permanently (by welding, etc.) or by means of fixing elements (screws, nuts, etc.) which make it impossible to remove/open without the use of tools (Fig. 6.3-2);
- **Mobile guard** - guard generally mechanically connected (for example by means of hinges or guides) to the frame of the machine or to a nearby fixed element which can be opened without the use of tools.

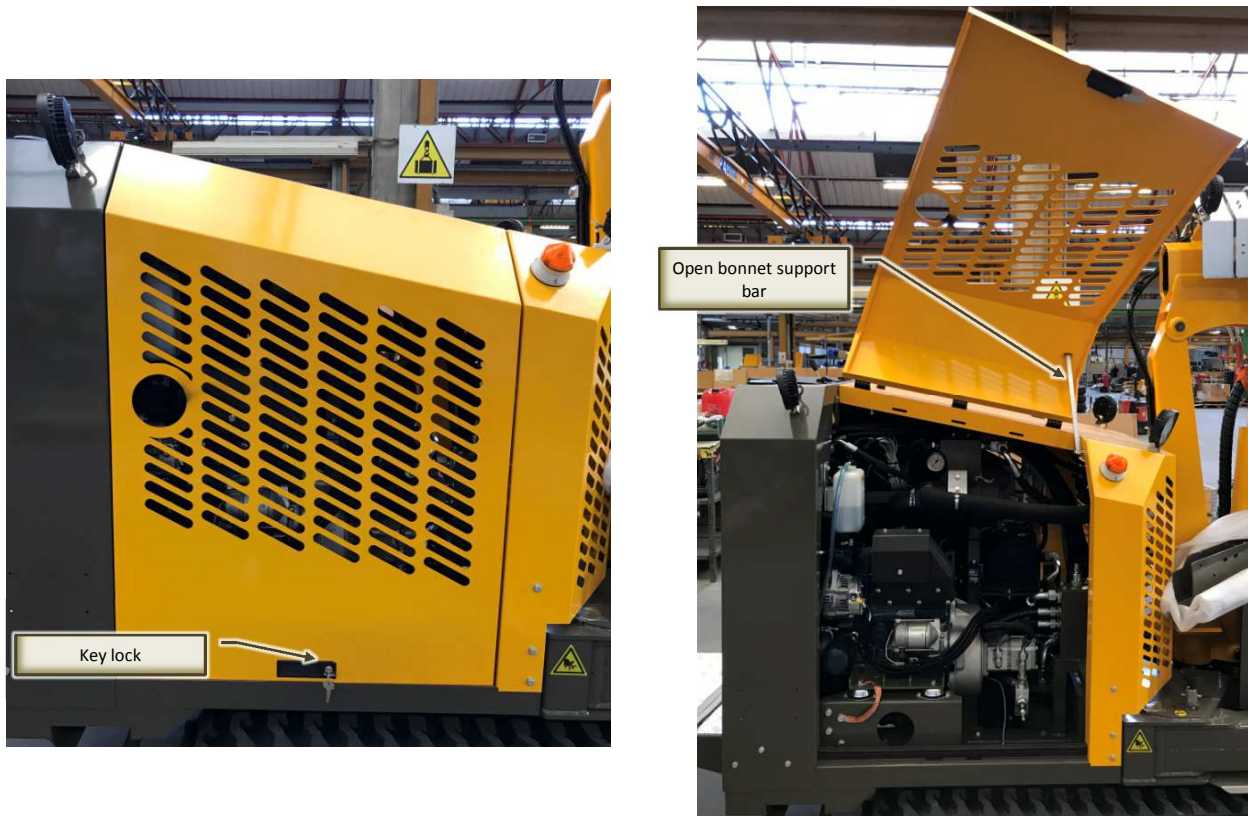


Fig. 6.3-2 - Motor compartment bonnet with key lock in closed (left) and open (right) position – right side view

6.3.3 Automatic protection switches and inverters, magneto-thermic switches, thermal relays and protection fuses

These devices trigger autonomously in the event of excessive current absorption (short circuit and/or overload) on the connected devices. They operate by disconnecting the circuit upstream of the device subject to anomaly.

The table below (Tab. 6.3-1) lists the codes of the automatic protection switches and the relative device protected.

Also refer to the wiring diagrams of the machine attached.



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<i>Code</i>	<i>Description</i>
C33	Electric motor protection magneto-thermic switch
FU1	Phase control fuses
C37	Transformer protection magneto-thermic switch
F13/14	Glow-plug pre-heat fuses
F16	Diesel pump fuse
F9	Endothermic engine indicator fuse
F1	Electric fan fuse
F2	Backward crawler movement fuse
F3	Services common to the two power supplies fuse
F4	Work headlight fuse
F5	Horn fuse

Tab. 6.3-1

6.3.4 Negative brake on the reduction gear

The undercarriage mounts a reduction gear with negative brake and hydraulic motor. To release the brake, pressure must be given to the circuit.

6.3.5 Outriggers

The machine outriggers ensure it is properly positioned during the spraying phases.

6.3.6 Maximum pressure valves

Valves limiting the pressure in the circuit to a maximum value.

They are mounted:

- On the proportional solenoid valve side to limit the maximum pressure of the boom movements.
- On the left side proportional solenoid valve to limit the maximum pressure of the undercarriage movements.
- Next to the pumps installed on the diesel engine, one for maximum line pressure, the other for double speed.

Also refer to the hydraulic diagrams of the machine attached.

6.3.7 Locking valves

These valves are used to lock a cylinder or an actuator, preventing flow in the opposite direction until pilot pressure is applied. Unidirectional check valves are normal when the pilot line is without pressure.

They are mounted:

- On the outriggers to lock them in case the hydraulic pipes break;
- On the boom to stop it from falling in case the hydraulic pipes break.

Also refer to the hydraulic diagrams of the machine attached.

6.3.8 Visual and/or audible indicators

The following are mounted on the machine:

- A visual indicator (flashing) that activates when the machine is operating;
- An audible indicator that activates when the machine is moving in reverse.



6.4 Getting started

6.4.1 Hydraulic control unit check

The Spritzbeton mobile spraying machine is equipped with a hydraulic oil tank supplying its hydraulic system, to drive the undercarriage, the boom and the outriggers.

Before starting the machine it is required to check the hydraulic oil level in the tank. The oil level can be checked by means of the specific indicator on the control unit tank (it is therefore required to open the engine bonnet). The oil level should indicatively be halfway up the indicator (with machine off and cold).

If the oil level is less than half the tank capacity, top up with identical oil. The oil must always be topped up after the machine has stopped and the oil has cooled down.

To top up, simply loosen and remove the screw cap at the top of the tank. It is advisable to use a funnel to facilitate insertion of the oil and to avoid potential dispersions.

During filling, check the level indicator to avoid oil overflow.

After completing the top up, tighten the closing cap firmly.

For additional information, see paragraph 8.12.



Fig. 6.4-1 - Hydraulic oil tank level visual indicator

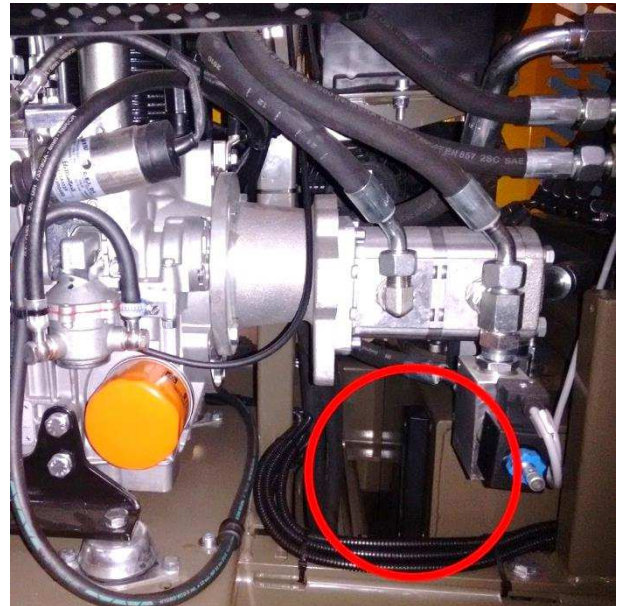


Fig. 6.4-2 - Tank position inside the engine compartment

N.B.: The engine compartment bonnets are closed by means of locks. Therefore, a specific key is required to open them. Once the preliminary operations have been carried out, always lock the bonnets and place the keys in a safe place so that they cannot be used by strangers and/or unauthorised employees.



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6.4.2 Check of the fuel for the endothermic engine

The Spritzbeton mobile spraying machine is equipped with a fuel tank (diesel) to supply the endothermic engine.

The fuel tank is located inside the engine compartment, and it is therefore required to open the bonnet to access it.

Before using the machine, make sure that the fuel level is sufficient for its operation with endothermic engine.

If the fuel level is too low, the red indicator light  (S7) lights up.

Refuelling must always be carried out while the machine is at a standstill (with the engine off) and away from heat sources.

To refuel, simply loosen and remove the screw cap on the tank.

Check that the fuel is suitable for the type of engine installed (according to the sticker on the tank or on the fuel filler cap of the tank).

Be careful that fuel does not leak while refuelling, paying special attention not to spill any fuel on the ground or on the engine.

It is advisable to use a funnel to facilitate refuelling and to avoid potential dispersions.

After completing refuelling, tighten the closing cap firmly.



Fig. 6.4-3 - Fuel tank



ATTENTION! Do not breath in fuel fumes while refuelling, wearing appropriate personal protective equipment.

N.B.: The engine compartment bonnets are closed by means of locks. Therefore, a specific key is required to open them. Once the preliminary operations have been carried out, always lock the bonnets and place the keys in a safe place so that they cannot be used by strangers and/or unauthorised employees.



7 Operator instructions

7.1 Safety instructions



ATTENTION! Failure to comply with the following safety instructions may result in injury, death or damage to the machine.



OBLIGATION! Use the machine with endothermic engine only in an open environment.

In a tunnel, use the machine only with electric motor.



OBLIGATION! A fire extinguisher must always be available on the machine and the operator in charge of driving must know how to use it.

The machine must be put into operation by “qualified personnel” based on the relative indications provided in this manual.

The machine must be used keeping it at a minimum safe distance from live parts of electrical lines and electrical systems, unprotected or not sufficiently protected, as indicated in the following table.

Rated voltage U_n [kV]	Minimum allowed distance [m]
≤ 1	3
$1 < U_n \leq 30$	3.5
$30 < U_n \leq 132$	5
132	7

Tab. 7.1-1

Some checking operations to be performed before and after machine commissioning are provided below.



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7.1.1 Checks to be performed before starting the machine.

- *Check that the operator's clothing is suitable. The operator must not wear loose clothing, wrist watches, rings, necklaces or similar objects. Long hair must be collected;*
- *Check that no unauthorised persons are present in the machine's operating area;*
- *Check that there are no foreign bodies (tools, rags, etc.) inside the machine;*
- *Check that the mobile guards are properly closed;*
- *Check the integrity of the safety devices and the operation of the emergency stop buttons;*
- *Check and, if required, do not start the machine if faulty instruments or indicators are detected on the control board;*
- *Check for damage and defects that can be externally identified on the machine. Immediately report any irregularities (also related to operation) to the competent person;*
- *Check, if the use of personal protection devices is required, that they comply with the requirements of the laws in force on the subject (Legislative Decree 9 April 2008 no.81);*
- *Check the integrity of the pipes connected to the machine (concrete pipes, air pipes and additive pipes). Replace in case of doubt.*

7.1.2 Checks to be performed and behaviour to be kept after starting the machine

- *Immediately stop the machine if it emits unusual noises after it has been started. Restart the machine only after having removed the cause of the noise;*
- *Immediately stop the machine if the indicator lights on the control panel emit abnormal signals. Restart the machine only after having identified and removed the anomaly;*
- *If changes are detected on the machine that compromise its safety or operational behaviour, stop the machine immediately and notify the fault to the manager;*
- *Only stop in the operator's specific area;*
- *When the machine is used with an endothermic engine, do not stand near the silencer;*
- *Keep a safe distance from moving parts;*
- *Never leave the machine unattended while it is running;*
- *Do not allow people to approach the machine during operation;*
- *Supervise the correct operating cycle of the machine, immediately stopping it in case of abnormal operation;*
- *Constantly ensure the absence of leaks from the hydraulic circuits. In case of a leak, stop the machine immediately and have it inspected by authorised and qualified personnel;*
- *Do not deactivate the protection and safety devices;*
- *Do not handle tools, equipment, etc., near the machine while it is moving;*
- *In case of low light, always turn on the machine headlights.*



7.1.3 Operations not permitted



PROHIBITION! It is forbidden to use the machine with strong wind conditions (over 20 km/h, or in any case such as to cause instability to the machine).

Should strong winds arise during spraying, stop the connected machines supplying the product to be sprayed, position the boom in transport position and wait for favourable environmental conditions.



PROHIBITION! It is forbidden to operate on electrical equipment with a live electric control board.



PROHIBITION! It is forbidden to carry out maintenance and/or lubrication adjustment operations while the machine is moving.



PROHIBITION! It is forbidden to carry out checks on the product being processed before the machine has stopped completely.



PROHIBITION! It is forbidden to remove protective screens or guards.

7.1.4 Non-obvious hazards

ATTENTION! Both the qualified operator and the technical staff of the company Turbosol Produzione S.r.l. working on a machine must take into account other less obvious hazards, which are often underestimated at the production sites:

- *Protruding parts of the machine;*
- *Parts of the machine which for functional requirements may have cutting and/or sharp edges;*
- *Electrostatic charges present even after switching off;*
- *Hot machine parts (engines, reduction gears, etc.);*
- *Pneumatically operated machine parts that can be pressurised.*



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7.2 Ignition set-up

7.2.1 Ignition set-up with operation by means of electric motor

- Before starting the machine, make sure that the electrical system of the construction site where it will be used is activated.
- Disconnect the battery of the internal endothermic engine by turning the battery cut-off switch clockwise;
- Remove the protective cap from the power supply socket and connect the power cable plug.



ATTENTION! Always disconnect the batteries of the endothermic engine when you wish to use the machine with an electric motor.

The power cable must be long enough to allow the machine to be moved to the place of use.



7.2.2 Ignition set-up with operation by means of endothermic engine

- Connect the battery of the internal endothermic engine by turning the battery cut-off switch anticlockwise;
- Make sure that the protective cap is inserted in the power supply socket;
- Make sure the silencer is not damaged before.

7.3 Power-up and start-up

7.3.1 Machine operation with electric motor

To power-up and start the Spritzbeton mobile spraying machine with electric motor, proceed as follows:

- Check that the red “EMERGENCY” (C21) button is not pressed. Otherwise reset it;
- Place the engine selection selector C25 downward  ;
- Power the electric control board, by rotating the master switch (C30) to “ON”. Power-up is signalled by the white indicator light “VOLTAGE PRESENCE” (S11) turning on;
- Rotate the “PHASE INVERTER” (C31) selector to position “1”. Should the yellow “PHASE ERROR” (S14) indicator light turn on, rotate the selector “PHASE INVERTER” (C31) to position “2”. If the “PHASE ERROR” (S14) white indicator light also does not turn off in this case, check the power cable;
- Insert the ignition key (C5) and turn it to position “1”;
- Should you wish to use the machine with remote control, proceed with its activation (see par. 7.4.2.1);
- Press the green button  (C26) to start the electric motor.



ATTENTION! Always check that the motor rotates the right way. Otherwise turn it off immediately to avoid damaging the hydraulic system.




OBLIGATION! Make sure that the electric motor is not subject to loads beyond its capacity during the work phases.



7.3.2 Machine operation with endothermic engine

To power-up and start the Spritzbeton mobile spraying machine with endothermic engine, proceed as follows:

- Check that the red “EMERGENCY” (C21) button is not pressed. Otherwise reset it;
- Place the engine selection selector (C25) upward ;
- Insert the ignition key (C5) and turn it to position “I”;
- Should you wish to use the machine with remote control, proceed with its activation (see par. 7.4.2.1);
- Turn the ignition key (C5) to position “II”: wait for the plugs to heat up;
- Once the plug indicator turns off, turn the ignition key (C5) to position “III”, then release it.

If the endothermic engine does not switch on, check that there is no plug on the power socket of the electric control board, other than the socket-closing cap.



ATTENTION! Start and use the endothermic engine only in well ventilated rooms. The accumulation of the engine's exhaust gas may reveal itself to be extremely dangerous.

7.4 Using the machine



ATTENTION! When spraying concrete, any operator must be away from the danger zone of the spraying nozzle (red area in Fig. 7.4-2).



OBLIGATION! The Spritzbeton mobile spraying machine must always be kept at a suitable distance from other machines in the place of use. Pay particular attention to the overlap of machine operating areas.

7.4.1 On-board machine operation (with control board)

The machine is equipped with driving footboard appropriately designed and manufactured to avoid the risk of slipping, tripping and falling in normal use conditions.

Lower and climb onto the footboard to handle the machine, making sure that it is firmly positioned.

During movement of the machine, make sure that the footboard is stable on the platform and hold onto it with both hands on the peripheral roll-bar to the traversing controls: this way it is possible to operate the traversing commands by using a finger.

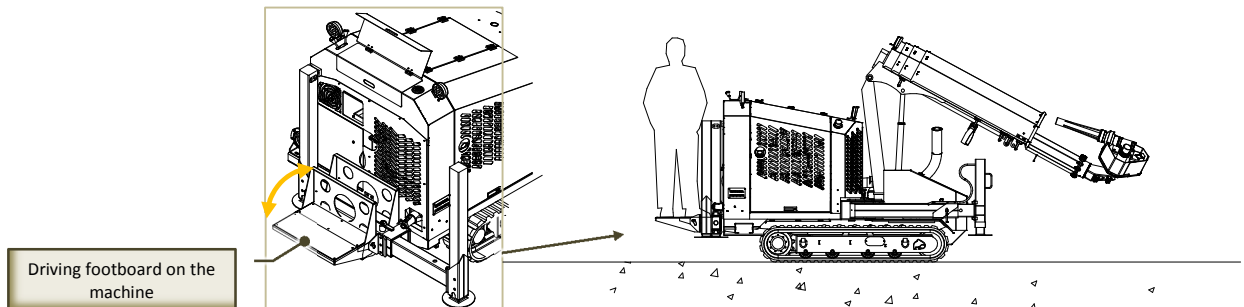


Fig. 7.4-1 - Driving footboard on the machines



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7.4.2 Driving the machine from the ground (with remote control)

The machine is equipped with a remote control with which it is possible to control the movement of parts of the machine, standing on the ground, in order to more closely see the point where the machine must be positioned for spraying.

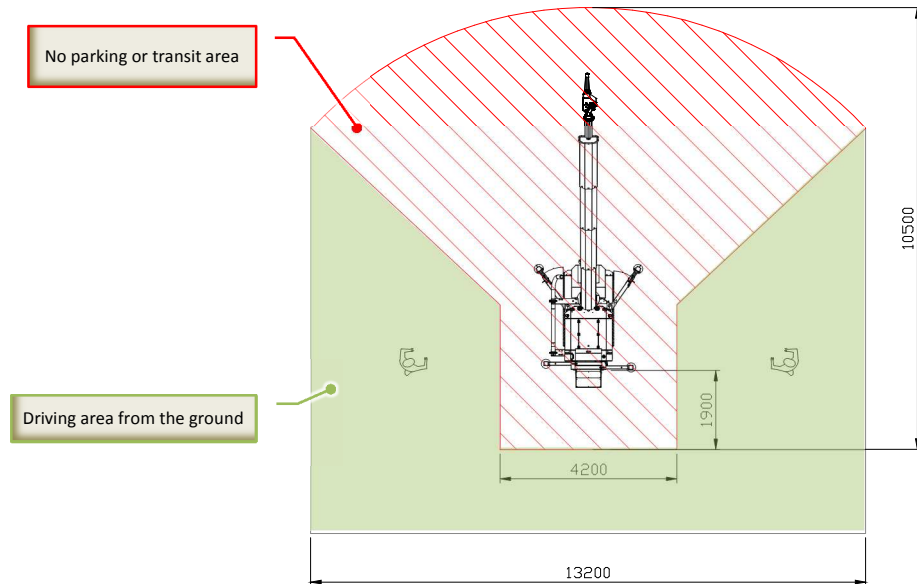


Fig. 7.4-2 - Driving station from the ground with remote control (plan view)



ATTENTION!:

- **When using the remote control for the first time or if it is used rarely, before starting to use it, familiarise yourself with its functions.**
- **Always position yourself so that you can observe all movements of the machine and the surrounding space, always standing in the ground driving area and without ever entering the danger zone of the machine (Fig. 7.4-2).**
- **When not used, the remote control must always be off. It is forbidden to leave the remote control active and/or unguarded, especially when the work position is changed, work is being performed that does not require its use, during work pauses and at work's end.**
- **When not being used, always secure the remote control against unauthorised use, for example keep it locked under key.**
- **In the event of an emergency and in the presence of an anomaly, immediately stop the machine by pressing the "STOP" (S1) pushbutton.**



7.4.2.1 Remote control activation

When you wish to drive the machine with the remote control, proceed as follows to activate it.

- Remove the cap from the “IM2” plug on the upper side of the electric control board, and insert the ILME connection socket of the remote control via radio (Fig. 7.4-3).



Fig. 7.4-3 - ILME socket inserted into the “IM2” plug of the electric control board for machine operation *with* radio control

- If using the wired remote control instead of via radio is not required, connect the remote control pushbutton panel (Fig. 7.4-4) to the remote control (Fig. 7.4-5) by means of the supplied coaxial cable (Fig. 7.4-6). The connection plugs of the two parts are all different so as to make a mistaken connection impossible.



Fig. 7.4-4 - Connection plug via cable (closed with cap) of the remote control pushbutton panel



Fig. 7.4-5 - Remote control with connection plug in the lower part



Fig. 7.4-6 - Remote control pushbutton panel and remote control connection cable

- If pressed, release the “STOP” pushbutton (S1), by rotating it in the direction of the engraved arrows.
- Activate the remote control, by moving the “I/O” selector (S9) upward towards “I”. Should the “I/O” (S9) selector already be in position “I”, lower it to “O” and then bring it back to “I”.

Activation of the remote control is signalled by the green indicator light on the transmitter and the blue indicator light on the receiver turning on.

N.B.: When switched on and active, the remote control has priority over the controls for moving the machine and moving the boom with respect to those on the machine.

From the remote control it is possible to enable the boom movements, by automatically disabling movement, or vice versa.



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7.4.2.2 Remote control deactivation

To deactivate the remote control, proceed as follows:

- Deactivate the remote control, by moving the “I/O” selector (S9) downward towards “O”.
- If the remote control was used with the cable, disconnect the connection cable (Fig. 7.4-6) from the remote control pushbutton panel plug (Fig. 7.4-4) and the remote control one (Fig. 7.4-5), taking care to insert the cap on all sockets/plugs.
- Disconnect the ILME socket and insert the cap supplied on the “IM2” plug on the upper side of the electric control board (Fig. 7.4-7).



Fig. 7.4-7 - Cap in the “IM2” plug of the electric control board for machine operation *without* radio control

N.B.: *If the remote radio control switches off automatically, for example in the event of loss of the RF signal (passive emergency), the machine stops and the engine is switched off. To resume machine operation, it is required to start it up again (see par. 7.3).*

If there is no RF signal, or the battery is low, use the remote control with the supplied cable.

7.4.3 Using the machine

- Bring the machine to the work position (see par. 7.5 “Moving the machine”)and make sure the ground is firm.
- Place barriers and warning signs around the work area of the machine to signal no entry to unauthorised personnel. Only the operator in charge of driving the machine can stand inside the work area.
- Position the machine so that it is perfectly stable (see par. 7.6 “Machine stabilisation”).
- Connect the supply lines of the product to be sprayed to the machine (see par. 7.7 “Connection to the equipment for feeding the product to be sprayed”).
- Move the boom during spraying (see par. 7.8 “Spraying boom movement”) by staying on the machine or by means of the remote control.



OBLIGATION!: *Always comply with the provisions of construction rules regarding interference between work tools. Especially when working in a tunnel, but also outdoors (assessing from case to case), position the machine safely to performs spraying, taking care to ensure to always provide vital space for the ground operator (in the allowed positions), and an adequate rear escape route to be used as a way out in case of danger.*

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OBLIGATION!: Always make sure you have good visibility in any situation so as to ensure the safety of personnel near the machine. In case of inadequate visibility, seek the aid of another person to direct movements (outside of the machine's operating area); this person must always be in sight.



ATTENTION!: The boom must be moved only and exclusively when the machine is in the position of use and stabilised.



OBLIGATION!: In case of low lighting in the work environment, always switch on the lighting headlights of the machine.



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7.5 Moving the machine

The machine can be moved with driver on board (see par. 7.5.2) or by means of remote control (see par. 7.5.3). In the first case to bring the machine near the place of use (and move it away), while in the second case for micro movements when the machine is already in the place where the spraying is to be carried out.

In any case, the movement speed selection must necessarily take place when the vehicle is stationary. Before tackling steep slopes (up or down), always select the lowest gear with the vehicle stopped.



OBLIGATION!: Before moving the machine, always check that:

- The spray boom is in transport position (see par. 7.5.1);
- The outriggers are fully lifted and retracted;
- The pipes for feeding the product to be sprayed are disconnected;
- The remote control is disconnected/deactivated and stored in the machine's storage compartment (if not performing a micro-movement, see par. 7.5.3);
- The movement speed most suitable for the type of ground and the slope of the route to be travelled has been selected.



ATTENTION!:

- Make sure before starting the machine that there are no people in its operating range.
- The movement speed must be adequate to the type of ground, the type of route and the type of work place; it must also not create dangers to the safety of the operator or of any people close to the machine.
- Before any movement, check that no one is in the surrounding area and that there are no obstacles.
- Pay the utmost attention to the risk of crushing in the external rotation part of the crawler.
- Pay the utmost attention to the risk of crushing between the internal part of the crawler and the rotating parts.
- Pay the utmost attention to the risk of crushing in between the crawler and the ground.
- When moving the machine in reverse, pay the utmost attention not to hit people or things.
- When moving the machine, follow the safety instructions provided in paragraphs 7.5.4 and 7.5.5.



PROHIBITION!: It is strictly forbidden to move the machine, even by a small amount, with the boom not "collected" in transport position and/or with outriggers not fully lifted and closed (retracted and returned).

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7.5.1 Machine transport configuration

The machine transport configuration, called transport position (Fig. 7.5-1), is with:

- Boom fully lowered and aligned with the machine;
- Nozzle facing upward;
- Supply pipes of the product to be sprayed disconnected (concrete pipe, air pipe, additive pipe);
- Boom hydraulic tubes appropriately collected so that they do not touch the ground, do not interfere with the gear and are not in the way.

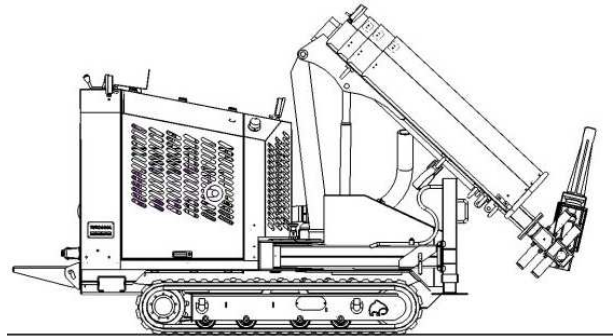


Fig. 7.5-1 - Machine transport position



Fig. 7.5-2 - Examples of hydraulic pipes of the boom collected for movement







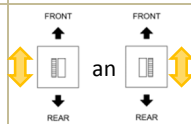
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7.5.2 Machine movement control

The machine is moved with the driver on board, standing on the driving footboard and firmly holding the roll-bar.





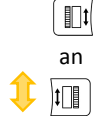
To move the machine, proceed as follows:

1)		<u>With machine stopped</u> , select the running speed by means of the speed selector (VEL): <ul style="list-style-type: none"> upward on  for <i>fast</i> speed; downward on  for <i>slow</i> speed.
2)		Move the selector C22 upward, in order to enable undercarriage movement.
3)		Use the left and right crawler distributing levers (CING-DX and CING-SX) to advance, reverse, steer, moving them as required forward or backward.

7.5.3 Machine micro-movement control

The micro-movement of the machine takes place with the driver on the ground, at a suitable safety distance from the crawlers, holding the remote control, previously connected and activated (see par. 7.4.2) with both hands.

For machine micro-movement, proceed as follows:

1)		<u>With machine stopped</u> , select the running speed by means of the speed selector (S6): <ul style="list-style-type: none"> upward on  for <i>fast</i> speed; downward on  for <i>slow</i> speed.
2)		Move the selector S3 upward, in order to enable undercarriage movement.
3)		Use the left and right joystick of the remote control to drive the right and left crawlers of the undercarriage (CING-DX and JOYSX) to advance, reverse, steer, moving them as required upward (forward) or downward (back).



7.5.4 Slopes and slope variations permitted

The machine can move facing only the slopes allowed and indicated in Fig. 7.5-3 and Fig. 7.5-4, and always checking that, when facing slopes, the boom does not touch the ground, with the risk of destabilising the machine.

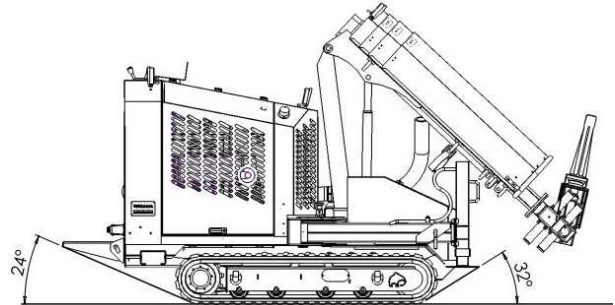


Fig. 7.5-3 - Slopes permitted for machine movement

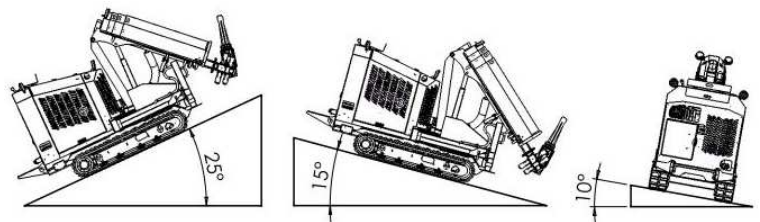


Fig. 7.5-4 - Slopes permitted for machine movement



ATTENTION!: Pay attention to slope variations as they can occur abruptly.

7.5.5 Machine movement operations safety requirements

- It is prohibited to pass over obstacles which exceed the centreline of the crawler (Fig. 7.5-5).
- It is prohibited to pass over obstacles by partially using the surface of the crawler.

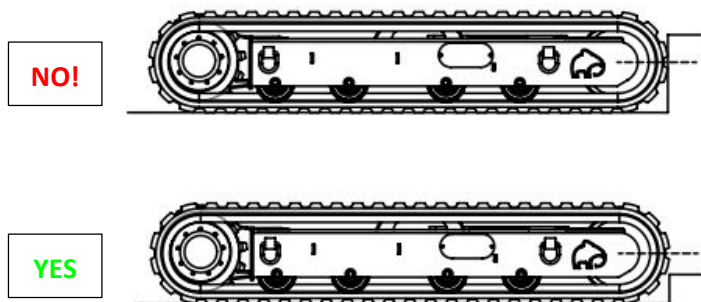


Fig. 7.5-5 - Examples of obstacle crossing: height of the obstacles that the crawlers can overcome

- It is prohibited to use crawlers with cuts (even small) on the rubber surface. The presence of cuts can cause the infiltration of water which could rust the internal structural ropes, causing them to break quickly.
- While moving, do not change directions on kerbs, rocks or uneven ground (more than 20 cm or 8"). In this case, always proceed perpendicular to the obstacles (Fig. 7.5-6).

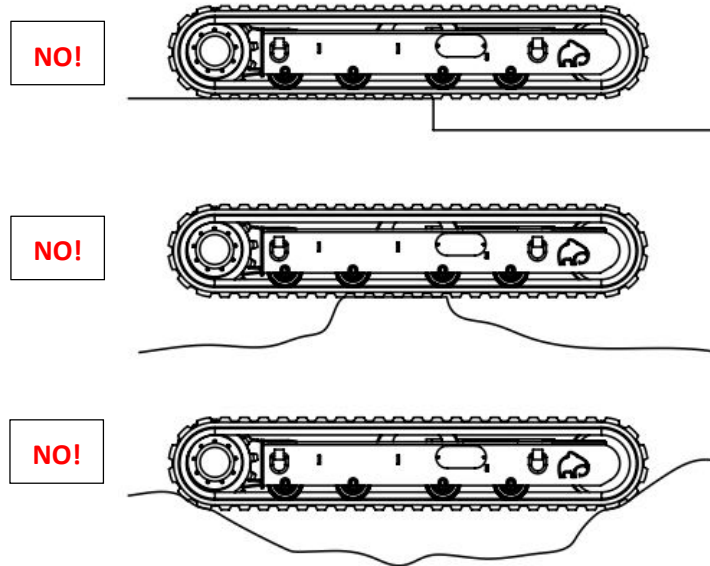


Fig. 7.5-6 - Example of an error in moving the machine: no change of direction on large differences in height

- While climbing, do not turn the steering wheel while passing from flat ground to the slope (Fig. 7.5-7). If this is absolutely necessary, perform the manoeuvre gradually.

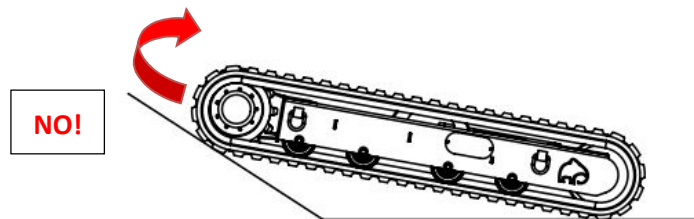


Fig. 7.5-7 - Example of an error when moving the machine: steering is forbidden when moving from flat to sloping ground

- Do not drive along the edge of a slope or on uneven ground with one crawler flat and the other inclined or partially lifted up (with the machine inclined beyond 10° approximately, Fig. 7.5-8). Always proceed with the slide blocks on the same horizontal plane to avoid damaging the crawlers.

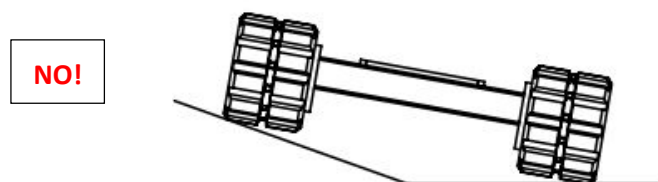


Fig. 7.5-8 - Example of an error in moving the machine: avoid holding one crawler on flat ground and the other on sloped ground



- When changing direction in a condition where the crawler cannot move sideways, due to an obstacle it is passing over, the crawler could be damaged and escape its seat (Fig. 7.5-9).

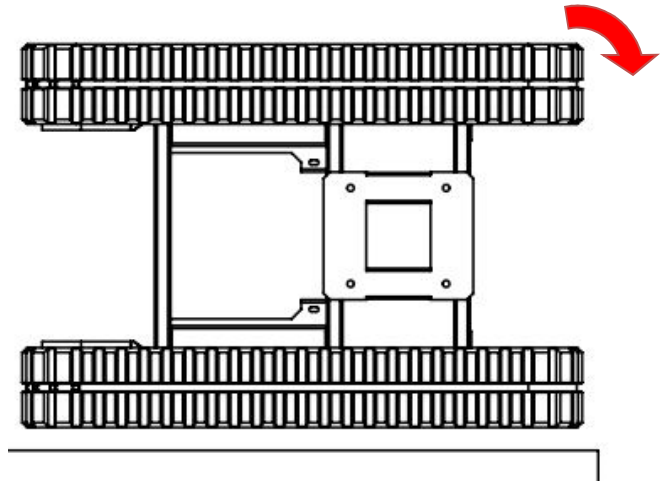


Fig. 7.5-9 - Example of a change of direction that may result in the crawler coming out from its seat when it cannot move sideways

- If the machine proceeds as shown in Fig. 7.5-10 (running on an obstacle), a void is created between the bearing roller, the front crawler tensioning wheel and the crawler with the risk that it escapes its seat.

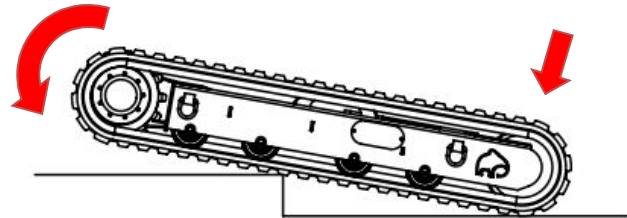


Fig. 7.5-10 - Example of running on an obstacle that may lead to the crawler coming out from its seat

- If steering as in the conditions of Fig. 7.5-11, the crawler comes out of its seat.

NO!

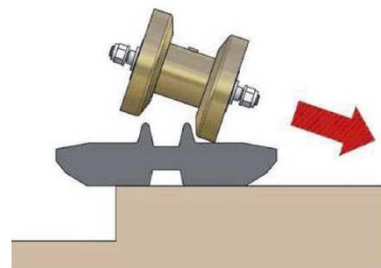


Fig. 7.5-11 - Example of an error in moving the machine (steering) which involves the crawler coming out from its seat



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7.6 Machine stabilisation

Once brought to the place of use, the machine must always be stabilised with its outriggers (see par. 7.6.3). The machine must be stabilised according to ground conditions. Always use distribution plates of adequate size: increase the support surface by means of appropriate support plates if the ground is not firm enough. Always centre the outrigger load at the centre of its plate (and of the additional support plates, if any).

If you have doubts regarding the capacity of the ground, you should examine the soil (penetrometer test).

The outriggers must be activated at low speed.

N.B.: Machine stabilisation does not consist in raising, even if slightly, the crawlers from the ground.



ATTENTION!

- *The machine must be positioned on a levelled surface (max inclination 5°) and on firm ground.*
- *Always remain a safety distance away from the boundaries of the worksite or from uneven ground.*
- *The outriggers must be positioned on solid ground, increasing the support base accordingly if required.*
- *Verify stability depending on the current operating conditions. If the outriggers rest on soft ground, increase the support surface of the outrigger plates or apply plates to increase the support surface.*
- *During the extension of the outriggers, the hydraulic pipes must not encounter obstacles or stretch excessively. With the outriggers completely extended the pipes must not be overly stretched.*
- *When the outriggers have to be moved, always make sure that no one stops near the outrigger plates, as there is a risk of crushing the lower limbs or the body.*
- *Check that the ground does not collapse when placing the outriggers.*
- *The outriggers can be retracted into the rest position only after the spraying boom has been brought into transport position (Fig. 7.5-1).*
- *When moving the outriggers, follow the safety instructions provided in paragraphs 7.6.4 and .*



OBLIGATION!: Always check that the ground (support area of the machine) can support the maximum load induced by the outriggers.



7.6.1 Outrigger support minimum areas

A table with the outrigger support minimum areas depending on the type of ground is provided below.

<i>Type of ground</i>	<i>Admissible contact pressure</i>	<i>Minimum area required</i>	<i>Recommended support plate (minimum dimensions)</i>
Natural ground	150 kN/m ²	1670 cm ²	50x50 cm
Asphalt (minimum thickness 20 cm)	200 kN/m ²	1250 cm ²	40x40 cm
Compressed stone	250 kN/m ²	1000 cm ²	40x40 cm
Compact muddy clay ground	300 kN/m ²	850 cm ²	40x40 cm
Compact mixed granular ground	350 kN/m ²	750 cm ²	30x30 cm
Well compacted stratified gravel	400 kN/m ²	625 cm ²	30x30 cm
Soft rock dissolved by atmospheric agents	1000 kN/m ²	250 cm ²	30x30 cm

Tab. 7.6-1

7.6.2 Outrigger set-up

To stabilise the machine, first of all it is required to prepare each outrigger as indicated below:

- For the front ones, release the spring positioning pin (Fig. 7.6-1), move the outrigger outwards (by rotating it on its centring pin) and re-insert the positioning pin into the hole for the working position;



Fig. 7.6-1 - Spring positioning pin of an outrigger

- Unscrew the stopping pin (Fig. 7.6-2) and fully extend the outrigger, then reinsert the locking pin into the hole for the extended position.



Fig. 7.6-2 - Extension stopping pin of an outrigger



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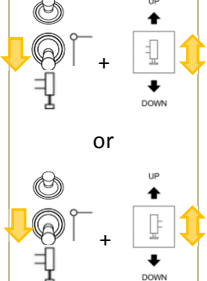
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Once the machine has been used, before carrying out its movement and after having retracted the spraying boom, the outriggers must be deactivated (see par. 7.6.3) and returned to rest/transport position, proceeding in the reverse manner as indicated above.

7.6.3 Control to move the machine outriggers

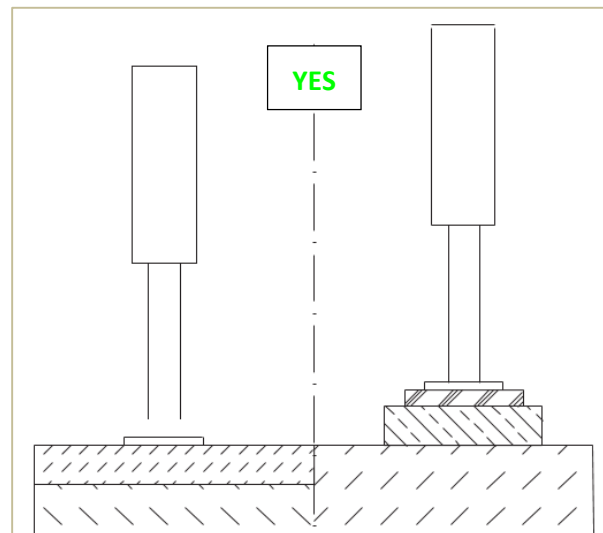
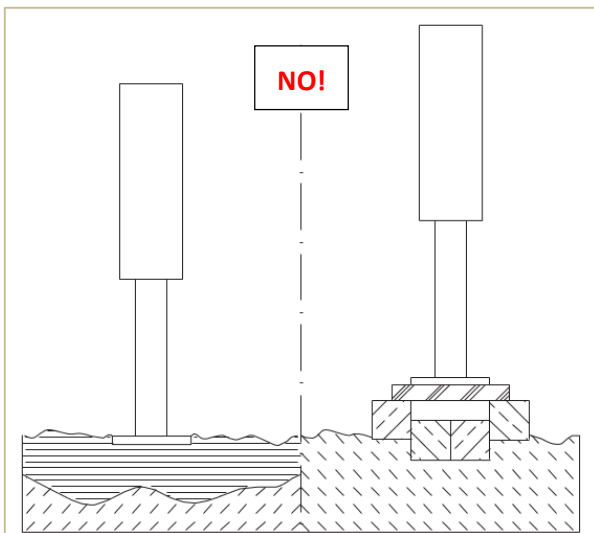
To move the machine outriggers, by staying on the machine driving footboard, proceed as follows.

In the event that the machine has to be stabilised, the outriggers must be moved until the machine is levelled correctly, by following the level (Fig. 6.2-4).

1)		Select the outriggers you wish to move by means of the specific selector (STAB): <ul style="list-style-type: none">▪ upward on  for the <i>front</i> outriggers;▪ downward on  for the <i>rear</i> outriggers (if present);
2)		Hold down the selector C22 (to enable the movement of the outriggers), and with the other hand (depending on the need): <ul style="list-style-type: none">▪ move the distributing lever STAB-DX forward or backward to raise or lower the right outrigger, or▪ move the distributing lever STAB-SX forward or backward to raise or lower the left outrigger.

7.6.4 Machine stabilisation operations safety requirements

The images of the figure below show a few examples (prohibited and correct) for outrigger positioning.



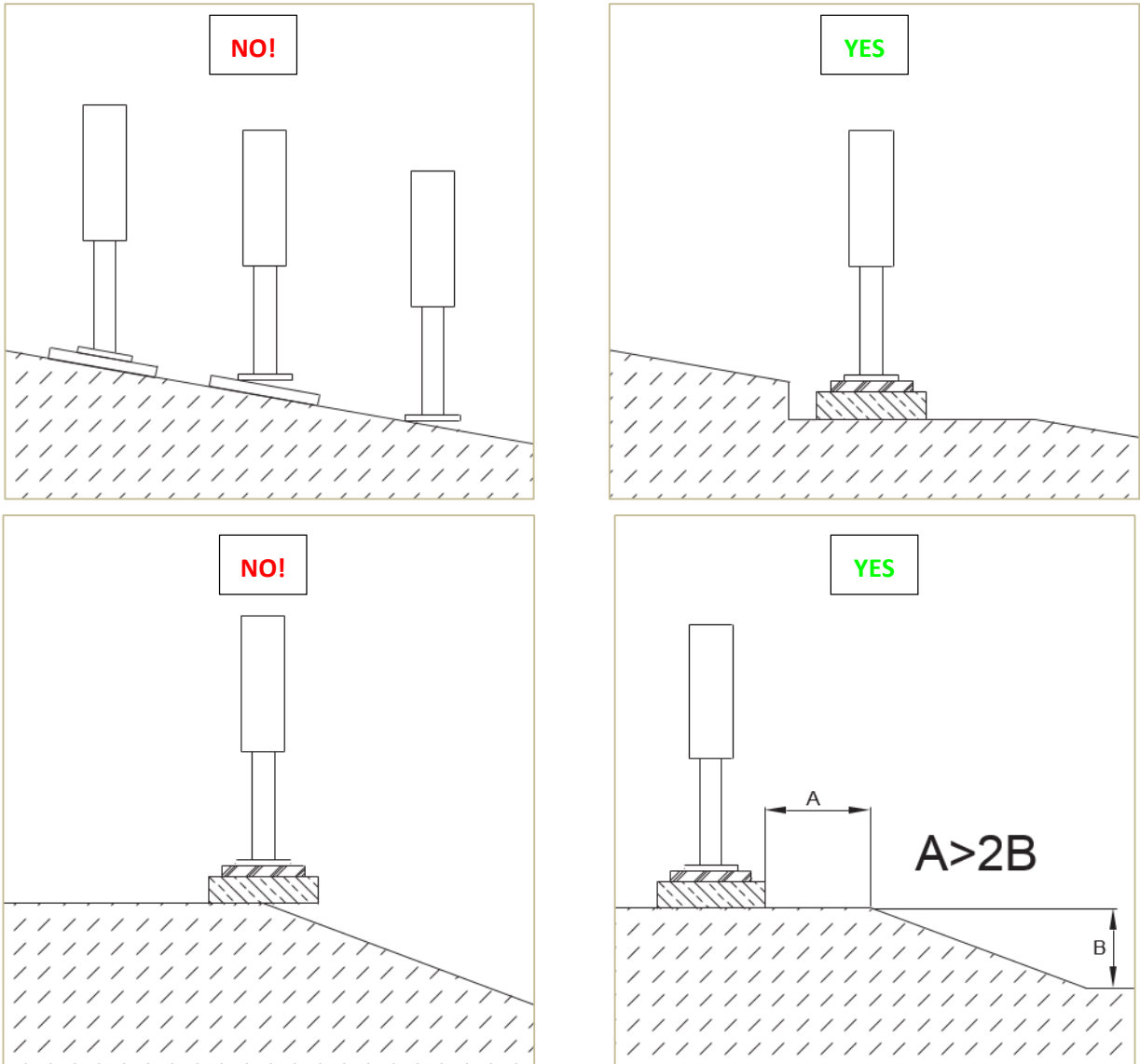


Fig. 7.6-3 - Examples of outrigger positioning: incorrect on the left, correct on the right



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7.7 Connection to the equipment for feeding the product to be sprayed

Once brought to the place of use and stabilised, in order to operate the machine must be connected, by means of pipes, to the equipment/machinery that will supply it with the material to be sprayed: concrete, compressed air, additive.

For the supplying characteristics of the product to be sprayed, see what is provided in par. 4.6.2.



ATTENTION! The supply pipes of the material to be sprayed must be sufficiently long so as to perform the boom manoeuvres in safety.

Be careful, during use of the boom, that the work pipes do not get caught on any obstacles or on parts of the machine.



OBLIGATION! The devices / equipment that supply the material for the product to be sprayed must be certified in compliance with the directives and regulations in force.

Use only suitable pipes for the intended purpose.

7.7.1 Concrete pipe connection

Connect the machine to a concrete pump by using a concrete pipe.

Connect the concrete pipe to the nozzle by means of the coupling **Victaulic 3"** (Fig. 7.7-1).

The pipe must be well blocked; check that the coupling is closed and insert the safety plug.

7.7.2 Compressed air pipe connection

Connect the machine to a compressed air compressor by means of a pneumatic pipe.

Connect the compressed air pipe to the nozzle, by means of the coupling **BSP (ogive 60°) 1 1/2"** (Fig. 7.7-1).

The connection must be well blocked, to avoid dangerous oscillation of the pipe.

7.7.3 Additive pipe connection

Connect the machine to a pump for the additive.

Connect the additive pipe to the nozzle by means of the coupling **Camlock 3/4"** (Fig. 7.7-1).

The connection must be well blocked, to avoid dangerous oscillation of the pipe.

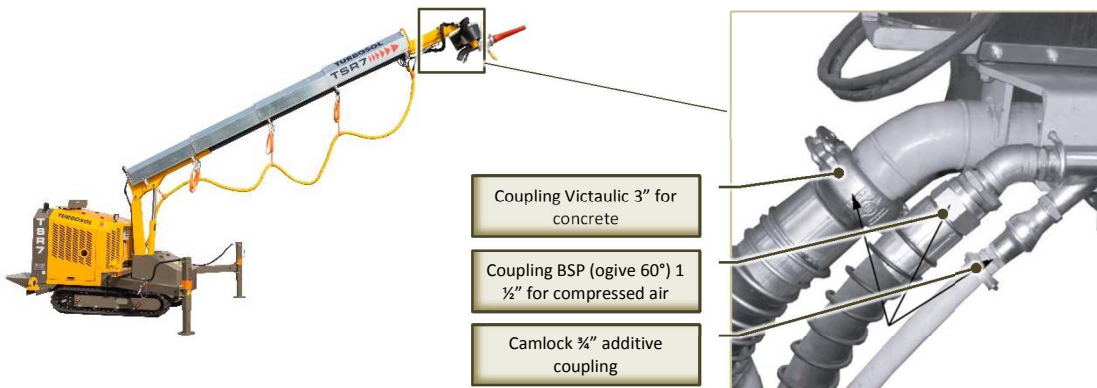


Fig. 7.7-1 - Material supply pipe connection points of the product to be sprayed on the nozzle



7.8 Spraying boom movement

The spraying boom can be moved with driver on board (see par. 7.8.1) or by means of remote control (see par. 7.8.2).



ATTENTION!:

- **Boom movement is only allowed when the machine is in position and stabilised.**
- **Avoid abrupt movements of the boom, act delicately and gradually on the control levers.**
- **During boom movement, be careful that the pipes of the boom (hydraulic, concrete, air and additive pipes) do not get caught or remain tangled (risk of pipes tearing and machine destabilisation).**
- **Always keep a safety distance away from unprotected or not sufficiently protected live parts of power lines and electric systems.**
- **Do not stand or move under the boom during handling or spraying.**
- **Do not stand or pass in front of the spraying nozzle.**


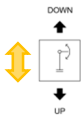
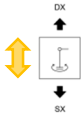

7.8.1 Boom movement control on the machine

The boom movement control distributing levers are supplied but not mounted on the control desk.

Boom movement on the machine is designed exclusively in exceptional cases due to serious anomaly.

Assemble the boom movement distributing levers only when required and for the required time. Once the boom has been reset to the transport position, remove the distributing levers and place them in the tool compartment.

To move the spraying boom, by staying on the machine driving footboard, proceed as follows:

1)		Move the selector C22 to the centre, in order to enable boom movement.
2)	<i>For boom movement:</i>	
a)		To raise / lower the boom, use the distributing lever SOLLEV , moving it as required backward or forward.
b)		To rotate the boom to the left (anticlockwise) or to the right (clockwise), use the distributing lever ROTAZ , moving it as required backward or forward.
c)		To extend/retract the boom, use the distributing lever SFILO , moving it as required forward or backward.



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<i>For nozzle movement:</i>	
d)	<p>To move the nozzle to the left or to the right (max rotation 240°), use the distributing lever POLSO1, moving it as required backward or forward.</p>
e)	<p>To rotate the nozzle on its axis to the left (anticlockwise) or to the right (clockwise) (max rotation 360°), use the distributing lever POLSO2, moving it as required backward or forward.</p>

7.8.2 Boom movement control with remote control

To move the spraying boom, while standing on the ground, holding the remote control, previously connected and activated (see par. 7.4.2) with both hands, proceed as follows:

1)	<p>Move the selector S3 downward, in order to enable boom movement.</p>
<i>For boom movement:</i>	
a)	<p>To raise or lower the boom, move the left joystick JOYSX backward or forward.</p>
b)	<p>To rotate the boom to the left (anticlockwise) or to the right (clockwise), move the left joystick JOYSX to the left or right.</p>
c)	<p>To extend or retract the boom, move the centre joystick JOY2 forward or backward.</p>
<i>For nozzle movement:</i>	
d)	<p>To move the nozzle to the left (anticlockwise) or to the right (clockwise), move the right joystick JOYDX backward or forward.</p>
e)	<p>To rotate the nozzle on its axis to the left (clockwise) or to the right (anticlockwise), move the right joystick JOYDX to the left or right.</p>
<i>For spraying</i>	
f)	<p>Move the selector S7:</p> <ul style="list-style-type: none"> ▪ upward "ON" to enable spraying nozzle orbital movement; ▪ downward "OFF" to disable spraying nozzle orbital movement.




7.9 Stop

7.9.1 Foreword


The stopping operating modes are provided below. The modes described are the only ones allowed by the manufacturer.

7.9.2 Normal stop

To stop the machine you must:

- Stop the supply of material to be sprayed;
- If you are using the electric motor, press the red button  (C27) to stop it;
- If you are using the electric motor, simply turn the motor ignition key (C5) to "0".

If you wish to turn off the machine you must:

- Stop the supply of material to be sprayed and discharge the pressure in the pipes;
- Move the boom to the fully "collected" position according to the transport configuration (see par. 7.5.1);
- Disconnect all the supply pipes of the materials to be sprayed and clean them (see par. 7.10);
- Control the lifting of the outriggers (see par. 7.6.3) and fully retract (Fig. 7.6-2) and move the outriggers towards the inside (Fig. 7.6-1), making sure you have secured them in place with the positioning/locking pins;
- Move the machine (see par. 7.5) where you wish to park it;
- If you are using the electric motor, press the red button  (C27) to stop it;
- Turn the motor ignition key (C5) to "0";
- If you are using the electric motor:
 - Turn the "PHASE INVERTER" (C31) selector to "0";
 - Turn the master switch (C30) on position "OFF";
 - Disconnect the power supply cable and insert the protective cap on the socket;
- If you are using the endothermic engine, disconnect the battery through the battery disconnecter;
- Remove the ignition key (C5).



ATTENTION!

- *Before disconnecting the pipes from the machine, discharge the pressure in the pipes: refer to user instructions of the equipment connected to the machine for supplying the product to be sprayed.*
- *Always clean after using the machine.*
- *Before leaving the machine, always remove the ignition key (C5) and store it in a safe place.*



PROHIBITION!: Never leave the machine started or with the ignition key (C5) inserted in the selector.

NEVER stop or park downhill.

In all cases make sure that the machine is stopped stably.



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7.9.3 Emergency stop



ATTENTION! *The emergency stop is needed when a danger has occurred that can put at risk the safety of the operator, of any people close to the machine and of the machine itself.*

After an emergency stop and before restarting the machine, check that the inconvenience that caused the machine to stop has been eliminated.

To stop under emergency conditions, simply press the emergency stop button (C21) on the control board of the machine or, if in use, the “STOP” button (C21) on the remote control.

After an emergency stop or if the machine stops due to some anomaly, first check the cause and remove it, restore the correct operation of all the devices (for the pushbutton, turn it in the direction of the arrows engraved), and then start the machine (paragraph 7.3).



7.10 Cleaning the machine at the end of operations



OBLIGATION!: *The operator must be specifically trained to perform the machine cleaning operations.*

During cleaning operations, no other operator must be in the vicinity of the machine.



ATTENTION!: *Ensure there is no residue pressure in the piping and no other persons are near-by, before opening a joint. This potentially dangerous operation must always be carried out with the utmost caution, by an experienced person.*



PROHIBITION!:

- *It is forbidden to perform washing while the machine is running.*
- *Do not aim high pressure water jets on electrical components.*

The machine must be always clean and in good working condition, eliminating any incrustations or residues/deposits of processed products such as concrete.

Thoroughly clean the pipes connected to the machine.

Thoroughly clean the nozzle, disassembling it from the boom support.

Disassemble the rubber diffuser and clean inside the nozzle to eliminate any incrustations inside the body (Fig. 7.10-1).

Clean the air diffusers of the nozzle body (Fig. 7.10-2).



Fig. 7.10-1 - Nozzle disassembled in its parts

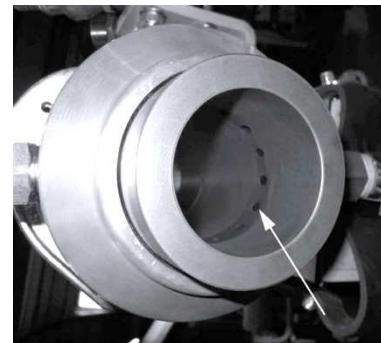


Fig. 7.10-2 - Air diffusers inside the nozzle body

7.10.1 Cleaning the piping

Some recommendations for cleaning the pipes are provided below.

The pipes can be cleaned by either pumping water or using compressed air. Use suitably sized sponges for the pipe's diameter.

If the distribution lines are cleaned pneumatically, a collection bin or similar device must be able to be connected at the end of the line. If there is a terminal, it must be secured against uncontrolled movement.

Introduce the sponge at the beginning of the section to be washed, being careful to restore pipe blocking through gaskets and joints.



OBLIGATION!: *Take all the necessary safety measures to avoid sponge ejecting from the piping section causing injuries to near-by persons and/or damages to objects.*

If compressed air is used (for example spray guns or other systems), safety goggles must be compulsorily used).



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ATTENTION! Carefully read the paragraph 0 to eliminate any clogging found during cleaning.



OBLIGATION! If water is used for cleaning, it is required to take the machine to a suitable place to avoid the dispersion of waste water into the environment. It is the user's responsibility to properly recover and dispose of washing water.

7.11 Removing pipe clogging



OBLIGATION! The operator must have been specifically trained to remove a pipe clogging.

During clogging removal operations, no other operator must be in the vicinity of the machine.



ATTENTION! Ensure there is no residue pressure in the piping and no other persons are near-by, before opening a joint. This potentially dangerous operation must always be carried out with the utmost caution, by an experienced person.

Discharge the pressure in the pipes before disconnecting them from the machine: follow the instructions provided by the manufacturers of the connected equipment by reading their instructions for use.



OBLIGATION! Read the safety prescriptions present in the use and maintenance manual of the compressor to disperse, without risks, the residual pressure in the compressed air pipe.

Read the safety prescriptions present in the use and maintenance manual of the additive pump to disperse, without risks, the residual pressure in the additive supply pipe.

Normally, in case of clogging, the critical points are at the fittings.

7.11.1 Steel pipes clogging

The obstruction is located by the noise emitted upon impact of the iron hammer against the pipe: a metallic sound is heard if the pipe is not clogged, whereas a plonking sound is heard if the pipe is clogged.

Disconnect the clogged hose from the piping line, once this has been preemptively depressurised.

Place the pipe vertically to evacuate its contents.

7.11.2 Rubber hoses clogging

The pipe is hard and rigid near the obstruction; on the contrary, the hose sags upon treading.

Disconnect the clogged hose from the piping line, once this has been preemptively depressurised.

Place the hose vertically to evacuate its contents. Shake the pipe and strike it with a hammer (Fig. 7.11-1) if required until the clogging is removed and the pipe is no longer rigid.



Fig. 7.11-1 - Clogging search on rubber pipe

7.12 Troubleshooting

7.12.1 Emergency procedure to be followed to lower the spraying boom in the event of a malfunction of the control system

In the event of a malfunction of the control system (for example, if the remote control does not work), to lower the spraying boom it is required to install the distribution levers that control it (supplied) on the driving desk and to move it (see par. 7.8.1).

7.12.2 Troubleshooting table

	Problem	Probable cause	Solution
UNDERCARRIAGE	CRAWLER DAMAGE	Tread excessively worn.	Replace the crawler.
		Slackening or breakage of internal structural steel rope.	
	FREQUENT SLACKENING OF CRAWLER	Tensioning valve faulty.	Replace the valve.
		The tensioner gasket is damaged.	Replace the tensioner gasket.
		Wear of tensioner components.	Replace the worn components.
		For models with screw tensioning: accidental loosening of the nut.	Restore crawler tension.
	THE TOP OF THE CRAWLER NO LONGER MAINTAINS THE ORIGINAL POSITION	Crawler slide worn.	Replace the slide.
		Upper roller worn.	Replace the upper roller.
	THE BOTTOM OF THE CRAWLER NO LONGER MAINTAINS THE ORIGINAL POSITION	Lower crawler guide worn.	Replace the lower crawler guide.
		Lower roller worn.	Replace the lower roller.
	BENDING OR BREAKAGE OF SLIDE BLOCKS	Slide block too wide in relation to the weight of the machine especially on stony ground.	Narrow the slide blocks.
			Lighten the machine.
	THE UNDERCARRIAGE SINKS INTO THE GROUND WHEN DRIVING	Slide block too narrow in relation to the type of ground.	Narrow the slide blocks.
			Excessive weight of the machine.
THE CRAWLER BLOCKS WHEN STEERING	Interposition of material (stones, earth, etc.) between rollers, drive wheel, crawler tensioning wheel and crawler.	Remove the material by turning the crawler both ways while slightly slackening tension, lifting the machine if possible.	
Below regarding the reduction gears and taken from the original instructions			
OIL LEAK FROM THE SEALS	Stiffening of seals	Clean the zone and check again for leaks after a few days.	



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	Problem	Probable cause	Solution
		Damage or wear of seals	Contact a specialised centre.
	EXCESSIVE NOISE	Internal wear anomaly of seals.	Contact a support centre.
	EXCESSIVE VIBRATIONS	Internal wear anomaly of seals	Contact a support centre.
	OVERHEATING	Oil missing.	Top up oil.
		High thermal power outputs.	Contact a support centre.
		Lamellar brake does not open completely.	Check brake opening pressure.
	THE REDUCTION GEAR DOES NOT TURN WITH ENGINE RUNNING	Engine assembled incorrectly.	Check coupling between reduction gear and engine
		Internal anomaly.	Contact a support centre.
		Brake possibly blocked.	Check braking systems.
	MULTI-PLATE BRAKE DOES NOT UNLOCK	Brake pressure missing.	Check brake connection.
		Brake seals faulty.	Contact a support centre.
	MULTI-PLATE BRAKE DOES NOT LOCK	Residual pressure in circuit.	Check hydraulic circuit.
		Plates worn.	Contact a support centre.
BOOM	VIBRATIONS IN CRANE EXTENSION JACKS, ACCOMPANIED BY JERKS DURING MANOEUVRES	Excessively low hydraulic oil temperature.	Run idle for a few minutes to heat up the hydraulic oil.
	VIBRATIONS ON ALL MOVEMENTS WITH OIL HOT	Oil missing in tank.	Top up hydraulic oil.
		Air in hydraulic circuit.	Act on the controls to bring the jacks to the end of stroke in both directions a few times.
	ALL MOVEMENTS SLOW EVEN WHEN EMPTY	Suction hose crushed.	Replace the suction hose
		Air suctioned.	Check tightening of the fittings on the suction hose
	HYDRAULIC SUSPENSION ESCAPE OUT OF SEQUENCE.	Lubrication missing.	Lubricate the extensions
		Slide blocks worn.	Replace the slide blocks *
		Sequence valve not adjusted or faulty.	Calibrate the valve *
	THE HYDRAULIC EXTENSIONS DO NOT COME OUT IN THE RIGHT SEQUENCE, THE CRANE DOES NOT ROTATE REGULARLY	Vehicle not a flat ground.	Stabilise the vehicle
		Hydraulic motor worn.	Replace hydraulic motor *
		Crown worm screws seized.	Replace screw and crown *
	CRANE ROTATION HAS EXCESSIVE PLAY	Crown fixing screws loosened.	Tighten the screws
		Worm screw shaft fixing nut loosened.	Tighten the nut
	THE CRANE LIFTS THE LOAD BUT DOES NOT SUPPORT IT	Boom valves not calibrated.	Calibrate the valves *
		Cylinder gaskets worn.	Replace the gaskets *
	NOISY JOINTS OR ROTATION BUSHES.	Lubrication missing.	Grease the joints or rotation bushes
THE OUTRIGGERS YIELD UNDER THE LOAD	Lock valves inefficient	Clean or replace the lock valves*	
	Gaskets worn.	Replace the gaskets *	

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	Problem	Probable cause	Solution
	DIFFICULTY IN MOVEMENTS	Cracks or structural deformation.	Contact the manufacturer
	ROTATION NOT FUNCTIONING	Faulty end of stroke sensors.	Disable the inductive end of strokes, immediately replace the sensor
	* Operations to be carried out at an authorised workshop.		
RADIO CONTROL	THE GREEN LED DOES NOT SWITCH ON	Control not enabled.	Enable the remote control from the control board.
	THE SINGLE CONTROLS ARE NOT PERFORMED	Faulty console.	Bring the console to a centre authorised for repair or replacement
		Connection cable to the machine interrupted.	Check that the cable is properly connected and is not damaged
Other types of faults require the intervention of the manufacturer's authorised technical assistance service.			

Tab. 7.12-1



8 Routine maintenance

8.1 Glossary and terminology

Some recurring terms in the manual are described below in order to univocally determine their meaning:

- **Routine maintenance:** set of operations required to maintain the functionality and efficiency of the component/part. Normally these operations are programmed by the Manufacturer, who defines the skills required and methods of operation;
- **Special maintenance:** set of operations required to maintain the functionality and efficiency of the component/part. These operations are not programmed by the Manufacturer and must be carried out by the expert maintenance technician;
- **Expert maintenance technician:** chosen and authorised technician among those who have the requisites, skills and information of mechanical and electrical nature to carry out repairs and special maintenance on the component/s;
- **Revision:** the revision consists in the replacement of mechanical components that show signs of wear that compromise the functioning of the component/part. Furthermore, the revision involves checking the status of all components (couplings, seals, contacts, etc.). In case of damage they must be replaced and the causes must be investigated;
- **Review specialist:** Specialists are persons whose technical training and experience have provided them with adequate knowledge in the field of concrete pumps and concrete spraying booms and who have acquired sufficient familiarity with the relevant national regulations, accident prevention regulations, directives and rules that represent the generally accepted state of the art to evaluate the safe operating condition of concrete pumps and spraying booms. In addition to specialist and competent experts, the following figures, for example, can be appointed to carry out regular inspections: production technicians, mechanical foremen, repairer hired by the manufacturer. The appointment of the expert or specialist to perform the inspections is at the discretion of the user, provided that the person selected meets the previously specified requirements.



8.2 Maintenance safety regulations



ATTENTION! Failure to comply with the following safety instructions may result in injury, death or damage to the machine.

Before starting maintenance operations, carefully read these instructions.



OBLIGATION! To carry out maintenance operations, the machine must be brought to a suitable place, large enough to be able to manoeuvre it and climb on it, with a rigid and smooth floor and an optimal room lighting.

Before starting any operation, check that all the necessary tools are present.



ATTENTION! Every maintenance operation must be carried out with the machine stopped, after having disconnected all power sources (electrical, etc.) from all the components of the machine and with the emergency stop button on (pressed). Only in this way can you be sure that an unexpected start cannot occur while the maintenance staff are working.

When, for certain operations, the current must be turned on, check that the appropriate safety devices are active. Switch on the power supply only for the time strictly required for carrying out the maintenance operation.

The operations must be carried out by qualified personnel, who have all the technical skills to carry out these operations in conditions of maximum safety and in full compliance with the applicable laws in force. The following warnings must be observed during every maintenance operation:

- Apply a warning sign (see example Fig. 8.2-1) on the power source disconnecting device/s;
- After having disconnected the power source/s, ensure that it cannot be inserted accidentally: by unplugging the power plug (by inserting the cap in the plug), removing the ignition key of the endothermic engine and disconnecting the battery by using the battery cut-off switch;
- Ensure efficient earthing and ensure that any live parts of the system cannot be reached;
- Do not let personnel not authorised for maintenance near the system.
- Check that no residual pressure is present.



Fig. 8.2-1 - Warning sign example



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ATTENTION!:

- *Always entrust the operations to personnel trained and qualified for the type of maintenance operation. Maintenance operations must always be carried out by the personnel in charge.*
- *Always keep a fire extinguisher available for the maintenance operator to use.*
- *Clean the machine before carrying out maintenance and repair operations, especially the connections and screw connections, removing oil, fuel or detergent residue. Do not use harsh detergents. Do not use stringy cloths.*
- *Before carrying out any operation on the machine with the boom raised (not in transport position), always apply blocks or supports to hold it.*
- *Use suitable means of access and in accordance with the requirements for reaching high parts of the machine. Never climb on the parts of the machine. The footboard must only be used to drive the machine.*
- *Never align holes or slots with fingers: use an adequate centring tool.*
- *Do not accumulate oily or greasy cloths as they constitute a fire hazard. Said cloths must be placed in a closed metallic container.*
- *Before starting the machine, ensure no tools or other materials are left inside the compartments containing the moving parts or near moving parts once maintenance or repair is completed.*



ATTENTION!: *For the dismantling of bulky parts, these must be anchored and secured on lifting equipment to avoid any danger related to their fall. Only use suitable and technically appropriate lifting equipment, as well as with sufficient capacity. Do not stop or transit below suspended loads. The operator must be qualified to use the chosen lifting equipment.*



ATTENTION!: *Should it be required to replace lubricating oils or greases, their disposal must be carried out in compliance with current regulations. Under no circumstances is it allowed to disperse these substances into the environment.*



PROHIBITION!: *The use of open flames on or near the machine is prohibited.*



8.3 Cleaning safety regulations



ATTENTION!: Every cleaning operation must be carried out with the machine stopped, after having disconnected all power sources (electrical, etc.) from all the components of the machine and with the emergency stop button on (pressed). Only in this way can you be sure that an unexpected start cannot occur while the cleaning staff are working.

The following warnings must be observed when cleaning the machine or parts of it:

- Do not clean electrical equipment by using water or other fluids. Only use a clean brush or a dry cloth to remove any dust deposits;
- If water jets are used to clean the machine, make sure that the components and the electrically operated devices are sufficiently protected. Before starting the machine, make sure that there is no water on the components and electrically operated equipment. Do not aim the water jets towards other people;
- Do not use compressed air to clean the machine. Use an extractor if required;
- Do not use fuel for the cleaning operations;
- Do not clean plastic surfaces by using alcohol or solvents. Use only specific detergents;
- Dispose of the cleaning materials in compliance the relative regulations. Do not disperse used materials or cleaning residues in the environment.



OBLIGATION!: During the cleaning operations it is mandatory to wear the personal protective equipment supplied.



OBLIGATION!: Always keep the machine clean so that the operator incur in the following risks:

- Slipping and falling;
- Damaging eyes due to ejection of filth;
- Difficulty in identifying damaged parts.

If the machine works in environments with a high degree of salinity, intensify general cleaning operations to prevent corrosion especially of electrical parts.



OBLIGATION!: After cleaning, fully remove covers and bondings. Also check all the fuel, motor oil and hydraulic oil pipes for leaks, loosened screwed connections, abrasion points and damage. Immediately repair any defects found.



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8.4 Repair safety regulations



OBLIGATION!: To carry out maintenance operations, the machine must be brought to a suitable place, large enough to be able to manoeuvre it and climb on it, with a rigid and smooth floor and an optimal room lighting.
Before starting any operation, check that all the necessary tools are present.



ATTENTION!: Every repair operation must be carried out with the machine stopped, after having disconnected all power sources (electrical, etc.) from all the components of the machine and with the emergency stop button on (pressed). Only in this way can you be sure that an unexpected start cannot occur while the maintenance staff are working.



When, for certain operations, the current must be turned on, check that the appropriate safety devices are active. Switch on the power supply only for the time strictly required for carrying out the maintenance operation.

The operations must be carried out by qualified personnel, who have all the technical skills to carry out these operations in conditions of maximum safety and in full compliance with the applicable laws in force. The following warnings must be observed during every maintenance operation:

- Apply a warning sign (see example Fig. 8.2-1) on the power source disconnecting device/s;
- After having disconnected the power source/s, ensure that it cannot be inserted accidentally: by unplugging the power plug (by inserting the cap in the plug), removing the ignition key of the endothermic engine and disconnecting the battery by using the battery cut-off switch;
- Ensure efficient earthing and ensure that any live parts of the system cannot be reached;
- Do not let personnel not authorised for maintenance near the system.
- Check that no residual pressure is present.



ATTENTION!: During the repair operations on the machine, any operation to disconnect the safety devices must be performed only by the person in charge of the Maintenance department, who must pay particular attention in order to avoid damage to people or the machine.



ATTENTION!:

- Always entrust the operations to personnel trained and qualified for the type of operation. Repair operations must always be carried out by the personnel in charge.
- Always keep a fire extinguisher available for the maintenance operator to use.
- Clean the machine before carrying out maintenance and repair operations, especially the connections and screw connections, removing oil, fuel or detergent residue. Do not use harsh detergents. Do not use stringy cloths.
- Before carrying out any operation on the machine with the boom raised (not in transport position), always apply blocks or supports to hold it.
- Use suitable means of access and in accordance with the requirements for reaching high parts of the machine. Never climb on



the parts of the machine. The footboard must only be used to drive the machine.

- *Never align holes or slots with fingers: use an adequate centring tool.*
- *Do not accumulate oily or greasy cloths as they constitute a fire hazard. Said cloths must be placed in a closed metallic container.*
- *Before starting the machine, ensure no tools or other materials are left inside the compartments containing the moving parts or near moving parts once maintenance or repair is completed.*



ATTENTION! *For the dismantling of bulky parts, these must be anchored and secured on lifting equipment to avoid any danger related to their fall. Only use suitable and technically appropriate lifting equipment, as well as with sufficient capacity. Do not stop or transit below suspended loads. The operator must be qualified to use the chosen lifting equipment.*



ATTENTION! *It will be the Customer's responsibility to check that only original spare parts, only ones that do not compromise the safety of the machine, are used for repairs.*

8.5 Routine maintenance of the machine

Carry out all the maintenance operations required and described in the following paragraphs and in the attached machine part instructions, always following the times indicated.

Maintain the machine paint in good conditions.

8.6 Safety signs check

Check **every six months** the presence (in the points required, see paragraph 3.3), the integrity and readability of all the safety signs on the machine.

If labels or warning signs are damaged, replace them.



ATTENTION! *The lack of safety signs may expose the worker to hazards as any residual risks may not be perceived.*

8.7 Checks and maintenance on the safety devices



ATTENTION! *At the end of the maintenance or repair operations, before restarting the machine, the Maintenance service manager must check that all the operations has been completed, that the safety devices have been restored and tested, and that no persons not assigned to driving the machine are inside its operating area.*



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8.7.1 Emergency buttons

Pushbutton or handheld emergency buttons **must always be checked visually** (functional integrity must be checked) **and tested every time the machine is used**.

Pushbutton or handheld emergency stop devices must be checked carefully and maintained **at least every 6 months**.

The fixing, the electrical and mechanical functionality, the reset function of the button and the status/visibility of the yellow band at the base of the button must be checked.

8.7.2 Guards

The guards must be checked **at least every 6 months**.

Specifically, it is required to check the following:

- Check the loss or damage of any part of the guard, especially if this causes a decrease in safety functions, for example the reduction of resistance due to impact or scratches on glazed parts;
- Replacement of parts subject to wear (coatings, joints and hinges, gas pistons, locks, etc.);
- Check the operation of the interlocks;
- Checking the wear of joints and fixing points;
- Check the deterioration due to corrosion, temperature variations, chemical effects;
- Check the sliding of moving parts and potential lubrication;
- Check the safety distances (especially in perimeter barriers);
- Check the efficiency of acoustic dampening and potential replacement of insulating coatings.

8.7.3 Reset of the magneto-thermic protection switches

One or more magneto-thermic protection switches can be present inside the electric control board.

To restore the magneto-thermic protections it is required to first operate on the main switch to cut off the voltage and then open the panel of the electrical control board containing them; identify the protection triggered and proceed as indicated in the figures Fig. 8.7-1 or Fig. 8.7-2.

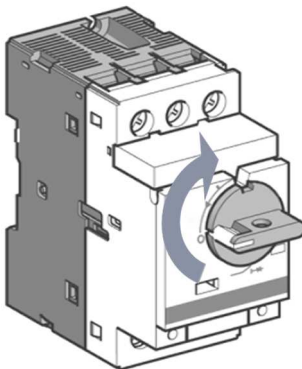


Fig. 8.7-1 - Magneto-thermic switch with rotary reset

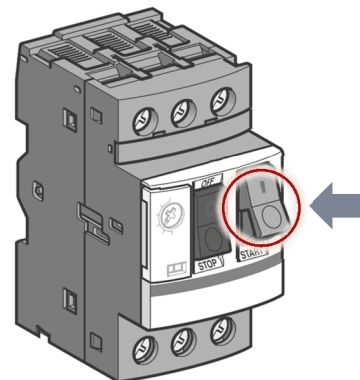


Fig. 8.7-2 - Magneto-thermic switch with switch reset

8.7.4 Protection fuse replacement

One or more protection fuses can be present inside the electric control board.

To replace a fuse it is required to first operate on the master switch to cut off the voltage and then open the panel of the electrical control board that contains it; once the fuse holder/s has been identified proceed with the sequence of operations represented in Fig. 8.7-3.

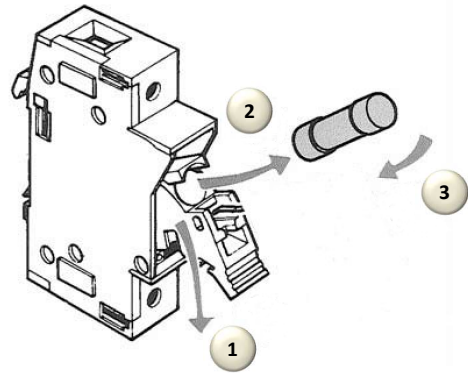


Fig. 8.7-3 - Fuse and fuse holder example

The table below (Tab. 8.7-1) shows the typical classification of fuses that can be used in electrical equipment.

Type	Description
Low voltage fuses in miniature format (e.g. 5x20)	
FF, FA	Superfast
F	Fast
M	Average
R, T	Delayed
RR, TT	Superdelayed
Low voltage fuses in larger format (e.g. 10,3x38)	
aM/ gM	Delayed (for motor protection)
gG/gL	Fast (general use)
aR/gR	Ultrafast (for semiconductor protection)

Tab. 8.7-1

8.7.5 Brake on reduction gears

These devices must be checked to make sure they function properly at least **every 6 months**.

8.7.6 Outriggers

Before each use, visually check the condition of the outriggers, that there are no cracks, breaks, or deformations.
Keep the extensions of the outriggers clean to avoid them jamming during the extension and return phases.

8.7.7 Maximum pressure valves

These devices must be visually checked at least **every 6 months**. It is required to check their fastening and that the connections are properly inserted/tightened.
Do not tamper with the calibration of the maximum pressure valves to avoid serious danger situations such as bursting of pipes and of hydraulic components.

8.7.8 Locking valves

These devices must be visually checked at least **every 6 months**. It is required to check their fastening and that the connections are properly inserted/tightened.



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8.8 Electric motor maintenance

Before carrying out any operation on the motor, the auxiliary circuits and/or accessories must be disconnected from the power supply.

In particular:

- Check the insulation from the electrical mains;
- Set up the appropriate protections from any live exposed parts;
- Make sure that no accidental restart occurs.

It is recommended to frequently observe the operation of the motor and to perform periodic inspections.

In general it is advisable to operate as follows:

1. Check that the operation is regular and the absorption within the values shown on the nameplate;
2. For self-braking motors, check the brake status, the air gap value and the adjustment value of the release lever (according to the instructions in the manufacturer's manual);
3. Keep the motor clean and check that there are no obstructions to ventilation;
4. Check the conditions of the seal rings on the shaft;
5. Check that the electrical connections and the fixing screws are tightened;
6. If the motors are equipped with condensation drain holes, periodically remove the cap closing screws to allow drainage of any condensation formed. The installation must require for the drain hole to be located in the lower part of the motor;
7. The bearings used in the standard execution are of the pre-lubricated type and do not require maintenance; it is still good practice to replace them after about 3 years.

For normal inspections it is not required to disassemble the motor except for replacement of the bearings. In this case operations should be performed by specialised personnel and with suitable tools.

8.8.1 Troubleshooting

Even if the electric motor has been previously tested by the Manufacturer, the information reported below (Tab. 8.8-1) is intended to help identify and correct any anomalies and malfunctions.

<i>Problem</i>	<i>Possible cause</i>	<i>Solution</i>
The engine does not start	Power supply interrupted	Check the wiring and the protections
	Incorrect connections	Check that the connections comply with the connection diagram
	Overload	Check sizing
	Short circuit on the stator, signalled by protection operation	The motor must be repaired
	Mechanical fault	Check that the motor and the coupled machine turn freely
The motor has long acceleration times or does not reach the rated speed	High loss of voltage in the line	Check the connections and the sizing of the power cables
	Load too heavy	Check the sizing (inertia and load resistive torque)
	The motor is designed for delta connection, but is connected with a star one	Change the connection
	Mains voltage or frequency not suitable for the	Compare the characteristics of the power supply

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Problem	Possible cause	Solution
	motor	with those of the motor
Incorrect motor rotation direction	Incorrect connection	Invert two phases between each other
The motor overheats during operation	Overload	Reduce the load
	Insufficient cooling	Check the regular ventilation air flow and clean the flaps
	Excessive room temperature	Check environmental conditions
	Motor phase interrupted	Check the connections
	Power supply voltage beyond tolerance or circuit unbalanced	Check the power supply voltage or balance the loads
Protection operation	Overload	Check the motor absorption and reduce the load if required
	Stator short circuit	The motor must be repaired
	Faulty connection	Restore the correct connection
	Phase interruption	Check the power supply
Excessive noise	Damaged bearings	Replace the bearings
	Mechanical contact	Identify the parts in contact
Abnormal vibrations	Motor shafts and duct not correctly aligned	Correct the alignment
	Faulty bearings	Replace the bearings
	Rotaries not balanced	Correctly balance the rotaries by using half key (rotor and coupled parts)
Bearing overheating	Incorrect alignment	Correct the alignment
	Bearing overload	Check the radial/axial loads
	Worn bearings	Replace the bearings

Tab. 8.8-1



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8.9 Endothermic engine maintenance

For maintenance of the endothermic engine, refer to the attached original documentation.

8.9.1 Accumulator

The electrolytic accumulator contains sulphuric acid and produces highly explosive hydrogen. Abide by the following precautions to avoid serious injuries and fire:

- Do not use or charge the accumulator when below the minimum level as this may cause an explosion;
- Periodically check the electrolyte is at the maximum level and, if needed, top up with distilled water;
- Wear personal protective equipment, such as rubber gloves, goggles;
- Do not smoke or use naked flames near the accumulator.



ATTENTION! It is very dangerous to inhale the fumes of the accumulator and to enter into contact with the acid, especially the eyes. In these cases, immediately wash with plenty of water; see a doctor.

8.10 Maintenance of mechanical parts

8.10.1 Keys and fixing grub screws

Check the absence of play in the mechanical couplings by means of keys **every six months**.

If play is detected on the coupling, tighten the locking screws of the key.
If the play persists, contact the Maintenance service.

8.10.2 Recommended lubricant greases

Recommended greases for lubrication of mechanical parts are provided in Tab. 8.10-1. The grease used by the manufacturer is of the Pakelo brand.

Generic greases	
Brand	-10°C + +40°C
	Bearing EP Grease NLGI 2
BP	Grease LTX2
	LM – Speerol SPT 2
	Alvania GR.R.2
	Beacon 2
	Lithium 20
	Traslube LI Grease 2

Tab. 8.10-1



8.11 Electrical system maintenance

8.11.1 Installation, operating and maintenance conditions

For each electrical system, proper and suitable maintenance, carried out by skilled and qualified personnel, contributes to keeping the level of system reliability and its safety rating constant over time. The objectives that electric maintenance personnel must achieve are many:

- Limit the deterioration of circuits and equipment;
- Prevent accidents;
- Contain costs for accidental failures;
- Limit the number and duration of operations;
- Perform maintenance by integrating it with the more general one required for the entire system.

To achieve these objectives the following are required:

- The presence of maintenance technicians during the installation stage of the system;
- Strict compliance with the maintenance instructions provided;
- Strict compliance with the safety Regulations and Standards;
- The organisation of an archive with maintenance data sheets, repair data sheets;
- Constant updating of maintenance personnel.

A fault is a probabilistic event and therefore its occurrence is cannot be exactly predicted. This statement contrasts with one of the main purposes of maintenance, which is precisely the prevention of faults. The optimisation of this prevention operation is facilitated by the knowledge of experimental data collected on the components of the system or on components of other systems with similar characteristics.

This prevention is required in case of components that ensure the safety of people. It is therefore always useful and in some cases required to register:

1. Characteristic electrical parameters of the system during normal operation;
2. Electrical parameters due to abnormal operations;
3. Manufacturer information on the mode and frequency of maintenance.

The correct knowledge of all the factors illustrated above allows to draw up a maintenance program that minimises the occurrence of problems, ensures the safety of the system and optimises the cost/benefit ratio, linked to maintenance. The automatic switches and the main equipment of the systems are supplied by the most qualified manufacturers, having already passed the running-in phase and, therefore, able to ensure regular operation for their lifespan.

8.11.2 Periodical maintenance

Each main or secondary electric control board of the machine **must be maintained every six months**.



ATTENTION!: Maintenance of the electrical system may require the execution of operations on live equipment (such as electrical measurements). It is therefore required for the maintenance personnel to be qualified to carry out works on electrical installations (according to CEI Standard 11-27).

Periodical maintenance requires:

- Cleaning the internal and external parts of the board (by using an extractor and a hard-bristle brush if required);



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- Checking the tightening of screws, terminal board and bolts of the electric control board (a thermal camera allows to easily identify the loose clamps that normally overheat);
- The check and potential arrangement of the electrical system cables in particular in and out of the equipment casings (tightening of the cable glands and position of the gaskets);
- The lubrication of all the guides and levers of the electric control board (hinges, closing rods, etc.);
- The check, and potential replacement, of lamp holders, fuse holders, limit switches, buttons, wire terminal gaskets, u-bolts and indicator instruments;
- The check of the charge of any buffer batteries present on the installed devices.
- The check of the position of sensors, microswitches and photocells;
- The check of thermal relay calibration and of any other relays;
- The check of the functioning of all the warning lamps;
- The insulation check between phases and between phase and mass.

After maintenance, before starting the machine:

- Check that no foreign bodies have been left inside the board;
- Preheat the board to eliminate any humidity or condensation;
- Gradually close the switches to easily identify any faulty lines;
- Check the voltage available for auxiliary services;
- Check the insulation status of auxiliary circuits;
- Check the manoeuvring parts;
- Check the release manoeuvre;
- Check block safety and functionality.



ATTENTION! *Incorrect positioning of the sensors, microswitches and photocells may compromise the correct operation of the machine. If the environment is particularly dusty, it is required to clean the lenses of the photocells every day by using a cloth, potentially wet with water. Never use alcohol or solvents to clean the photocells.*

8.11.3 Remote control maintenance

For maintenance of the remote control, refer to the attached original documentation. In any case, the remote control does not need any particular maintenance. Comply with the following points:

- Regularly check the functionality of the STOP switch. Any dirt deposits on the switch may block the mechanism compromising its functionality.
- Regularly check that the rubber gaskets or the seals of the bellows of the control elements are not damaged. Defective gaskets or bellows must be immediately replaced since moisture infiltrations and dirt may compromise the functioning of the control elements.
- Never clean the transmitter with a high-pressure water-jet cleaner or with sharp or pointed objects.

If a faulty remote control is detected, it must not be used, and immediately request support from the manufacturer.



OBLIGATION! *Remote control repairs must only be performed by specialised, trained and authorised personnel. Only use original spare parts and accessories, otherwise it would not be possible to guarantee the safety of the device.*



8.12 Hydraulic system maintenance

Maintenance activities (inspection, maintenance, repair) must be defined according to the specific requirements for the components, the operating conditions (pressures, temperatures, environmental conditions) and the use (start-up time, cycle duration, operation on multiple shifts).

In this regard it is required to carry out a visual inspection concerning the most obvious problems:

- Unreadable indications and warning plates, including the operating symbols of the control levers;
- Leaks;
- Detached and/or missing parts;
- Signs of external force.

8.12.1 Maintenance documentation

It is recommended to document the results of the inspections and of the measures arising therefrom, so that, in consideration of functionality and performance, the inspection intervals can be adapted to the actual operating conditions as these, through comparative evaluation, provide the option of recognising faults early on (preventive maintenance).

NOTE: A negative tendency of the control parameters such as for example the temperature of the oil, the interval for replacing the filter elements or noise, is an indication of variations.

Error detection provides useful help in defining the problem.

NOTE: A gradual increase in temperature and/or a reduction in filter replacement intervals indicate the wear of pumps, driving edges, seals and ageing of the oil and should suggest a general check of all the components considered.

A sudden and considerable temperature rise represents an alarm signal and requires immediate check of the machine.

8.12.1.1 Washing and care (maintenance)



ATTENTION!: The penetration of dirt and liquids causes faults!

The safe operation of the hydraulic unit/components is no longer guaranteed. Keep as clean as possible when working on the hydraulic control unit.



ATTENTION!: Surface damage due to aggressive solvents or detergents!

Aggressive detergents may damage the control unit seals and cause them to age faster. Never use aggressive solvents or detergents.



ATTENTION!: Damage to the hydraulics and gaskets!

- *The water pressure of a high-pressure water jet cleaner may damage the hydraulics and the seals of the hydraulic control unit;*
- *Do not use high pressure cleaning equipment for washing.*
- *Close all connections by means of suitable protective devices so that no type of detergent may enter the hydraulic control unit;*
- *Check that all the gaskets and connections of the coupling electrical connections are placed in such a way that no detergent enters.*



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8.12.2 Inspection, maintenance and repair

All the considerations that follow are based on the standard condition of a control unit installed in standard climatic conditions (Central European climate) and with environmental pollution characteristic of companies with an average level of cleanliness.

NOTE: Before proceeding with the inspection operations, carry out a washing if required. If operations are to be performed on the hydraulic control unit, pay specific attention when cleaning it.

Check the safety of the hydraulic system **every six months**.

8.12.3 Leak inspection

Before using the machine, and in any case **every month**, it is always required to check that no hydraulic system leaks are present. Therefore check the hoses, fittings and other components of the hydraulic system **every day** to prevent oil leaks.

Pressurised fluid leaks through small holes are almost invisible and can have enough force to pierce the skin. It is important to protect the eyes using safety goggles, provided with side lenses also, before checking for leaks.

Search for any pressurised liquid leaks by using a piece of cardboard or wood, never the hands. Injuries caused by pressurised fluids can lead to serious infections: we recommend contacting a doctor for immediate intervention with appropriate care.

8.12.4 Filling level








The filling level must be checked **every day**. The oil level is not constant during operation of the hydraulic control unit.

The level variations are due to the different useful volume of the plunging and differential cylinders or to the assimilation/emission of oil by hydraulic accumulators during a work cycle.

To visually check the oil level, according to the conditions mentioned above, it is required to observe a complete cycle of the machine to determine if it is necessary to top up oil and in what quantity. The oil level must not exceed the upper mark and fall below the lower mark during operation. If the oil drops below the minimum filling level, there is a risk that the pump will stop due to cavitation.

If the oil exceeds the maximum filling level, this may be caused by thermal expansion of the oil or by the infiltration of liquid (e.g. water due to internal leaks of the water/oil heat exchanger).

Hydraulic oils permitted are provided in Tab. 8.12-1. Do not mix different types of oil. The maximum capacity of the tank is **40 litres**.

Hydraulic system oils	
Brand	-10°C ++60°C
	RAISOL Oil ISO 46
	OSO 46
	TESSUL 46
	DTE 46
	HYPIN AWS 46
	NUTO M 46
	MR 46 AT

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8.12.5 Measures to be taken if the maximum filling level is exceeded

Expansion of the casing due to temperature increase:

- Correct the filling level.

Exceeding the maximum filling level due to probable water infiltration:

- Close the water valves (block the cooling water supply);
- Take oil samples at the deepest point of the tank and check the water content;
- If a water leakage is detected, stop the work cycle of the machine and put it in safe conditions;
- Repair, or if required, replace the water/oil heat exchanger according to the manufacturer's instructions;
- Take further control measures and based on the results achieved, perform the following operations:
 - Clean, drain or replace the oil;
 - Perform washing if required;
 - Check the oil in terms of the permitted water content.

8.12.6 Measures to be taken in case of oil below the minimum filling level



ATTENTION!: Danger of damage to property or persons due oil leak!

A decrease in the oil level is always linked to a leak.

- **First identify and eliminate the true cause of the leak;**
- **Only then fill the oil up to the correct filling level.**

8.12.7 Oil temperature

The oil temperature must be checked **at operating intervals of 8 hours.**

The potential causes of temperature increase are:

- Heat exchanger malfunction (if present);
- Change of cooling water conditions (if present);
- Malfunction or incorrect setting of pressure valves (e.g. maximum pressure limitation, pump regulator, pressure relief valve);
- Heating malfunction (if present);
- Pump defect (wear, leak increase);
- Variation of environmental conditions (e.g. increase in room temperature);
- Variation of drive load conditions.

In the event of an increase in the temperature not permitted, it is required to identify and remove the causes.



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8.12.8 Pressure values

The pressure values must be checked if the behaviour of the drives changes (e.g. cycle time increase, etc.). Alternatively it is recommended to perform **at least one check every six months**.

It is recommended to keep the pressure values in accordance with the maintenance documentation.

Lead sealing, e.g. of the accumulator safety valves, indicate that the original pressure calibration has not been changed. Without reaching the set pressure, it is not possible to check the lead sealed valves as part of a normal inspection. In this case the inspection consists in checking the integrity of the lead seals.

In case of faulty lead seals, contact the manufacturer.

8.12.9 Oil maintenance

Oil analysis should be carried out **at least once a year**.

To analyse the oil it is essential to take a suitable sample of oil. The oil sample must be analysed in a qualified laboratory according to the instructions provided by the oil manufacturer.

Based on the results obtained, adopt further measures if required, such as:

- Additional filtering operations;
- Dehydrogenation;
- Replacement.

NOTE: Avoid using purified waste oil (regenerated oil).

In case of oil replacement, allow the oil to drain completely. In this regard, also check the complete draining of the pipes and the fixture. Perform ventilation operations if required.

As for the first filling, fill after venting the hydraulic system.

8.12.10 Flexible pipes and compensators

The flexible pipes and compensators are composed of an elastic part (flexible pipe/bellows) and fittings mounted on both sides.

The flexible pipes can be (optionally) equipped with:

- Protection against abrasion (apply only in areas visibly subject to abrasion);
- Safety system for flexible pipes;
- Splash-protection (also possible with safety system for flexible pipes);
- Flame-protection (only possible with safety system for flexible pipes).

NOTE: Flexible pipes and compensators are components that require continuous inspection.



OBLIGATION!: Replace the flexible pipes and/or compensators in the event that the inspection shows:

- **Damage to the outer coating up to the reinforcement (e.g. points with abrasions, cuts or cracks);**
- **Visible traces of overheating, flames: Carbonisation, formation of bubbles or encrustations due to the partial effect of heat (hot spot);**
- **Embrittlement of the external coating (formation of cracks in the elastic parts).**
- **Deformation, not corresponding to the original shape of the components, both in the absence of pressure and with pressure charge;**
- **Non-hermetic points;**
- **Damage or deformation of the fitting (reduction of the sealing function);**
- **Reduction of operation and stability due to corrosion of the fitting;**
- **Flexible pipe coming out of the fitting;**
- **Storage and use duration exceeded.**

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OBLIGATION!: Ensure to have discharged any residue pressure, before disassembling or loosening the piping and hydraulic system fittings.

8.12.11 Pipes

The pipes are made up of pipes and connecting elements.

Connection types:

- Pipe deformation fitting;
- Threaded fitting for countersunk pipes
- Fitting with weld-in stud;
- Fitting with cutting ring;
- Flanged connection.

Pipe check must be performed **at least once every six months** (or more frequently based on operating conditions and usage).

To allow visual check, preventive washing may be required.

The check regards:

- Corrosion;
- Formation of cracks;
- Leaks;
- Signs of external force.

In the event of leakage at the threaded fittings these must be tightened again and monitored. If a fitting continues to leak, it is required to examine the fitting to identify the cause of the leak. Based on the results of the inspection, insert new gaskets and/or replace the fitting with the pipe part. In case of leakage from the flanges, proceed in the same way.

In the event of cracks or leaks in the welds, identify and eliminate the cause. Then, replace the affected components or repair them according to the rules of good practice.

In case of signs of external force locate and eliminate the cause. Then check the presence of damage to the component and also to the nearby pressurised parts and evaluate reliability for subsequent use. If required, replace these components or repair them according to the rules of good practice.

In the presence of signs of corrosion check if the component is damaged and assess its reliability for subsequent use. If required, replace the component or repair it according to the rules of good practice. In any case, set up an anti-corrosion protection.



8.12.11.1 Requirements for the assembly and disassembly of flexible hydraulic conduits

It is recommended to determine the number of supports based on the following average anchoring distances:

- 1500 mm for pressurised pipes;
- 3000 mm for low pressure pipes (Returns and drains).

When connecting hydraulic devices (distributors, valves, control unit, cylinders, etc.) make sure that the pipes and the devices themselves can be easily dismantled if required.

Therefore set up appropriate fittings on the inlets of the appliances and in the nodes of the pipes that allow to quickly remove any pipe section.

The pipes must not obstruct accessibility and visibility of the equipment, particularly at the points where there are control systems, fine-tuning or control devices and safety plates. Avoid installing too small radii and torsional stress when assembling the flexible pipes. The drainage connections of the hydraulic motors and of the different valves must be suitably fitted to the tank to avoid oil leaks.

The fittings are supplied according to the characteristics of the system and especially of the operating pressure and the diameters of the pipes.

For connecting rigid and flexible pipes, 3-piece fittings with a conical ring are normally used (Fig. 8.12-1).

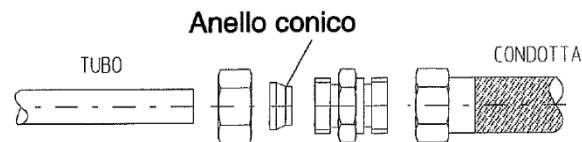


Fig. 8.12-1 - Rigid pipe connection

The path of the assembled pipe and the environment in which it is used directly affect the lifespan of the component. The following diagrams show the correct route of the assembled pipes that will maximise their lifespan, ensuring safe operation.

When pipe installation must be performed in a straight direction, it is important to check that the pipe play is sufficient to allow length changes when a specific pressure is applied. When it is under pressure, a pipe that is too short can disconnect from the relative fittings or negatively stress the connections of the fittings, causing breakages in the sealing joints or metal components.

The length of the pipe must be determined so that the assembled pipe has enough play to allow the components of the system to move or vibrate without creating tension on the pipe.

However, extreme caution must be exercised in order not to allow excessive play and therefore cause the risk of getting the tube caught on other equipment or rubbing it against other components.

It is required to avoid mechanical stress of the pipe: for this reason, during installation, it must not be bent beyond its minimum curvature radius nor twisted.

Depending on your needs, it is required to also take into account the movement surface and the pipe path.

The pipe path is also crucial for the selection of the fittings, which if chosen correctly, are able to prevent negative stress on the pipe, reducing its length and the multiple threaded joints.

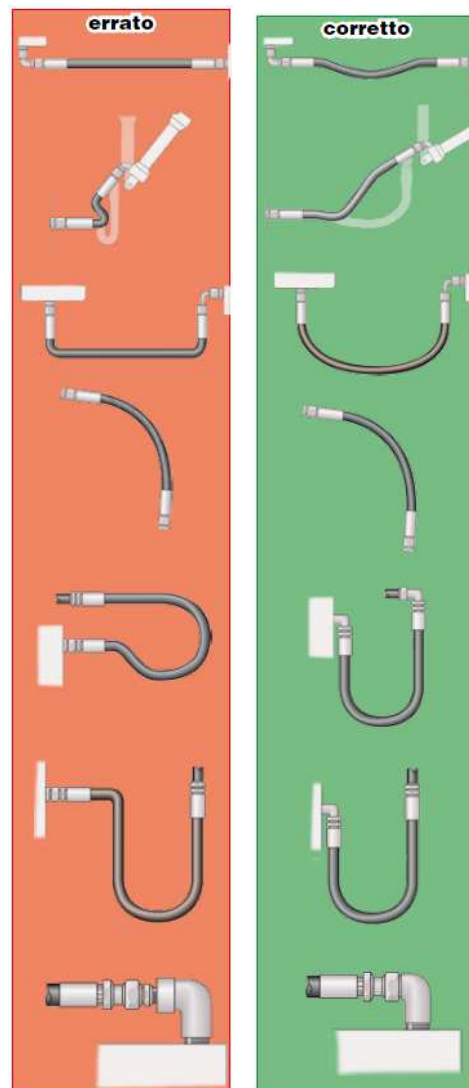


Fig. 8.12-2 - Pipe positioning

A correct tightening (block/support) of the pipe is crucial to properly direct the pipe and to prevent it from coming into contact with surfaces that may damage it. However, it is important for the pipe to preserve its “flexible pipe” functionality and to not be limited in extension when under pressure.

Please note that flexible pipes for low and high pressure applications must not be installed crosswise or fixed together, as the difference in their lengths may cause damage to the pipe coating. Do not bend the pipe on more than one surface. If the pipe follows a compound curve, it must be coupled in separate segments or secured in segments that can each bend on a surface.

The pipes must be installed at a correct distance from high temperature components as this factor reduces the lifespan of the pipe. It may be required to implement a protective insulation system in environments where the temperature reaches particularly high values.

Since the systems require regular maintenance, when designing the pipe, it would be better to avoid overly complex or sophisticated paths.



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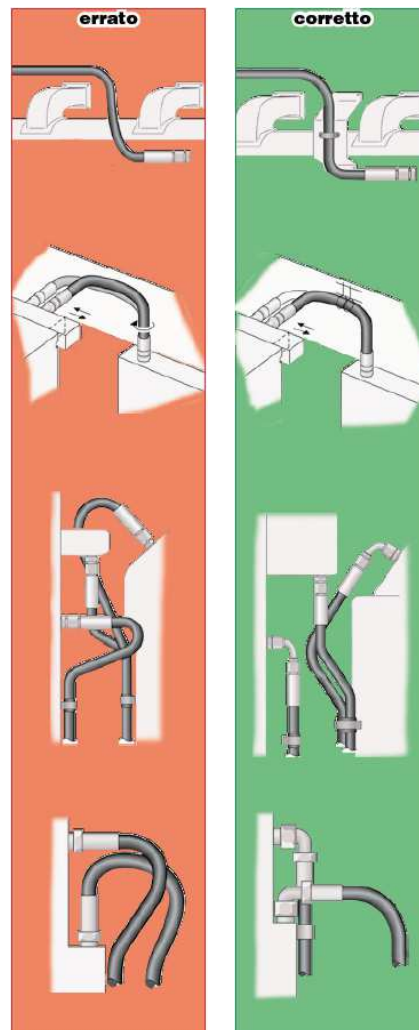


Fig. 8.12-3 - Pipe positioning

As a general precaution, it is important not to place the flexible pipe directly on surfaces that can cause wear or abrasion damage to the outer coating (pipe-to-pipe or pipe-to-object contact).

If, however, the application is such that it is not possible to avoid this type of installation, it is required to use a high-strength protective coating or sheath.

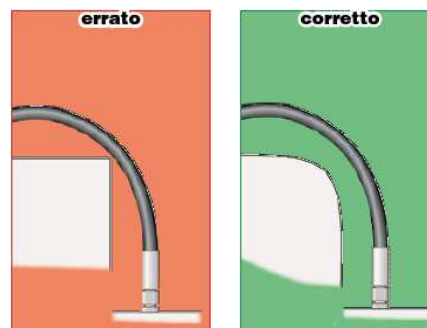


Fig. 8.12-4 - Contact surfaces detail

Once assembly is complete, fill the system with oil; the reliability of any machine or hydraulic system is related to the quality and the state of the fluid and the absence of impurities in the circuit.

- Bleed the air in the hydraulic system;



- The air enclosed in the pipes must be removed by loosening the connections of the highest parts of the system;
- The outflow of air is signalled by the presence of foam: when the flow from the fitting is continuous, the air has been removed;
- After a few hours of operation, clean the filters, check the oil levels in the tank again and check the tightness of the fittings;
- Any oil top-ups must be carried out with oil of the same brand, to avoid functional problems of various kinds.

8.12.12 Heat exchanger

The hydraulic system includes an air/oil heat exchanger.

When the cooling function of the heat exchanger is reduced, refer to the manufacturer's instructions for use.

To use the air/oil heat exchanger, regularly check the contamination of the plates and, if required, perform a washing.

8.12.13 Steel tanks and components external check

The external check is a visual check and must be performed **at least once every six months** (or more frequently based on operating conditions and usage). To allow visual check, preventive washing may be required. The visual inspection regards:

- Leaks;
- Formation of cracks;
- Corrosion,
- Dents caused by external forces.

In the event of leaks from the components screwed into the tanks these must be tightened again and monitored. If a part continues to leak, it is required to examine the contact point to identify the cause of the leak. Based on the results of the inspection, insert new gaskets and/or replace the component. In case of leakage from the flanged components, proceed in the same way.

In the event of cracks or leaks in the welds, identify and eliminate the cause. Then, replace the affected components or repair them according to the rules of good practice.

In case of signs of external force locate and eliminate the cause. Then check the presence of damage to the component and also to the nearby parts and evaluate reliability for subsequent use. If required, replace these components or repair them according to the rules of good practice.

NOTE: In case of signs external forces on the tank, it is required to perform an internal examination of the tank.

In the presence of signs of corrosion check if the component is damaged and assess its reliability for subsequent use. If required, replace the component or repair it according to the rules of good practice. In any case, set up an anti-corrosion protection.

8.12.14 Internal tank check

The internal check is a visual check of the inside of the tank and normally **occurs when the oil is replaced**. Oil replacement depends on the result of the analysis of the oil samples taken. To perform the visual check, it is first required to fully drain the oil. In case of contamination it is required to perform an internal washing in addition.

The visual inspection/test regards:

- Corrosion;
- Formation of cracks;
- Foreign bodies;
- For screw fittings, check that they are properly secured.



8.13 Crawler undercarriage maintenance

In addition to what is indicated below, refer to the attached original documentation for crawler undercarriage maintenance.

8.13.1 Crawler undercarriage periodic maintenance

Daily:

- Check the tension of the crawler;
- Check proper operation of the gearmotors;
- Check wear and the condition of the crawlers: replace them if only 10 mm of tread remains or even earlier if any cuts are found;
- Carry out a general and overall machine check;
- Check that there are no foreign bodies between the rollers and crawlers, between the idler wheels and crawlers, between the drive wheels and crawlers;
- Check that there is no leakage of flammable liquid and that it does not come into contact with hot parts or elements of the machine.

Monthly:

- Check the reduction gear oil level;
- Visually check fixing of the rollers;
- Check the bearings for any play.

Every 6 months:

- Check wear and the condition of the connections, pinions, lower rollers (they must be replaced when wear reaches the values shown in Tab. 8.13-3 of paragraph 8.13.4) etc;
- Check that the brakes work properly;
- Check tightening of the screws in general and especially those of the slide blocks.

Periodically:

- Check that the entire machine is clean;
- Check the integrity of the anchors, supports, framework, welds, pins etc. and especially the condition of the upper crawler slide;
- Check and maintain the paint in good conditions;
- Lubricate the crawler undercarriage (see par. 8.13.2).

8.13.2 Hydraulic gearmotor maintenance

The crawler operation reduction gear require specific care.

Two oil caps are present on them, which can be placed at various angles and of which only two examples are shown (Fig. 8.13-1), one for the drain hole (identified with the letter "A") and one for the filling one (identified with the letter "B").

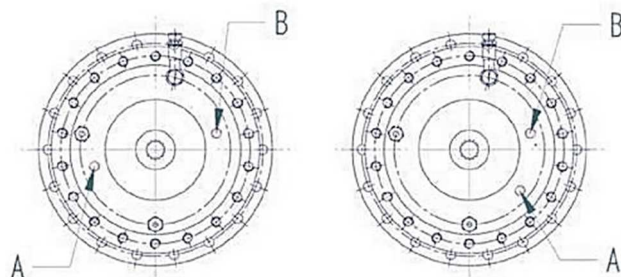


Fig. 8.13-1 - Oil caps on reduction gears: two different examples of cap position

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After approximately 100 hours of operation (running in), change oil in the reduction gear. Then, **every 2,000-2500 hours** of operation **or** in any case **every year**. Empty oil with the reduction gear hot to favour the outflow. Wash the inside of the reduction gear with suitable liquid and recommended by the manufacturer of the lubricants.

Periodically check the levels (about **every month**) and top up the oil, if necessary. Do not mix different types of oil.

The oils permitted for reduction gear lubrication are provided in Tab. 8.13-1. The oil used by the manufacturer is of the Pakelo brand.

The same lubricating oil lubricates all the gears of the reduction gear and therefore when you change oil in the reduction gear, the brake oil is also changed automatically.

Check that the magnetic cap of the reduction gear has no unusually sized metal parts.

Reduction gear oils				
Brand	-20°C + +50°C IV 95 min	-5°C + +30°C IV 95 min	-30°C + +50°C IV 95 min	-30°C + +65°C IV 95 min
	Eurolobe EP C ISO100	Eurolobe EP C ISO150*	Eurolobe EP C ISO320	Eurolobe EP C ISO460
	Spartan EP 100	Spartan EP 150	Spartan EP 320	Compressor Oil LG 150
	Blasia 100	Blasia 150	Blasia 320	Blasia SX 220
	Degol BG 100	Degol BG 150	Degol BG 320	Degol BG 220
BP MACH	GR HP 100	GR HP 150	GR HP 320	GR HP 220
	Alpha SP 100	Alpha SP 150	Alpha SP 320	Alpha SN 6
	Reductelf SP 100	Reductelf SP 150	Reductelf SP 320	Oritis 125 MS Syntherma P30
	Non leaded gear Compound 100	Non leaded gear Compound 150	Non leaded gear Compound 320	-
	-	EP lubricant HD 150	EP lubricant HD 150	-
	Mellana 100	Mellana 150	Mellana 320	Mellana Oil 100
Mobil	-	Mobilgear629	Mobilgear632	Glycoyle 22/30 SHC 630
	Omala Oil 100	Omala Oil 150	Omala Oil 320	Omala Oil SA
	Carter EP 100N	Carter EP 150N	Carter EP 320N	-
	Lamora 100	Lamora 150	Lamora 320	-
ISO 3448	VG100	VG150	VG320	VG150-200

Tab. 8.13-1



PROHIBITION! It is prohibited to open the reduction gear for any operation not included in routine maintenance. The manufacturer will not be held liable for operations not included in routine maintenance which cause damage to objects or persons. If needed, contact the specified assistance centres.



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8.13.2.1 Reduction gear lubrication

- Turn the reduction gear until the drain cap (position "A", Fig. 8.13-1) reaches approximately 15° below the centreline of the reduction gear.
- Remove the oil caps.
- Enter oil in the reduction gear by using the filling hole (position "B", Fig. 8.13-1) until oil seeps out from the drain hole (position "A", Fig. 8.13-1).
- Reassemble the caps.
- Turn the reduction gear a few times to eliminate any air pockets and then recheck the different levels.

8.13.2.2 Oil change

- Turn the reduction gear until the drain cap (position "A", Fig. 8.13-1) reaches the maximum lowest point.
- Unscrew the drain (position "A", Fig. 8.13-1) and filling (position "B", Fig. 8.13-1) caps to promote oil outflow from the reduction gear. Once oil has been emptied, put the drain cap back in.
- Wash the inside of the reduction gear with suitable washing oil and recommended by the manufacturer of the lubricants: introduce the washing oil in the reduction gear, then put the filling cap back on; spin the reduction gear for a few minutes and then empty it again.
- For filling, see par. 8.13.2.1.

8.13.3 Nuts and bolts tightening

The tightening torques of the undercarriage screws are provided below. Preloads F and tightening torques M for screws with ISO metric thread.

<i>Normal metric thread DIN 13</i>	<i>Class 8.8</i>	
	<i>F [N]</i>	<i>M [Nm]</i>
M4	3825	3
M5	6257	6
M6	8836	10.5
M8	16230	25.5
M10	25791	50
M12	37657	87.5
M14	51681	138.5
M16	71196	211
M18	86494	289.5
M20	111305	412
M22	139254	559
M24	160338	711
M27	210842	1049
M30	255952	1422
M33	319695	1932
M36	374612	2481
M39	451104	3226
M42	515827	3991

Tab. 8.13-2

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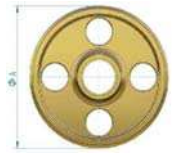
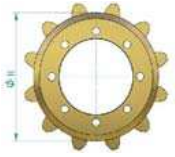
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8.13.4 Crawler part replacement

The following crawler components (Tab. 8.13-3) must be replaced before they reach the maximum limit of 100% wear.

Their replacement is to be considered a special operation.

Description	Type (code)	Image	Original diameter	Wear percentage			
				25%	50%	75%	100%
Lower rollers	_____		130 mm	129 mm	127.5 mm	125.5 mm	123 mm
Front wheels	_____		264 mm	263 mm	261.5 mm	259.5 mm	257 mm
Drive wheels	_____		264 mm	263 mm	261.5 mm	259.5 mm	257 mm

Tab. 8.13-3



ATTENTION!

- *Special maintenance is reserved to qualified and appropriately trained personnel, preferably employed by the manufacturer or by authorised workshops.*
- *Whenever important parts of the machine are disassembled and reassembled (engine, etc.) the control and adjustment operations must be repeated before using the undercarriage.*
- *Only use original spare parts.*
- *Make sure the machine is in a stable position.*

8.13.4.1 Crawler replacement

The crawler must be replaced when only **10 mm of tread remains or even earlier if any cuts are found.**

Proceed as follows:

- Do not lift the machine too far off the ground (30/40 cm will suffice).
- Thoroughly clean the parts of the undercarriage.
- Remove the side closing of the spar (Fig. 8.13-2).

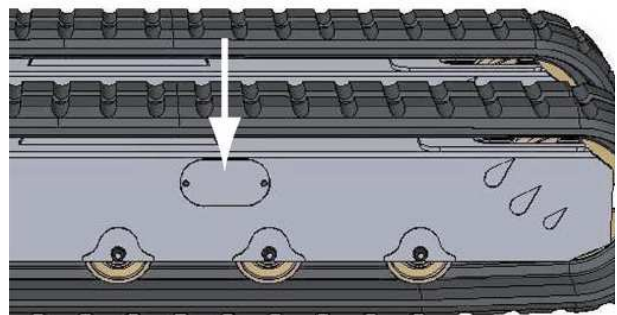


Fig. 8.13-2 - Crawler spar side closing position



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- Loosen the tensioning valve (Fig. 8.13-3). Only disassemble the tensioning valve when grease pressure has been released.

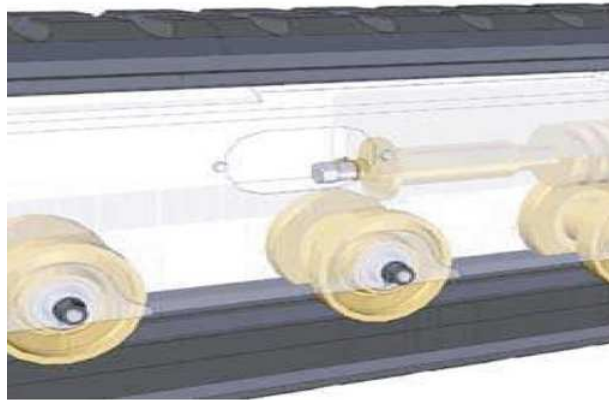


Fig. 8.13-3 - Crawler tensioning valve

- Move the front wheel back, pressing the crawler with your foot.
- Lift the crawler in the bottom centreline.
- Remove the crawler from its seat (outwards), making leverage between it and the idler wheel.

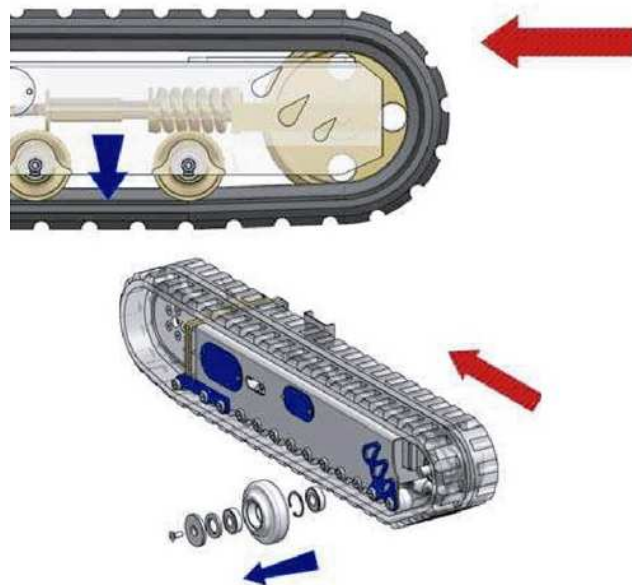


Fig. 8.13-4 - Crawler removal



ATTENTION! Use personal protective equipment (safety footwear) Pay close attention when the crawler drops to the ground.

- To install the new crawler, proceed as indicated above in inverse order.
- The right crawler tension is achieved by using the tensioning kit (Fig. 8.13-5).

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Fig. 8.13-5 - Tensioning kit

The correct tensioning pressure of the crawler is 150 bar.



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8.14 Spraying boom maintenance



ATTENTION! *If operations must be performed with a mobile boom not in transport position, always apply blocks or supports to eliminate the risk of falling boom in the event of any anomaly.*

In addition to what is indicated below, refer to the attached original documentation for spraying boom maintenance.



PROHIBITION! *Different parts of the boom are built in high elastic limit special steel. Never perform processes (welding, drilling, grinding) without the authorisation and instructions of the Manufacturer.*



ATTENTION! *The boom is equipped with electric and electronic devices. Disconnect the power and earth cables of these devices, before performing welding or other operations with electric tools on the machine.*

8.14.1 Mobile boom periodic maintenance

Daily:

- Check that the boom can be operated easily and that the controls return to their neutral position.
- Check that the rest of the boom is free of damage.
- Immediately repair any faulty parts or elements of the boom.

Monthly:

- Check and tighten the fixing bolts of the boom.
- Check and tighten the fittings of hoses and pipes.
- Check the fixing devices and other safety devices.
- Check the pipe support hooks used.
- Perform a visual check of the structural parts to verify any deformation, play in the pins etc.
- Check regular operation of the rotation system making sure to grease the screw and the crown with specific grease, making sure the spreader is still efficient.
- Perform an operating test of the boom listening for any suspicious noise.
- Grease hydraulic extensions (see par. 8.14.2.1).

Every 6 months:

- Clean the boom.
- Check and tighten screwed assemblies.
- Check and tighten the fixing bolts of the boom.
- Check and tighten the pipe fittings.
- Perform a visual check of the structural parts to verify any deformation, play in the pins etc.
- Perform an operating test of the boom listening for any suspicious noise.

8.14.2 Mobile boom lubrication

The parts indicated in Fig. 8.14-1 and Fig. 8.14-2 must be periodically lubricated with the modes and greases indicated in Tab. 8.14-1.

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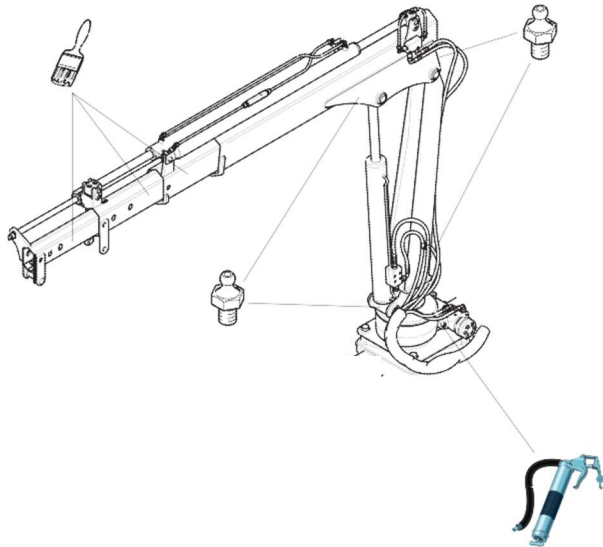












Fig. 8.14-1 - Boom lubrication points



Fig. 8.14-2 - Nozzle holding wrist lubrication points

<i>Grease for boom</i>			
<i>Brand</i>			
	MULTIS EP2	MULTIS EP2	-
	MOBILGREASE MP	MOBILGREASE MP	MOBILTAC D
	BEACON EP2	BEACON EP2	EDL-501
	GR MU EP2	GR MU EP2	-
	ATHESIA EP2	ATHESIA EP2	-
	ENEGREASE LR MP	ENEGREASE LR MP	-
	-	-	GS-80

Tab. 8.14-1

8.14.2.1 Extension lubrication

Spread grease on the outer part of the extensions.

Perform this operation by extending the hydraulic extensions to facilitate greasing the inside of the extension.



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8.14.3 Boom rotation end of stroke

Boom rotation is controlled by:

- Inductive end of strokes;
- Mechanical end of strokes.

The inductive end of strokes have functional priority over the mechanical ones.

In the event that the inductive sensors do not work properly or fail, only the mechanical end of strokes will work. The inductive end of strokes must therefore be immediately replaced.

During replacement, or in the case where it is required during the maintenance operations to temporarily disable the inductive end of strokes, proceed as follows.

To deactivate the inductive end of strokes, open the electric control board and turn the cut-off switch (**SA1**).



Fig. 8.14-3 - Boom rotation end of stroke

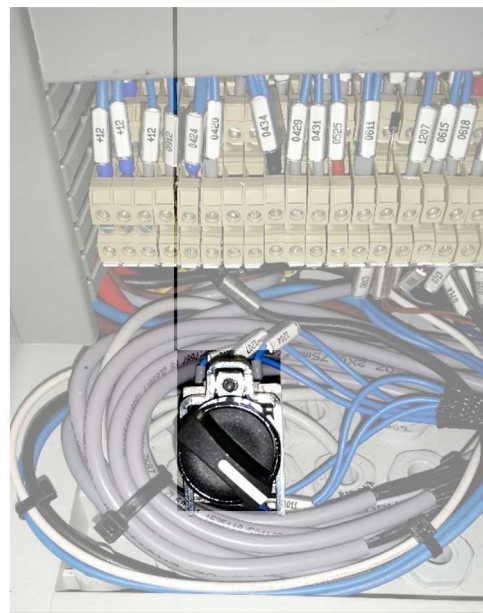


Fig. 8.14-4 - Inductive end of strokes cut-off switch (inside the electric control board)



OBLIGATION!: Inductive sensors must remain deactivated for as little as possible. Restore them as soon as possible.



8.15 Outrigger maintenance

8.15.1 Outrigger periodic maintenance

Clean and grease, if required, the outrigger extensions **every day**.
 The greases permitted for outrigger lubrication are provided in Tab. 8.15-1.
 The grease used by the manufacturer is of the Loctite brand.

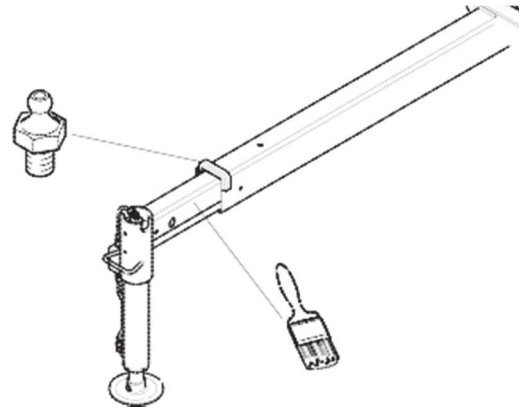








Fig. 8.15-1 - Outrigger lubrication points

<i>Grease for outrigger extensions</i>		
<i>Brand</i>		
LOCTITE	8192	-
	MULTIS LR MP	MULTIS EP2
Mobil	MOBILGREASE MP	MOBILGREASE MP
	BEACON EP2	BEACON EP2
	GR MU EP2	GR MU EP2
	ATHESIA EP2	ATHESIA EP2
BP	ENEGREASE LR MP	ENEGREASE LR MP

Tab. 8.15-1



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8.16 Cleaning the machine

Before using the machine always check that the air inlets or heat exchangers are kept clear of impurities in order not to obstruct the free flow of air could cause harmful overheating.

The entire machine must be kept clean and in good condition, eliminating any incrustations or residues/deposits of processed products (such as concrete), or due to the environment of use such as snow and ice, in particular from the handles and the driving footboard. Additionally, the machine must be washed **after each use** (see par. 7.10).

For cleaning operations, follow the requirements below:

- Protect yourself using goggles with side guards, when using compressed air to clean parts. Limit the pressure to a maximum of 2 bar.
- Never use petrol or solvents or other flammable liquids such as detergents. Use authorised, non-flammable and non-toxic trade solvents.
- Never wash the spraying boom with chemical degreasers or high-pressure water jets.



OBLIGATION!: In all cleaning operations it is mandatory to wear adequate respiratory tract and eye personal protective equipment.

8.17 Recommended spare parts

To ensure efficient machine maintenance, Turbosol Produzione S.r.l. recommends its customers to procure spare parts (recommended spare parts). Annex A9 Spare parts **list** lists the spare parts recommended for the Spritzbeton mobile spraying machine.

Use only the components indicated in the specific product documentation.
For gaskets, only use new parts with the required fluid resistance.

To request spare parts, always indicate:

- The identification date on the rating plate: type of machine, serial number, year of manufacture;
- Description of the part to be replaced, found in this manual;
- The amount of requested parts.

When requesting spare parts of components not manufactured by us, provide the data on the relative rating plates and contact the assistance centre.

Repairs, maintenance and parts replacements not compliant with that indicated this manual exclude the user from any warranty and relieve the Manufacturer from all liability for malfunctioning of the machine and any resulting consequences.



ATTENTION!: Only use original spare parts.

Spare parts that do not match to the specific documentation of the product supplied may cause mechanical damage or malfunction of the machine.



8.18 Machine examination

The machine must be re-examined for operational reliability by a competent person appointed by the user **at least once a year**. The re-inspection must be carried out even if a year has not passed since the last inspection **after 1000 operating hours at the latest**.

The operating counter on the machine must be used to determine when a re-inspection is required.

The operating counter must always be kept in operating conditions. It must not be altered in any way.

Machines **more than 5 years old** must be re-examined as soon as **500 operating hours are reached, however at least once a year**.

Machines **more than ten years old** must be re-examined as soon as **250 operating hours are reached, however at least once a year**.

The examination of the machine is essentially a visual and functional inspection for safety purposes and must be documented in a specific register.

The machine examination includes:

- The inspection of the condition of components and devices in relation to cracks, damage, wear, corrosion and other changes;
- The inspection of the completeness and functionality of the safety devices;
- The inspection to determine if the defects found during the aforementioned inspections, which may compromise safety, have been carried out correctly.

It is the responsibility of the user to assign an inspector, i.e. a specialist in re-examinations, for the complete inspection of the machine to be carried out within the times required and indicated above.

8.18.1 Spraying boom inspection register

The results of the examinations/inspections of the machine must be entered in the inspection register and certified by the inspector.

The register header that the user must maintain is provided below by way of example.

Concrete spraying boom	Spritzbeton mobile spraying machine		
Manufacturer	Turbosol Produzione S.r.l.		
Model	TSR 7	Serial no.	_____
Customer (owner)	_____		

Tab. 8.18-1

Annex A10 Machine inspection report includes an example of a machine inspection report.

It is recommended to copy it, in order to have it always available at every re-examination of the machine.



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9 Machine storage conditions

9.1 Temporary decommissioning

In the event that the machine needs to be decommissioned for short periods, it will be sufficient to disconnect the connections to the electric and pneumatic mains, as well as to the product refuelling equipment, perform cleaning at the end of the operations and protect the rough parts (not protected by paints, surface treatments or plastic) by means of anti-rust protective oils.

9.2 Decommissioning for long periods

In the event that it is expected for the decommissioning to last a long period of time, it is recommended to thoroughly clean the machine. Then repeat the operations provided at paragraph 9.1 and at the following paragraphs 9.2.1 and 9.2.2.

Once these operations have been completed, seal the machine inside an opaque (black) multilayer nylon bag inside which a special dryer (silica gel) has been previously inserted.

If required, empty the fuel tank.



All connection or disconnection operations of the machine to the electrical mains must be carried out by authorised personnel in accordance with Decree 22 January 2008 no.37.

9.2.1 Preparation for decommissioning of the hydraulic system

Place enough large storage tanks to hold the total volume of oil.

The overall volume of the hydraulic system consists of the volumes of the tank, the pipe system, the drives, etc.

In principle, observe the following safety instructions:

- Avoid damage due to the proximity of the machines;
- Preventing unauthorised persons from standing inside the premises;
- Decrease the load or set up a solid base.

9.2.2 Performing decommissioning of the hydraulic system

- Disconnect the electric current and prevent any activation (power supply side short-circuit - bridge);
- Close and secure the hydraulic pressure supply;
- Depressurise the oil side accumulator;
- Drain the oil into the storage tank set up. For this purpose, make sure that the pipes and the fixture are fully drained. Perform venting if required.



OBLIGATION!: Oil disposal must take place in compliance with current regulations. Under no circumstances is it allowed to disperse these substances into the environment.



10 Dismantling the machine

10.1 Dismantling the machine

The machine must be dismantled at a workshop with the specific authorisations to perform this activity. In any case it is required to remember some operations that must be carried out before demolition and in any case after decommissioning.



PROHIBITION! It is strictly forbidden to dispose of the machine or parts of it through the normal urban solid waste collection service (even if differentiated).



- Remove any lubricants (oils and greases) from the devices that contain them. For the removal of these substances follow the instructions provided in the maintenance chapter and the previous chapter 9. Lubricant disposal must take place in compliance with current regulations. Under no circumstances is it allowed to disperse these substances into the environment;
- Remove any accumulators (buffer batteries, dry cells, etc.) from the machine. The accumulators removed must be disposed of in compliance with current regulations;
- Remove and subsequently destroy the identification plates, and any other document relating to the machine (manuals, diagrams, etc.) from it.

10.2 General regulations concerning the disposal of industrial waste

Since different regulations are in force in the individual Countries, the prescriptions set by the laws and by the bodies designated by the Countries must be complied with. The following text is valid for the Italian territory.

The following notes for the disposal of the machine, follow the current legislation:

- Directive 91/156/EEC on waste;
- Directive 91/689/EEC on hazardous waste;
- Directive 94/62/EC on packaging and packaging waste;
- Legislative Decree 8 November 1997, no. 389;
- Legislative Decree 3 April 2006, no. 152 and subsequent amendments.

The *machine*, according to current legislation, once discarded, is classified as *special waste*.



The costs regarding disposal activities are borne by the holder of the waste, who must deliver it to an authorised collector or to a person who carries out the operations identified in Annex B - at Part four, Title I, of Legislative Decree no.152/2006.

The responsibility of the holder for the correct recovery or disposal of waste, is excluded in case of waste transfer to the public collection service and in the case of transfer of hazardous waste to persons authorised for recovery or disposal, provided that the holder has received a form pursuant to art. 193 of Legislative Decree no.152/2006, countersigned and dated as required by the same.



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10.3 Waste management by companies



ATTENTION! The following requirements do not apply, if the holder of the waste is a private person.

Pursuant to Legislative Decree no.152/2006, companies and industrial bodies are required to annually communicate, with the methods established by law, the quantities and quality characteristics of hazardous waste in the aforementioned activities.

it is mandatory to keep a loading and unloading record with numbered sheets and authenticated by the Registry Office, on which the information on the qualitative and quantitative characteristics of the waste must be noted (loading and unloading registers).

The annotations must be performed weekly and must indicate:

- The origin, quantity, characteristics and specific destination of the waste;
- The date of loading and unloading of waste and the means of transport used;
- The treatment method used.

The registers, with numbered sheets and registered by the Registry Office, must be kept at the waste production, storage, recovery and disposal facilities.

The registers integrated with the waste transport *forms* will be kept for five years from the date of the last registration.

If annual waste production does not exceed 5 tonnes of non-hazardous waste and one tonne of hazardous waste, companies can fulfil the obligation to keep the waste loading and unloading registers also through the relevant trade associations or service providers that record the data required on a monthly basis, keeping a copy of the transmitted data at the company headquarters.

The aforementioned *form*, known as "*identification*", is used to accompany waste during transport by bodies or companies.

The *Sub-form* must specifically indicate the following data:

- Name and address of the waste producer and of the holder;
- Origin, type and quantity of waste;
- Destination plant;
- Date and location of the installation;
- Name and address of the recipient.

The *form* must be drawn up in 4 copies signed by the waste holder and countersigned by the transporter.

A copy must remain with the holder; of the other three, one remains at the recipient and two remain at the transporter.

Copies of the *form* must be kept for 5 years.

During transport and collection, hazardous waste must be packaged and labelled in accordance with applicable regulations.

For any *packaging* of the machine or spare parts, it is mandatory to comply with the rules set by CONAI (National Consortium for packaging), which shall indicate in detail how to recover and dispose of the packaging on the territory.

Regarding oil management, the law requires the establishment of a mandatory national consortium for the collection and treatment of waste vegetable and animal oils and fats, which ensures the transportation, storage, treatment and reuse of waste vegetal and animal oils and fats.

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ATTENTION! Anyone who, by reason of their activity and pending the consortium, holds waste vegetable and animal oils and fats, is obliged to store them in an appropriate container complying with the provisions in force concerning disposal.



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11 Summary table for periodic maintenance

The frequency of maintenance operations, broken down by type, is summarised below (Tab. 10.3-1).

See chapter 8 for detailed information on the operations to be performed.

Frequency ⁷	Daily (8 hours)	Every week (40 hours)	Every two weeks (80 hours)	Monthly (170 hours)	Every three months (510 hours)	Every six months (1020 hours)	Every year (2040 hours)	Other
SAFETY SIGNS AND DEVICES								
Safety signs check par. 8.6, page 101						<input checked="" type="checkbox"/>		
Emergency buttons par. 8.7.1, page 102						<input checked="" type="checkbox"/>		Check on each machine use
Guards par. 8.7.2, page 102						<input checked="" type="checkbox"/>		
Protection fuse replacement par. 8.7.4, page 102								In case of fusion
Brake on reduction gears par. 8.7.5, page 103						<input checked="" type="checkbox"/>		
Outriggers par. 8.7.6, page 103								Check on each machine use
Maximum pressure valves par. 8.7.7, page 103						<input checked="" type="checkbox"/>		
Locking valves par. 8.7.8, page 103						<input checked="" type="checkbox"/>		
MOTORS								
Electric motor maintenance par. 8.8, page 104							<input checked="" type="checkbox"/>	See manual and/or sheets attached
Endothermic engine maintenance par. 8.9, page 106								See manual and/or sheets attached
MECHANICAL PARTS								
Keys and fixing grub screws par. 8.10.1, page 106						<input checked="" type="checkbox"/>		
ELECTRICAL SYSTEM								
Electrical system maintenance par. 8.11, page 107	<input checked="" type="checkbox"/> Photocell lenses*					<input checked="" type="checkbox"/>		* In dusty environment

⁷ Referred to 8 hours of machine operation.

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Frequency ⁷	Daily (8 hours)	Every week (40 hours)	Every two weeks (80 hours)	Monthly (170 hours)	Every three months (510 hours)	Every six months (1020 hours)	Every year (2040 hours)	Other
Remote control maintenance par. 8.11.3, page 108								Check on each machine use
HYDRAULIC SYSTEM								
Inspection, maintenance and repair par. 8.12.2, page 110				<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		Continuous inspection
Leak inspection par. 8.12.3, page 110	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>				
Filling level par. 8.12.4, page 110	<input checked="" type="checkbox"/>							
Oil temperature par. 8.12.7, page 111	<input checked="" type="checkbox"/>							
Oil maintenance par. 8.12.9, page 112							<input checked="" type="checkbox"/>	Oil replacement Internal tank check in case of oil replacement (see par. 8.12.14)
Flexible pipes and compensators par. 8.12.10, page 112		<input checked="" type="checkbox"/>						Continuous inspection Wear Tightening of fittings
Pipes par. 8.12.11, page 113						<input checked="" type="checkbox"/>		Wear Tightening of fittings
Heat exchanger par. 8.12.12, page 117						<input checked="" type="checkbox"/>		
Steel tanks and components external check par. 8.12.13, page 117			<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>		
OTHER OPERATIONS								
Cleaning the machine par. 8.16, page 128	<input checked="" type="checkbox"/>							See the relative paragraph

Tab. 10.3-1



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The frequency of maintenance operations for the **undercarriage crawler**, is summarised below (Tab. 10.3-2).

Refer to chapter 8 and the documentation of its enclosed parts for detailed information on the operations to be performed.

Parts	Frequency When necessary	Daily	Every 50 hours or every week	Every 250 hours or every month	Every 500 hours or every year	Every 1000 hours or every 24 months	Other
GENERIC CHECKS							
Cleaning the machine		<input checked="" type="checkbox"/>					
Leaks from pipes check		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>			
Nuts and bolts tightening check				<input checked="" type="checkbox"/>			
Painting check				<input checked="" type="checkbox"/>			
Undercarriage lubrication				<input checked="" type="checkbox"/>			
Outrigger extensions check		<input checked="" type="checkbox"/> Cleaning and greasing		<input checked="" type="checkbox"/>			
CRAWLERS							
Crawler tension check		<input checked="" type="checkbox"/>					
Gearmotor check		<input checked="" type="checkbox"/>					
Reduction gear oil level check				<input checked="" type="checkbox"/>			
Crawler wear check		<input checked="" type="checkbox"/>					
Absence of foreign bodies inside crawlers check		<input checked="" type="checkbox"/>					
Roller fixing check				<input checked="" type="checkbox"/>			
Brake check				<input checked="" type="checkbox"/>			
HYDRAULIC SYSTEM							
Hydraulic services operation check		<input checked="" type="checkbox"/>					
Hydraulic system oil check		<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/> Replacement	
Flexible pipe friction and damage check			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			

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Frequency	When necessary	Daily	Every 50 hours or every week	Every 250 hours or every month	Every 500 hours or every year	Every 1000 hours or every 24 months	Other
Parts							
Pipe wear check			<input checked="" type="checkbox"/>				
Tightening of fittings				<input checked="" type="checkbox"/>			
Oil tank breather cap replacement				<input checked="" type="checkbox"/>			
Hydraulic oil filter replacement				<input checked="" type="checkbox"/>			
ELECTRICAL SYSTEM							
Indicator lights and audible alarms check		<input checked="" type="checkbox"/>					
Electric appliances operation check		<input checked="" type="checkbox"/>					
Dashboard check		<input checked="" type="checkbox"/>					
Battery electrolyte level check				<input checked="" type="checkbox"/>			
Battery pole cleaning				<input checked="" type="checkbox"/>			
Safety check		<input checked="" type="checkbox"/>					
Audible-luminous warning devices check	<input checked="" type="checkbox"/>						

Tab. 10.3-2



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The frequency of maintenance operations for the **spraying boom**, is summarised below (Tab. 10.3-3).

Refer to chapter 8 and the documentation of its enclosed parts for detailed information on the operations to be performed.

The special maintenance operations are those with a yearly frequency: contact the support service.

Parts	Frequency	When necessary	Daily	Every 50 hours or every week	Every 150 hours or every year	Every 500 hours or every year	Every 1000 hours or every 24 months	Other
STRUCTURE								
Main supports check (no cracks)				<input checked="" type="checkbox"/>				
Boom and outrigger extensions check and greasing (no cracks)				<input checked="" type="checkbox"/>				
Casings check and cleaning				<input checked="" type="checkbox"/>				
Joints check				<input checked="" type="checkbox"/>				
Fixing bolts check					<input checked="" type="checkbox"/>			
Wrist greasing					<input checked="" type="checkbox"/>			
Wear and tightening of pipes check (concrete pipes, air pipes, additive pipes)	<input checked="" type="checkbox"/>							
HYDRAULIC SYSTEM								
Valves and cylinders check (leaks / operation)					<input checked="" type="checkbox"/>			
Distributor check (leaks / operation)					<input checked="" type="checkbox"/>			
Pipe check (leaks / operation)				<input checked="" type="checkbox"/>				
Fittings tightening check				<input checked="" type="checkbox"/>				
Hydraulic pressure check					<input checked="" type="checkbox"/>			
ELECTRICAL SYSTEM								
Panel check (Oxidization)					<input checked="" type="checkbox"/>			
Power supply check (Check Conditions)					<input checked="" type="checkbox"/>			
SAFETY								

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Parts	Frequency	When necessary	Daily	Every 50 hours or every week	Every 150 hours or every year	Every 500 hours or every year	Every 1000 hours or every 24 months	Other
	Stickers and visual warnings check				<input checked="" type="checkbox"/> Cleaning	<input checked="" type="checkbox"/>		
Rotation end of stroke sensors check				<input checked="" type="checkbox"/>				
COMPLETE CHECK								
Complete check of boom including tests						<input checked="" type="checkbox"/>		

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A1 EC Declaration of Conformity Copy

ANNEXES



Use and maintenance manual





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A2 EC plate copy

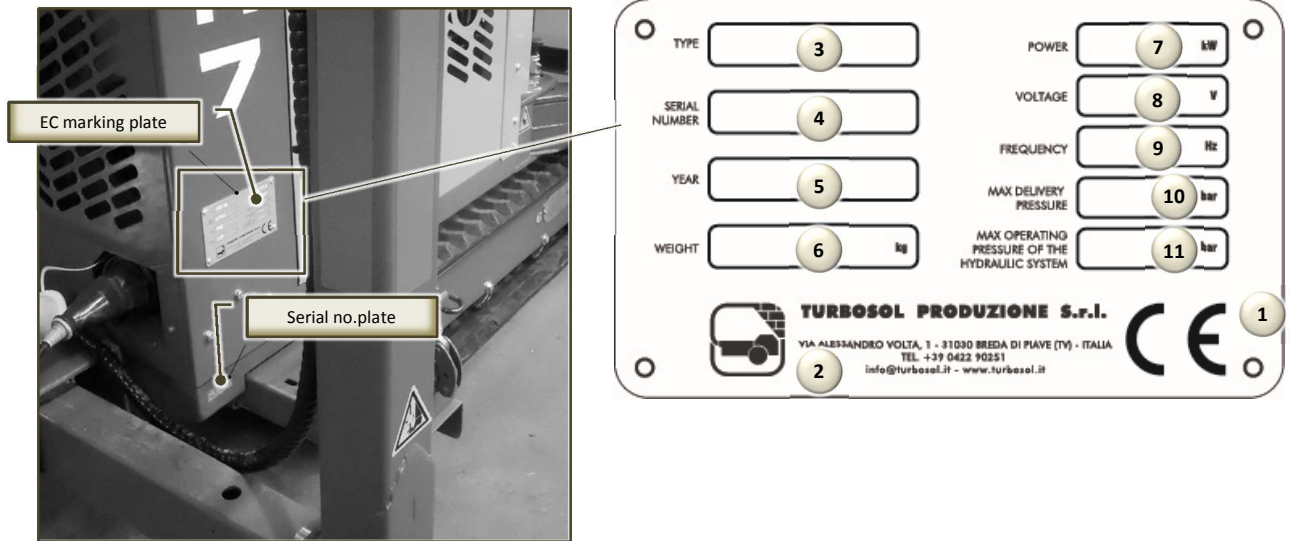


Fig. A2-1 - EC plate of Spritzbeton mobile spraying machine

1	CE Marking
2	Manufacturer's company name and address
3	Type
4	Serial no.
5	Year of manufacture
6	Weight
7	Installed power
8	Power voltage
9	Frequency
10	Maximum pumping pressure
11	Maximum hydraulic system pressure



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A3 Wiring diagram



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A4 Hydraulic diagram



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A5 Endothermic engine instructions



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A6 Crawler undercarriage instruction



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A7 Electric motor technical data sheet



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A8 Remote control instructions



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A9 Spare parts list



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A10 Machine inspection report

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Azienda		CAP:		Luogo	
Tipo di braccio per la distribuzione di calcestruzzo		N° braccio per la distribuzione di calcestruzzo:		Reparto	

Verifica - Risultato dell'ispezione

Nessun difetto	<input type="radio"/>	Difetti	<input type="radio"/>
Richiesta nuova ispezione	<input type="radio"/>	Arrestare il funzionamento	<input type="radio"/>
Nuova ispezione entro (data):			

Codice avaria:

00 nessuna obiezione	08 corrosione	16 poroso	24 deformazione
01 cricche	09 vernice danneggiata	17 fuso	25 gioco dei cuscinetti
02 rotto	10 perforato	18 allentato	26 lubrificazione
03 perdita	11 inciso	19 inceppato	27 leggibilità
04 nessuna funzione	12 piegato	20 tagliato/interrotto	28 parti mancanti
05 durata breve	13 rumore	21 sporco	29 avaria idraulica
06 usura	14 vibrazioni	22 contatto allentato	30 avaria elettrica
07 trucioli	15 altri	23 temperatura	31 richiesta nuova ispezione

	Codice avaria	Codice avaria
100 Documenti della macchina		Cilindro oscillante
Manuale di istruzioni		Idrraulica dell'estensione
Elenco parti di ricambio		Regolazione della pressione
200 Telaio di base	400 Stabilizzatori posteriori D+S	
Ancoraggi al telaio		Sistema di blocco stabilizzatori
300 Stabilizzatori anteriori D+S		Telai stabilizzatori
Sistema di blocco stabilizzatori		Elemento sfilabile
Telai stabilizzatori		Telaio della sovrastruttura dell'elemento sfilabile
Elemento sfilabile		Protezione elemento sfilabile
Protezione elemento sfilabile		
Cuscinetti guida		Osservazioni:
Protezione rotazione		
Protezione stabilizzatori		
Blocchi stabilizzatori		
Collegamento cilindro stabilizzatore		
Cilindro stabilizzatore		

Inserire il numero avaria corrispondente, per esempio 01 (cricche) - non contrassegnare 31 Contrassegnare il numero del codice avaria corrispondente (00, 31) 01
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Tipo di braccio per la distribuzione di calcestruzzo		N° braccio per la distribuzione di calcestruzzo:		Reparto	

Verifica - Risultati dell'ispezione

Nessun difetto	<input type="radio"/>	Difetti	<input type="radio"/>
Richiesta nuova ispezione	<input type="radio"/>	Arrestare il funzionamento	<input type="radio"/>
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07 trucioli	15 altri	23 temperatura	31 richiesta nuova ispezione

	Codice avaria		Codice avaria
Cuscinetti guida		Dispositivo idraulico di salita	
Protezione rotazione		Adattatore per torre rampante	
Protezione stabilizzatori		Connettore a disconnessione rapida,	
Blocchi stabilizzatori		Connettore a disconnessione rapida,	
Collegamento cilindro stabilizzatore	600	Gruppo rotazione: ralla-riduttore	
Cilindro stabilizzatore		Torretta	
Cilindro oscillante		Ralla	
Idraulica dell'estensione		Attacco ralla	
500 Supporto del braccio per la distribuzione di		Motoriduttore rotazione braccio	
Attacco del supporto del braccio per la		Attacco motoriduttore rotazione braccio	
Telaio della sovrastruttura		Fine corsa	
Telaio		Azionamento della rotazione (gioco degli	
Sostegno del braccio per la distribuzione di		Azionamento della rotazione	
		Funzione frenante	
Sostegno del braccio per la distribuzione di		Velocità	
Blocco parti mobili		Regolazione della pressione	
Linea idraulica		Linee idrauliche	
Colonna tubolare ___ m	700	Gruppo rotazione sottotorretta	
Colonna tubolare ___ m		Torretta	
Base del braccio tubolare		Gioco della colonna rotante	
Basamento a X		Motoriduttore	
Telaio di sostegno dei piani		Velocità	
Telaio di sostegno dei piani		Regolazione della pressione	
Telaio di sostegno della colonna		Linee idrauliche	
Telaio di sostegno della colonna		Cilindro oscillante	

Osservazioni:

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Tipo di braccio per la distribuzione di calcestruzzo		N° braccio per la distribuzione di calcestruzzo:		Reparto	

Verifica - Risultati dell'ispezione

Nessun difetto	<input type="radio"/>	Difetti	<input type="radio"/>
Richiesta nuova ispezione	<input type="radio"/>	Arrestare il funzionamento	<input type="radio"/>
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05 durata breve	13 rumore	21 sporco	29 avaria idraulica
06 usura	14 vibrazioni	22 contatto allentato	30 avaria elettrica
07 trucioli	15 altri	23 temperatura	31 richiesta nuova ispezione

	Codice avaria		Codice avaria
800	Braccio per la distribuzione di calcestruzzo	900	Giunzione "A" - Sezione 1
	Sezione 1		Bullone di giunzione
	Guida e blocco del braccio		Cilindro A
	Sostegno linea di distribuzione		Velocità
	Gancio		Regolazione della pressione
	Sezione 2		Linee idrauliche
	Guida e blocco del braccio		Valvola di sicurezza (lato pistone)
	Sostegno linea di distribuzione		Valvola di sicurezza (lato stelo)
	Gancio		Sincronizzazione due cilindri
	Sezione 3	1000	Giunzione "B" - Sezione 1-2
	Guida e blocco del braccio		Bullone di giunzione
	Sostegno linea di distribuzione		Cilindro B
	Sezione 4		Velocità
	Guida e blocco del braccio		Regolazione della pressione
	Sostegno linea di distribuzione		Linee idrauliche
	Sezione 5		Valvola di sicurezza (lato pistone)
	Guida e blocco del braccio		Valvola di sicurezza (lato stelo)
	Sostegno linea di distribuzione		Sincronizzazione due cilindri
			Osservazioni

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Tipo di braccio per la distribuzione di calcestruzzo		N° braccio per la distribuzione di calcestruzzo:		Reparto	

Verifica - Risultati dell'ispezione

Nessun difetto	<input type="radio"/>	Difetti	<input type="radio"/>
Richiesta nuova ispezione	<input type="radio"/>	Arrestare il funzionamento	<input type="radio"/>
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Codice avaria:

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07 trucioli	15 altri	23 temperatura	31 richiesta nuova ispezione

	Codice avaria		Codice avaria
1100	Giunzione "C" Sezione 2 + 3		
	Leva di inversione		Bullone di giunzione
	Asta della pressione		Cilindro E
	Bullone di giunzione		Velocità
	Cilindro C		Regolazione della pressione
	Velocità		Linee idrauliche
	Regolazione della pressione		Valvola di sicurezza (lato pistone)
	Linee idrauliche	1400	Valvola di sicurezza (lato stelo)
	Valvola di sicurezza (lato pistone)		Linea di distribuzione del calcestruzzo
	Valvola di sicurezza (lato stelo)		DN _____ della linea di distribuzione
			DN e lunghezza del terminale
1200	Giunzione "D" Sezione 3 + 4		Spessore parete linea di distribuzione residuo
	Leva di inversione		Giunti di rotazione della linea di distribuzione
	Asta della pressione		Sicurezza elementi di giunzione
	Bullone di giunzione		Protezione tubo terminale
	Cilindro D		Adattatore
	Velocità		Linea di distribuzione originale/si/no
	Regolazione della pressione		Osservazioni
	Linee idrauliche		
	Valvola di sicurezza (lato pistone)		
	Valvola di sicurezza (lato stelo)		
1300	Giunzione "E" Sezione 4 + 5		
	Leva di inversione		
	Asta della pressione		

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Tipo di braccio per la distribuzione di calcestruzzo		N° braccio per la distribuzione di calcestruzzo:		Reparto	

Verifica - Risultati dell'ispezione

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06 usura	14 vibrazioni	22 contatto allentato	30 avaria elettrica
07 trucioli	15 altri	23 temperatura	31 richiesta nuova ispezione

	Codice avaria	Codice avaria
1500 Idraulica, valvole di controllo e idrauliche		
Valvole di sovrappressione		Targa "L'uso come gru è proibito"
Regolazione della pressione		Targa: istruzioni per la pompa per calcestruzzo e il braccio per la distribuzione di calcestruzzo
Linee idrauliche		Targa dati
Funzionamento manuale (funzione di		Targa di avvertimento alta tensione
Blocco comandi del braccio per la distribuzione di		
Pompa idraulica		Specialista:
1600 Sistema elettrico		
Comando a distanza (funzione di commutazione)		Data:
Funzione di arresto di emergenza		Nome:
Selettore elettrico della funzione del braccio per la		(in stampatello maiuscolo)
Selettore elettrico dei movimenti del braccio per la		
Cablaggi elettrici		
Sistema di lubrificazione centrale		
1700 Targhe ed etichette		
Targhe di avvertimento		Firma (Timbro)
Targhe informative		
Targhe di informazioni operative		
Targhe di istruzioni operative abbreviate		Cliente:
Osservazioni:		Firma (Timbro)
		Archiviare il presente rapporto di ispezione nel registro dei controlli.

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